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BULLETIN

OF THE

TORREY BOTANICAL CLUB

CONTENTS

Hepaticae of Puerto Rico—VII. Stictolejeunea, Neurolejeunea, Omphalanthus, and Lopholejeunea. (Plates 1–4.) . . ALEXANDER WILLIAM EVANS 1

Studies on the Rocky Mountain flora—XVII. . . . PER AXEL RYDBERG 35

INDEX TO AMERICAN BOTANICAL LITERATURE 51

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THE TORREY BOTANICAL CLUB

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CONTENTS

EVANS, ALEXANDER WILLIAM. Hepaticae of Puerto Rico, VII. Stictolejeunea, Neurolejeunea, Omphalanthus, and Lopholejeunea (with plates 1–4) - - - - - - - - - - - 1
RYDBERG, PER AXEL. Studies on the Rocky Mountain flora, XVII - 35
HAYNES, CAROLINE COVENTRY. Two new species of Aytonia from Jamaica (with plates 5 and 6) - - - - - - - 57
WILSON, GUY WEST. Studies in North American Peronosporales, I. The genus Albugo (with ten figures) - - - - - - 61
BURLINGHAM, GERTRUDE SIMMONS. Some Lactarii from Windham County, Vermont - - - - - - - - - 85
PECK, CHARLES HORTON. New species of fungi - - - - - 97
NASH, GEORGE VALENTINE. Costa Rican orchids, I (with plates 7 and 8) 113
GAGER, CHARLES STUART. An occurrence of glands in the embryo of Zea Mays (with three figures) - - - - - - - 125
BRITTON, ELIZABETH GERTRUDE, and HOLLICK, CHARLES ARTHUR. American fossil mosses, with description of a new species from Florissant, Colorado (with plate 9) - - - - - - 139
HOUSE, HOMER DOLIVER. Studies in the North American Convolvulaceae, III. Calycobolus, Bonamia, and Stylisma - - - - 143
MACKENZIE, KENNETH KENT. Notes on Carex, II - - - - 151
ROWLEE, WILLARD WINFIELD. Two new willows from the Canadian Rocky Mountains - - - - - - - - - 157
COOK, MELVILLE THURSTON. The embryology of Rhytidophyllum (with plate 10) - - - - - - - - - - 179
BERRY, EDWARD WILBER. Contributions to the Mesozoic flora of the Atlantic coastal plain, II. North Carolina (with plates 11–16) - 185
GRIFFITHS, DAVID. Concerning some West American fungi - - 2c7
KIRKWOOD, JOSEPH EDWARD. Some features of pollen-formation in the Cucurbitaceae (with plates 17–21) - - - - - - 221
UNDERWOOD, LUCIEN MARCUS. American ferns, VIII. A preliminary review of the North American Gleicheniaceae (with two figures) - 243
ABRAMS, LE ROY. Studies on the flora of Southern California, II - 263
COOK, MELVILLE THURSTON. The embryology of Rhizophora Mangle (with plates 22 and 23) - - - - - - - - 271
SCHREINER, OSWALD, and REED, HOWARD SPRAGUE. The production of deleterious excretions by roots (with a figure) - - - 279
SHEAR, CORNELIUS LOTT. New species of fungi - - - - 305
KNOX, ALICE ADELAIDE. The stem of Ibervillea Sonorae (with plate 24 and two figures) - - - - - - - - - 329

PECK, CHARLES HORTON. New species of fungi - - - - 345
HARPER, ROLAND MCMILLAN. A midsummer journey through the coastal plain of the Carolinas and Virginia - - - - - 351
WILSON, GUY WEST. Studies in North American Peronosporales, II. Phytophthoreae and Rhysotheceae - - - - - - 387
RYDBERG, PER AXEL. Studies on the Rocky Mountain flora, XVIII 417
BENEDICT, RALPH CURTISS. The genus Antrophyum, I. Synopsis of subgenera, and the American species - - - - - - 445
KERN, FRANK DUNN. New western species of Gymnosporangium and Roestelia - - - - - - - - - - - - 459
MURRILL, WILLIAM ALPHONSO. Some Philippine Polyporaceae - 465
HOWE, MARSHALL AVERY. Phycological studies, III. Further notes on Halimeda and Avrainvillea (with plates 25–30) - - - 491
WOOTON, ELMER OTTIS, and STANDLEY, PAUL. The genus Androsace in New Mexico - - - - - - - - - - - 517
EVANS, ALEXANDER WILLIAM. Hepaticae of Puerto Rico, VIII. Symbiezidium, Marchesinia, Mastigolejeunea, Caudalejeunea, and Bryopteris (with plates 31–33) - - - - - - - 533
WILLIAMS, ROBERT STATHAM. Mosses from tropical America - - 569
BARNHART, JOHN HENDLEY. A new Utricularia from Long Island (with plate 34) - - - - - - - - - - 579
ARTHUR, JOSEPH CHARLES. New species of Uredineae, VI - - 583
EDGERTON, CLAUDE WILBUR. Notes on a parasitic Gnomonia (with three figures) - - - - - - - - - - 593
CUSHMAN, JOSEPH AUGUSTINE. A synopsis of the New England species of Tetmemorus - - - - - - - - - 599
MACKENZIE, KENNETH KENT. Notes on Carex, III - - - - 603

AMERICAN CODE OF BOTANICAL NOMENCLATURE - - - - 167

INDEX TO AMERICAN BOTANICAL LITERATURE (1901–1905) - - 51
INDEX TO AMERICAN BOTANICAL LITERATURE (1906) - 105, 267, 575
INDEX TO AMERICAN BOTANICAL LITERATURE (1907)
161, 213, 319, 379, 439, 483, 521, 609

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Errata

Page 221, title, for **qollen** read **pollen.**

Page 255, line 2, *for* 1869 *read* 1896.

Page 411, line 31, for *Pucinia* read *Puccinia.*

Page 423, line 23, *for* Gooding *read* Goodding.

Page 430, line 6, for *Telypodium* read *Thelypodium.*

Page 573, line 15, *for* 1897 *read* 1907.

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JANUARY, 1907

Hepaticae of Puerto Rico

VII. STICTOLEJEUNEA, NEUROLEJEUNEA, OMPHALANTHUS, AND LOPHOLEJEUNEA

ALEXANDER WILLIAM EVANS

(WITH PLATES 1–4)

STICTOLEJEUNEA

The genus *Stictolejeunea* is so clearly defined among the *Lejeuneae* that even Spruce was almost willing to accord it generic rank. It includes two species only, the variable *S. squamata* (Willd.) Schiffn. and *S. Kunzeana* (Gottsche) Schiffn. Both of these species are widely distributed in the American tropics, *S. squamata* occurring on the plains and at low elevations on the mountains, while *S. Kunzeana* is restricted to somewhat higher altitudes. *S. squamata*, which must be regarded as the type of the genus, has also been recorded from the East Indies and from the Hawaiian Islands. The first of these records is based upon the original specimens, which Weber received from Willdenow. These are labeled, "in corticibus *Myrti caryophyllatae* ex Ind. orient." Portions of the original material have been examined by Stephani * and also by Schiffner,† both of whom pronounce it identical with the American plant. The species is also listed by Mitten ‡ from the East Indies, but solely on the authority of the original record. Since the plant has not recently been collected in these regions, in spite of its striking character, it is possible that there was an error in the original label. There is also much doubt in regard to the specimens from the Hawaiian Islands, and it is probable that this

* Hedwigia 29 : 18. 1890.

† Bot. Jahrb. 23 : 595. 1897.

‡ Jour. Linn. Soc. Bot. 5 : 112. 1861.

[The BULLETIN for December 1906 (33 : i–v, 591–635) was issued 7 F 1907.]

record is based either on an incorrect label or on a false determination. At all events the specimens so labeled, which are quoted in the Synopsis, seem to have disappeared. On the whole the evidence that *S. squamata* occurs outside the American tropics is very inconclusive.

The two species of *Stictolejeunea* grow preferably on trees, although *S. squamata* is occasionally found on rocks. They differ somewhat in habit, but both of them exhibit a regular pinnate or bipinnate branching. In many cases the plants are distinctly plumose in appearance, the majority of the branches being limited in growth. Both species are conspicuous and differ from most of the larger *Lejeuneae* in their pale or bright green color, which becomes yellowish or brownish only upon age. Not infrequently they form pure mats or tufts of considerable extent, but they also occur mixed with other species.

The leaves spread widely from the stem, the lobes being plane and varying in outline from ovate to oblong (PLATE 1, FIGURE 2). They are rounded at the apex, and their margins are entire. The lobules are relatively small and bear a strong superficial resemblance to the galeate or clavate lobules which are found in the genus *Frullania*. They are, however, entirely different in structure and conform more nearly in this respect to the lobules of other *Lejeuneae*. They are attached to the axis by a long basal line which runs almost longitudinally (FIGURE 4). From this line the free margin curves abruptly toward the postical margin of the lobe, meeting it close to the base and extending just beyond it. The margin is entire and appressed to the lobe throughout the greater part of its length. The lobule is strongly inflated, forming a distinct water-sac, and the bulging portion sometimes extends beyond the line of contact between the free margin and the lobe. The apical tooth of the lobule is curved and slender (FIGURES 12, 13); it is also strongly involute and forms, together with the shallow sinus and the basal portion of the margin of the lobe, a circular opening into the sac. The keel is short and often incurved, and it is largely to this fact that the lobule owes its peculiar appearance. The hyaline papilla is not marginal but is displaced to the inner surface of the lobule, somewhere between the base and the apex. In this respect the genus agrees with *Odon-*

tolejeunea and with other genera of the *Lejeuneae Holostipae.* In addition to the papilla just mentioned there is a second papilla at the junction between the free margin and the axis, and a third papilla is also to be observed at the antical base of the lobe. Of course these two papillae, as Leitgeb * has pointed out, are usual in the *Lejeuneae*, but in *Stictolejeunea* they are remarkably large and conspicuous.

The leaf-cells are plane or nearly so and their walls are slightly thickened (FIGURE 8). Except in the basal portion of the lobe the thickening is fairly uniform and there are no distinct trigones. Ocelli are numerous and form a striking feature of the plants (FIGURE 3). They never occur in groups but are scattered throughout the lobes, underleaves and perianths. On a robust individual there may be thirty or more on a single lobe. The ocelli are scarcely larger than the other cells and are distinguished by their thin walls and more refractive contents. Many specimens of *S. squamata* are also characterized by peculiar hyaline cells, the protoplasmic contents of which have disappeared. These cells form a scarious border along the margins of lobes, lobules and underleaves. At the apex of a lobe they sometimes form a zone three or four cells wide, and this zone gradually narrows out and disappears on both antical and postical margins (FIGURE 9). On the underleaves and along the free margin of the lobule the hyaline cells are usually in a single row. Cells of this character are apparently never developed in *S. Kunzeana* and they are far from constant in *S. squamata* (see FIGURE 10). They seem to be most frequent in exposed situations and doubtless enable the plants to cling more closely to the substratum. Similar hyaline cells are found in the genera *Neurolejeunea*, *Cololejeunea* and *Diplasiolejeunea.*

The underleaves in *Stictolejeunea* are broadly orbicular in outline and undivided (FIGURE 1). They are usually large and loosely imbricated. At the base they are abruptly and narrowly decurrent for a short distance, and the line of attachment is distinctly arched. When rhizoids are present they grow out from a basal disc (FIGURE 7), and their tips are frequently branched.

One of the most important characters of the genus, as Spruce

* Unters. über Lebermoose 2: 15. 1875.

points out, is its type of branching. Throughout the *Jubuleae* the branches are invariably lateral and are derived from the postical halves of the segments cut off from the apical cell. Two special types of branching within the group are however recognized and described by Leitgeb.* In the genus *Frullania* the whole of a postical half-segment is used up in the formation of a branch, and the leaf which develops from the same segment is therefore destitute of a lobule. In the majority of the *Lejeuneae*, on the other hand, a portion only of the postical half-segment enters into the formation of the branch, and a complete leaf with both lobe and lobule develops from the same segment. In the genus *Stictolejeunea* both types of branching are exhibited. The ordinary vegetative branches are like those found in *Frullania*, and the leaves subtending them are therefore without lobules (FIGURE 2). The male and female branches, however, and the subfloral innovations are like those found in other *Lejeuneae* and are borne behind leaves with lobules (FIGURES 1, 3). The first underleaf of a vegetative branch is very small and is displaced from its normal postical position in such a way that the branch apparently springs from its axil. The first side-leaf is also small and shows but slight trace of a lobule. In the second side-leaf the lobule is already well-developed, although the lobe is still small, and the second underleaf is normal, both in size and in position.

Even in its branching, however, *Stictolejeunea* is not wholly unique among the *Lejeuneae*. In *Dicranolejeunea* the vegetative branches also conform to the *Frullania* type, and the same statement would apply to the majority of the vegetative branches in *Ptychanthus* and *Bryopteris*. The first two of these genera agree with *Stictolejeunea* and other *Lejeuneae* in their subfloral innovations. The genus *Jubula*, which may also be mentioned in this connection, agrees with *Frullania* in its vegetative branches but produces subfloral innovations and occasionally male branches of the *Lejeunea* type. So far as their branching goes, these five genera form connecting links between *Frullania* and the typical *Lejeuneae*.

The female branch in *Stictolejeunea* is exceedingly short and bears a single leaf and a single underleaf in addition to the bracts

* Bot. Zeit. 29: 557, 558. 1871.

and bracteole (FIGURE 1). The inner bract, which is situated on the side of the branch away from the axis, is subtended by a short and sterile innovation, which rarely bears more than five pairs of leaves. The bracts are much smaller than ordinary leaves. They are complicate and bifid, with rounded lobes, those of the inner bract being subequal in size. The bracteole is free and differs from ordinary underleaves in being longer than broad.

The perianth is strongly compressed and bears a broad and rounded postical keel. It is obovate in outline, gradually broadening out from a narrow base. At the apex the compressed lateral keels are dilated into two large auricles, the short beak being included between them at the bottom of a deep depression. The surface of the perianth is smooth and the keels develop neither teeth nor wings. A somewhat similar type of perianth is found in *Neurolejeunea*, in *Odontolejeunea* and its immediate allies, and in certain species of *Cololejeunea*. In some of these cases, however, the structure is further complicated by the presence of teeth or spines.

The male spikes in *Stictolejeunea* are short, and the bracts exhibit no striking peculiarities (FIGURE 3). The antheridia occur in pairs, and the bracteoles are restricted to the bases of the spikes. Vegetative reproduction has not yet been described for the genus. At the present time only one species is known from Puerto Rico, namely:

STICTOLEJEUNEA SQUAMATA (Willd.) Schiffn.

Jungermannia squamata Willd. in Weber, Hist. Musc. Hepat. Prodr. 33. 1815.

Phragmicoma ocellulata Nees & Mont. Ann. Sci. Nat. Bot. II. **19**: 259. 1843.

Lejeunea squamata Nees in G. L. & N. Syn. Hep. 322. 1845.

Symbiezidium squamatum Trevis. Mem. R. Ist. Lomb. III. **4**: 403. 1877.

Lejeunea (*Sticto-Lejeunea*) *squamata* Spruce, Hep. Amaz. et And. 82. 1884.

Stictolejeunea squamata Schiffn. in Engler & Prantl, Nat. Pflanzenfam. $\mathbf{1}^3$: 131. 1895.

Pale-green, glossy, becoming brownish with age, growing in depressed mats: stems prostrate, 0.2 mm. in diameter, more or less regularly pinnate, the branches obliquely spreading, simple or sparingly subdivided, with smaller leaves than the stem but not microphyllous: leaves imbricated, the lobe plane or nearly so, slightly falcate, ovate, often attaining in the stem-leaves a length of 1.4 mm. and a width of 0.85 mm., attached by a curved line of insertion and arching across or slightly beyond the axis, antical margin straight or nearly so near base, then more or less outwardly curved to the broad and rounded apex, postical margin straight or slightly curved, distinctly incurved at junction with keel; lobule broadly ovoid, 0.15 mm. long, 0.14 mm. wide, inflated throughout, curved and contracted in outer part, apical tooth consisting of about three cells in a single row, keel incurved (except on some of the branch-leaves); cells of lobe plane, averaging 9 μ in diameter at the margin, 14 μ in the middle, and measuring about 23 × 18 μ at the base, trigones indistinct except in basal region; ocelli measuring about 20 × 17 μ in the middle of the lobe: underleaves contiguous or slightly imbricated, broadly reniform, mostly plane, 0.85 mm. long, 1.2 mm. wide, rounded or subretuse at the broad apex, sometimes broadly cordate at the base, sometimes straight or nearly so along the basal margin, entire: inflorescence dioicous: ♀ branch springing directly from the main stem; bracts sometimes narrowly winged along the keel, the lobe ovate to obovate, rounded at the apex, measuring (in larger bract) 0.8 × 0.5 mm., lobule obovate, rounded at the apex, 0.5 mm. long, 0.25 mm. wide; bracteole obovate, 0.6 mm. long, 0.4 mm. wide, rounded to truncate at the broad apex; perianth long-exserted, obovate, 1.4 mm. long, 0.85 mm. wide, apical auricles rounded to truncate, not overlapping, beak short but distinct: ♂ inflorescence occupying a short branch or terminal on a longer branch; bracts in from two to five pairs, imbricated, strongly inflated, shortly and subequally bifid with a strongly arched keel and erect, rounded divisions; bracteole single at base of spike, broadly obovate: capsule spherical, 0.4 mm. in diameter; mature spores not seen (PLATE I, FIGURES 1–16).

On bark of trees, more rarely on rocks. Without definite locality, *Sintenis* (*49*). Near Cayey, *Evans* (*84*). El Yunque, *Evans* (*134*, *173*, *192*, *195*). Mount Morales, near Utuado, *Howe* (*1100*). The following West Indian stations may also be quoted: Cuba, *Wright*, *Underwood & Earle*; Haïti, *Nash*; Jamaica, *Boswell*, *Evans*; Guadeloupe, *L'Herminier*; Dominica, *Elliott*, *Lloyd*; St. Vincent, *Elliott*. In South America the species is known from various parts of Brazil, *Martius*, *Bongard*, *Spruce*, and, on the mainland of North America, has recently been collected by *Maxon* in Costa Rica.

Although the account just given adds but little to Spruce's full description, it seems advisable to figure the species and to redescribe it on account of its striking peculiarities. *S. Kunzeana* is closely allied to *S. squamata* and was first recognized as a distinct species by Spruce, the authors of the Synopsis considering it simply a well-marked variety. It is, however, much more robust than *S. squamata* and differs from it completely in habit, the stems arising from a prostrate caudex and being entirely free from the substratum. These stems are bipinnate but the branching is much looser than in *S. squamata*. The lobule in *S. Kunzeana* is very small and narrowly cylindrical in form, the free margin being strongly curved near its base and then running parallel with the axis. The lobule is built up on the same plan as in *S. squamata*, but the apical tooth and sinus are very much shorter. The apical auricles of the perianth are larger and more dilated than in *S. squamata*, so that they sometimes overlap above the beak. In many cases they are bordered by a broad white zone, due to the dying away of cells, and in this way the perianths acquire a very striking appearance. *S. Kunzeana* has not yet been reported from the West Indies but is known along the chain of the Andes from Guatemala to Chile.

NEUROLEJEUNEA

The subgenus *Neuro-Lejeunea*, as originally described by Spruce,* included three species, *L. seminervis* Spruce, *L. catenulata* Nees, and *L. Breutelii* Gottsche. The first two are characterized by the presence of a false nerve, consisting of a row of ocelli, which runs longitudinally through the lobes and extends to the middle or a little beyond. This peculiarity is given as one of the subgeneric characters and is responsible for the name of the group. In spite of these facts the third species which Spruce recognized, *L. Breutelii*, shows no sign of a false nerve, being entirely destitute of ocelli. Of course a nerve of this nature cannot be expected to yield a very reliable generic or subgeneric character, and its absence from *L. Breutelii* would not necessarily exclude it from a group to which *L. seminervis* and *L. catenulata* belonged. Similar nerves occur in various species of *Frullania*, in *Ceratole-*

* Hep. Amaz. et And. 84. 1884.

jeunea brevinervis, and in certain species of *Cololejeunea*, although the majority of the plants belonging to these same genera present a uniform cell-structure or show basal ocelli only. Fortunately the three species which Spruce referred to *Neuro-Lejeunea* present characters in common which would distinguish them as a natural and clearly defined group of plants, even if false nerves and ocelli were left entirely out of consideration.

In certain respects *Neurolejeunea* shows an approach to *Cerato-lejeunea*, several species of which have undivided underleaves. This fact was soon recognized by Stephani,* who added *Lejeunea portoricensis* Hampe & Gottsche to *Neurolejeunea* but at the same time transferred *L. Breutelii* to *Ceratolejeunea*. Shortly afterwards,† upon studying the type specimen of *L. catenulata* he perceived its close relationship to *L. Breutelii* and suggested that this species also ought perhaps to be transferred to *Ceratolejeunea*. Later,‡ however, he replaced it in *Neurolejeunea* without question. When Schiffner § raised the group to generic rank he accepted the views of Stephani, retaining in the genus *L. catenulata*, *L. seminervis* and *L. portoricensis* but excluding *L. Breutelii*. Spruce,|| on the other hand, continued to regard *L. Breutelii* as a *Neurolejeunea*, although he followed Stephani in including *L. portoricensis* in the same group. In the opinion of the writer *L. portoricensis* forms a connecting link between *Neurolejeunea* and *Ceratolejeunea*, with the preponderance of its characters pointing toward the latter genus. In order to avoid proposing a new genus for its accommodation it is here transferred to *Ceratolejeunea*. In *Neurolejeunea*, however, the three species are retained which were originally placed there by Spruce.

The genus *Neurolejeunea* is apparently confined to the American tropics. Its three species usually grow on the trunks of trees or on rotten logs, sometimes forming pure mats, sometimes mixed with other hepatics. They are all more or less tinged with olive-brown, and the pigmentation is often so pronounced that the color of the chloroplasts is completely masked. The species seem to

* Hedwigia **27**: 288, 283. 1888.

† *L. c.* **29**: 18. 1890.

‡ Bot. Gaz. **17**: 171. 1892.

§ Engler & Prantl, Nat. Pflanzenfam. 1^3: 131. 1895.

|| Jour. Linn. Soc. Bot. **30**: 334. 1894.

be most at home in moist forests, especially on the lower slopes of mountains.

The stems are prostrate and freely but irregularly branched. In most cases the branch-leaves are smaller than those borne on the stem, and occasionally microphyllous branches are produced. The latter, however, are less modified than in certain other genera of the *Lejeuneae*. The lobes of the leaves spread widely from the stem and are broad and rounded at the apex (PLATE 2, FIGURES 1–3). The margin is entire throughout, unless hyaline cells are present at the apex. The lobule is strongly inflated, especially in the basal portion, and forms a distinct water-sac. The free margin spreads widely from the axis and terminates in a slender curved tooth which is usually from three to five cells long and two cells wide at the base (FIGURES 7, 8). This tooth and the shallow lunulate sinus commonly bound the circular opening into the sac. The hyaline papilla arises from one of the marginal cells of the sinus but is displaced to its inner boundary and cannot be seen without dissection. The keel is arched and sometimes very strongly so. The leaf-cells have thickened walls, but the thickening is uniform or nearly so and there are no distinct trigones. Of course when ocelli are present these have thin walls, and the same is true of the hyaline cells found at the apices of the lobes in *N. catenulata* (FIGURES 5, 6). The underleaves are orbicular and undivided. They are attached by a short and slightly arched basal line, and their margins are entire (FIGURES 1–3).

The female inflorescence is borne on a short or somewhat elongated branch and usually innovates on both sides, the innovations being nearly always simple and sterile (FIGURE 1). The bracts are larger than the branch-leaves which precede them but smaller than the leaves on robust stems. They are distinctly complicate and unequally bifid, and their lobes spread obliquely. The bracteole is free and differs but little from the other underleaves except in size. In most respects the perianth is similar to that described for *Stictolejeunea*. The postical keel, however, is much more variable and is sometimes produced upward as a broad and rounded sac, which may equal in length the two lateral auricles (FIGURE 12). In extreme cases the beak of the perianth may even be displaced to the antical surface of this sac. When the sac is not formed the postical keel of the perianth is often distinctly two-angled. The lateral keels are sometimes very indistinctly winged, but they are never toothed. The male spike is short, and the bracteoles are limited to its base. Except for the perianth the genus has but little in common with *Stictolejeunea.*

Two species of *Neurolejeunea* have been found in Puerto Rico, one by the writer and the other by Schwanecke and Sintenis. Neither appears to be abundant. Descriptions of these two species are given below and are followed by a description of *Lejeunea portoricensis.*

NEUROLEJEUNEA CATENULATA (Nees) Schiffn.

Phragmicoma catenulata Nees, Naturg. Eur. Leberm. **3**: 248. 1838 (*nomen nudum*).

Lejeunea catenulata Nees, in G. L. & N. Syn. Hep. 323. 1845.

Symbiezidium catenulatum Trevis. Mem. R. Ist. Lomb. III. **4**: 403. 1877.

Lejeunea (*Neuro-Lejeunea*) *catenulata* Spruce, Hep. Amaz. et And. 84. 1884.

Lejeunea (*? Cerato-Lejeunea*) *catenulata* Steph. Hedwigia **29**: 131. 1890.

Neurolejeunea catenulata Schiffn. in Engler & Prantl, Nat. Pflanzenfam. **1**^{3}: 131. 1895.

Brownish-green, more or less glossy, growing in depressed mats: stems prostrate, 0.1 mm. in diameter, irregularly pinnate, the branches obliquely to widely spreading, simple or sparingly subdivided, usually with smaller leaves than the stem, sometimes distinctly microphyllous: leaves imbricated, the lobe plane or nearly so, falcate-ovate, measuring in the stem-leaves 0.9 mm. in length and 0.6 mm. in width, attached by an almost longitudinal line of insertion, antical margin arching partially or wholly across axis, outwardly curved to the broad and rounded apex, postical margin straight or slightly incurved, sometimes forming a continuous line with the keel, sometimes slightly indented at the junction; lobule ovoid, 0.2 mm. long, 0.12 mm. wide, sometimes inflated throughout, sometimes strongly inflated in the basal portion and plane in the outer half, keel slightly arched or almost straight, free margin curved, usually appressed to the lobe throughout its entire length but sometimes revolute at the base, sinus shallow, unulate, apical tooth mostly two to four cells long and two cells wide at the base; cells of lobe plane or nearly so, averaging 9 μ at the margin and $18 \times 13 \mu$ in median and basal portions, walls uniformly thickened, middle lamella sometimes distinct; ocelli averaging $23 \times 14 \mu$, usually in a continuous straight row from eight to twelve cells long, extending from the base to about the middle of the lobe, subparallel with the keel and about one-fourth the distance from the postical margin to the antical; hyaline cells (when present) occupying the broad apex of the lobe and forming a group from one to three cells wide, the marginal ones free and rounded at their tips, sometimes attaining a length of 20μ: underleaves contiguous to slightly imbricated, broadly orbicular, 0.4 mm. long, 0.45 mm. wide, abruptly narrowed at the base, sometimes minutely auriculate or indistinctly short-decurrent on one side, apex broad, rounded to slightly retuse, margin entire: inflorescence dioicous: ♀ inflorescence borne on a more or less elongated branch, innovating on both sides (rarely on only one side), the innovations obliquely spreading, usually simple and sterile; bracts obliquely spreading, the lobe falcate, oval to obovate, 0.85 mm. long, 0.4 mm. wide, rounded at the scarious apex, margin entire, ocelli less distinct than in the leaves, often irregularly scattered in the basal region or forming an interrupted row, keel sharp, very narrowly winged, lobule ovate, 0.35 mm. long, 0.17 mm. wide, rounded at the apex; bracteole orbicular-obovate, 0.55 mm. long, 0.5 mm. wide, gradually narrowed toward the base, rounded to retuse at the broad apex, margin entire; perianth about half-exserted, obovate in outline, 0.85–1.2 mm. long, 0.6–0.85 mm. wide, narrowed toward the base, compressed, antical face plane or with a short and low median fold, lateral keels sharp and occasionally indistinctly and interruptedly winged, rounded at the upper angles or dilated into flat horns, the apex of the perianth thus varying from truncate to deeply emarginate, beak short but distinct, postical keel sharply two-angled or rounded, sometimes dilated in the upper part in the form of a rounded swelling extending beyond the beak: ♂ inflorescence terminal on a more or less elongated branch; bracts in from three to five pairs, imbricated, strongly inflated, shortly and subequally bifid, keel strongly arched, lobes rounded and scarious at the apex; bracteoles similar to the underleaves but smaller: antheridia and mature sporophyte not seen (PLATE 2, FIGURES 1–12).

On bark of trees and on logs. El Yunque, *Evans* (*119*, *143*, *144*). Also collected recently in Jamaica, *Evans*. The type locality of *Lejeunea catenulata* is given in the Synopsis as follows: "In *Hymenophyllo ciliato* et *Neckera abietina* Hook. Americae septentrionalis (Hb. Sieber., Flotov., N.)." On account of the indefinite nature of this record further information regarding the type specimen was much to be desired. This has been kindly supplied by Prof. Dr. H. Graf zu Solms-Laubach, of Strassburg, where the herbarium of Nees von Esenbeck is preserved. Under *Lejeunea catenulata* two specimens are to be found. The first is labeled as follows, in Nees von Esenbeck's handwriting: "*Phragmicoma catenulata* N. ex herb. Sieber Am. sept. in *Neckera abietina* v. Flotow." This specimen undoubtedly represents the type of the species, and a portion of it, which was sent to the writer for examination, agrees in all respects with the specimens from Puerto Rico and Jamaica. The inscription on the second specimen is in Gottsche's handwriting and reads as follows: "*Lejeunia floccosa* Ld. Java. An *Hymenophyllum* welches sie mit etwas *J. cucullata* als Original dieser letzteren an Lehmann geschickt hatten. Diese Pflanze würde sich eher als *β incompleta* bei *Phragmicoma catenulata* unterbringen lassen." This specimen consists of a single small stem, which Count Solms refers without question to the *L. floccosa* of the Synopsis, or, as it is now called, *Cololejeunea floccosa* (Lehm. & Lindenb.) Schiffn., a tropical species confined to the islands of eastern Asia. Unfortunately the label on the type specimen does not indicate the part of "North America" where it was found. In all probability it came from one of the Antilles, since Sieber's collectors in North America confined their attention to these islands.* This being the case the moss mixed with the type must have been incorrectly determined, the true *Neckera abietina* Hook., or *Dendroalsia abietina* E. G. Britton, being restricted to the region west of the Rocky Mountains from British Columbia to California. At all events *Neurolejeunea catenulata* does not seem to have been collected recently except in the West Indies.†

Even when sterile, *N. catenulata* is an easily recognized species. It forms brownish tufts which cling closely to the substratum, and its plane and appressed leaves are usually distinctly glossy, especially when dry. The false nerves and the patches of hyaline cells at the tips of the lobes are also very striking features. Apparently the hyaline cells enable the leaves to cling more closely to the

* Allgem. Deutsche Biog. 34: 177. 1892.

† In the Nat. Pflanzenfam. Schiffner accredits the species to Africa but does not state his evidence.

substratum, in much the same way as in *Stictolejeunea squamata.* Microphyllous branches are only occasionally present, and the modifications which they exhibit are not very strongly marked. Their leaves bear a strong resemblance to those found at the base of a normal branch and apparently retain some of the juvenile characters of the species. The lobes of these leaves are sometimes only 0.15 mm. long; they are destitute of hyaline cells and tend to assume a suberect position. The lobules and underleaves on microphyllous branches are smaller than usual but otherwise normal. Branches of this character are more frequent in crowded tufts and are perhaps due to a lack of illumination.

The perianth in *N. catenulata* is subject to a great deal of variation. When well-developed the lateral auricles and the large postical swelling extend for a considerable distance beyond the beak, and it sometimes appears as if the latter were an outgrowth from the antical surface of the swelling. Under these circumstances there is frequently a short and low fold in the middle of the postical keel (FIGURE 12) and a similar fold in the middle of the antical surface. When poorly developed the apex of the perianth is truncate and the beak forms the most projecting part, no lateral auricles being formed. When this is the case the postical keel is usually distinctly two-angled, and there are no supplementary folds on either surface. Between these two extremes there are many intermediate conditions. The wings along the lateral keels form a very inconstant feature of the perianth (FIGURE 1).

Neurolejeunea Breutelii (Gottsche)

Lejeunea Breutelii Gottsche, in G. L. & N. Syn. Hep. 324. 1845.

Symbiezidium Breutelii Trevis. Mem. R. Ist. Lomb. III. **4**: 403. 1877.

Lejeunea (*Neuro-Lejeunea*) *Breutelii* Spruce, Hep. Amaz. et And. 84. 1884.

Lejeunea (*Ceratolejeunea*) *Breutelii* Steph. Hedwigia **27**: 283. 1888.

Ceratolejeunea Breutelii Schiffn. in Engler & Prantl, Nat. Pflanzenfam. 1^3: 125. 1895.

Dark olive-green or brownish, somewhat glossy, loosely tufted: stems 0.1 mm. in diameter, with few rhizoids, irregularly pinnate, the branches obliquely to widely spreading, variable in length and rarely subdivided, usually with smaller leaves than the stem and sometimes microphyllous : leaves more or less imbricated, the lobe slightly to strongly convex, falcate-ovate, 0.6 mm. long, 0.35 mm. wide, attached by an almost longitudinal line of insertion, antical margin arching partially or wholly across the axis, almost straight near the base, then strongly outwardly curved to the rounded or very obtusely pointed apex, postical margin also outwardly curved, strongly indented at junction with keel ; lobule ovoid, 0.17 mm. long, 0.1 mm. wide, narrowed in the outer part, strongly inflated throughout, keel strongly arched, slightly roughened from projecting cells, free margin revolute but appressed to the lobe in the outer part, apical tooth sharp, commonly consisting of a row of two cells, appressed to the lobe, sinus nearly straight in an intact leaf, lunulate when flattened out ; cells of lobe plane or slightly convex, averaging $8\,\mu$ at the margin, $13 \times 10\,\mu$ in the middle and $23 \times 14\,\mu$ at the base, walls more or less thickened with indistinct trigones ; ocelli and hyaline cells wanting : underleaves distant to contiguous, broadly orbicular, 0.2 mm. long, 0.25 mm. wide, sometimes plane but usually reflexed along the sides and often at the apex as well, abruptly narrowed at the base and sometimes minutely and indistinctly auriculate, apex broad, rounded or truncate : inflorescence dioicous : ♀ inflorescence on a more or less elongated branch, innovating on both sides, the innovations obliquely spreading, usually simple and sterile ; bracts obliquely spreading, the lobe ovate, somewhat falcate, 0.75 mm. long, 0.45 mm. wide, antical margin much more curved than the postical, apex rounded, margin entire, lobule ovate, 0.2 mm. long, 0.15 mm. wide, rounded at the apex ; bracteole broadly orbicular-obovate, 0.5 mm. long, 0.55 mm. wide, gradually narrowed toward the base, broad and rounded to truncate at the apex ; perianth about half-exserted, 1.25 mm. long, 0.75 mm. wide, obovate in general outline, gradually narrowed toward the base, broad and emarginate to obcordate at the apex with a distinct beak, antical face plane or with a broad median groove, lateral keels sharp, sometimes narrowly and indistinctly winged, dilated in the upper part into broad and rounded horns, postical keel sharply two-angled or rounded, occasionally bearing a low and short fold on its surface, often extended beyond the beak in the form of a rounded swelling : ♂ spike occupying a short branch ; bracts mostly in from two to six pairs, loosely imbricated, strongly inflated, shortly and subequally bifid with rounded or bluntly pointed lobes and a strongly arched keel ; bracteoles similar to the underleaves but smaller ; antheridia and mature sporophyte not seen (PLATE 1, FIGURES 17–23).

On trees and rocks. Puerto Rico, without definite localities, *Schwanecke, Sintenis* (*23*). Also recorded from the following islands: St. Kitts, *Breutel*, the type locality; Guadeloupe, *L'Herminier*, *Marie*, *Duss;* Dominica, *Elliott;* Martinique, *Bélanger*. Recently collected by the writer in Jamaica.

N. Breutelii is very closely related to *N. seminervis* (Spruce) Schiffn., the type of the genus, which is known at present only from northern Brazil. The two species agree in general appearance, in size, in color, and in the form and structure of the leaves, underleaves and floral organs. In *N. seminervis*, however, the underleaves are plane and there is a false nerve in the lobes, consisting of a row of ten or more ocelli. Since these differences, although so slight, are apparently constant the two species should undoubtedly be kept apart. The relationship which they bear to each other is in fact the same as that which exists between *Ceratolejeunea valida* and *C. brevinervis*. From *N. catenulata* the present species may at once be distinguished by its convex leaf-lobes and by its entire lack of both ocelli and hyaline cells.

The most important characters separating *Neurolejeunea* from *Ceratolejeunea* are apparently those derived from the leaf-cells, the lobules, and the perianths. In *Neurolejeunea* the walls of the cells are more or less uniformly thickened, the trigones being indistinct; in *Ceratolejeunea* the trigones are large and conspicuous. In *Neurolejeunea* the lobule is tipped with a tooth two or more cells in length, and the hyaline papilla is borne in the sinus and slightly displaced from the margin; in *Ceratolejeunea* the lobule is tipped with a single cell, and the marginal papilla is borne at its proximal base. In *Neurolejeunea* the lateral horns of the perianth are flat, and the postical keel (when produced at all) forms a single swelling; in *Ceratolejeunea* there are four distinct horns, all more or less inflated. *Lejeunea portoricensis* agrees with *Neurolejeunea* in its leaf-cells (FIGURE 15), but with *Ceratolejeunea* in its lobules (FIGURE 18) and perianths (FIGURE 13). It is, therefore, referred to this latter genus.

Ceratolejeunea portoricensis (Hampe & Gottsche)

Lejeunea portoricensis Hampe & Gottsche, Linnaea **25**: 352. 1852.

Lejeunea (*Neurolejeunea*) *portoricensis* Steph. Hedwigia **27**: 288. 1888.

Neurolejeunea portoricensis Schiffn. in Engler & Prantl, Nat. Pflanzenfam. **1**^{3}: 131. 1895.

Yellowish-green, apparently becoming pale with age, mixed with other hepatics: stems prostrate, 0.15 mm. in diameter, irregularly pinnate, branches obliquely to widely spreading, sometimes subdivided, often ascending, usually with smaller leaves than the stem but scarcely microphyllous: leaves imbricated, the lobe widely spreading, slightly falcate, broadly ovate, 0.9 mm. long, 0.7 mm. wide, plane or somewhat convex, occasionally scarious at the apex, attached by a short almost longitudinal line of insertion and arching across the axis, antical margin nearly straight near the base, then strongly outwardly curved to the broad and rounded apex, postical margin nearly straight, slightly indented at junction with keel, margin minutely and indistinctly crenulate from projecting cells; lobule ovoid, 0.17 mm. long, 0.1 mm. wide, inflated, keel slightly arched, smooth or nearly so, free margin curved and entire, sometimes more or less revolute, sometimes appressed to the lobe along its whole length, sinus straight or slightly lunulate, apical tooth long, straight or variously contorted, appressed to the lobe and extending nearly or quite to the end of the keel, consisting of a single cell with a strongly thickened wall and a hyaline papilla at its proximal base; leaf-cells plane or slightly convex, averaging 11 μ at the margin, 14 μ in the middle and $20 \times 14 \mu$ at the base, uniformly thickened throughout or with very indistinct and confluent thickenings in the basal region; ocelli averaging $20 \times 15 \mu$, forming an irregular cluster or short row in the basal portion of the lobe and sparsely and irregularly scattered through the remainder; hyaline cells when present forming a short border a single cell wide at the apex of the lobe, united at the base but free and blunt at the tips, averaging $35 \times 12 \mu$, becoming broken down with age; leaves of the ascending branches strongly convex and destitute of hyaline cells: underleaves of stem distant, plane, orbicular, 0.35 mm. long, cuneate toward the base and attached by a short and almost straight line, retuse at the apex with broad and rounded lobes, margin as in the leaves; underleaves of the ascending branches contiguous to subimbricated, more or less reflexed at the broad and rounded apex, appearing concave when seen from below: inflorescence dioicous: ♀ inflorescence on a more or less elongated branch, innovating on one side, the innovation (so far as observed) simple and sterile; bracts obliquely spreading, unequally bifid, complicate, the lobe obovate, 0.85 mm. long, 0.5 mm. wide, rounded at the apex, margin as in the leaves, keel sharp, sometimes with a narrow and entire wing in the upper part, lobule ovate to obovate, 0.4 mm. long, 0.2 mm. wide, rounded to very obtuse at the apex; bracteole free or very slightly connate on one side, orbicular, 0.4 mm. long, cuneate toward the base, broad and truncate to retuse at the apex, margin as in the leaves; perianth almost hidden by bracts, obovoid, 0.7 mm. long, 0.5 mm. wide, compressed, beak short but distinct, antical surface plane or nearly so, postical surface with two sharp keels more than half as long as the perianth, lateral keels and postical keels all extended beyond the beak in the form of short, erect, rounded and inflated horns: ♂ inflorescence and mature sporophyte not seen (PLATE 2, FIGURES 13–22).

On a twig. Puerto Rico, *Schwanecke* (*126*), the type locality. Not since collected on the island, but reported by Spruce from either Dominica or St. Vincent, where it was collected by *Elliott.*

When the writer's paper on the Puerto Rico species of *Cerato-lejeunea* * was published, no reference was made to *C. portoricensis* because it was supposed that this species belonged to *Neurolejeunea.* A study of the type, however, which is preserved in the Hampe herbarium, brings out the facts which are noted above. The "*status morbidus*" described by the original authors as having the leaves digitate-palmulate at the apex probably represents the normal condition of the species, the peculiar appearance being due to the presence of hyaline cells. These cells doubtless serve the same purpose as in *Neurolejeunea catenulata*, in helping the plants cling to the substratum. Hyaline cells of this nature have not been described for any other species of *Ceratolejeunea.*

The only species with which *C. portoricensis* is likely to be confused is *Neurolejeunea catenulata.* The irregularity in the arrangement of the ocelli, the different plan upon which the lobules are constructed, the single subfloral innovation, and the four-horned perianth will at once serve to distinguish it. In separating it from the other Puerto Rico species of *Ceratolejeunea*, the different cell-structure, the hyaline cells at the apices of the lobes, and the undivided or merely retuse underleaves all yield differential characters of importance. The species is also somewhat anomalous from the fact that it never develops the utriculi which are found in so many members of the genus.

OMPHALANTHUS

The artificial character of the genus *Omphalanthus*, as originally described in the Synopsis Hepaticarum, was clearly demon-

* Bull. Torrey Club 32: 273–290. *pl. 19, 20.* 1905.

strated by Spruce. It is made up of two very distinct sections, one characterized by undivided underleaves, the other by bifid underleaves. Spruce considered both of these sections subgeneric in value and included them under the comprehensive genus *Lejeunea.* For the first he reserved the name *Omphalanthus,* changing it to *Omphalo-Lejeunea* for the sake of consistency. The species included under the second section he transferred to his subgenus *Taxi-Lejeunea.* This disposition of the matter has been followed by subsequent writers, including Schiffner, who raised both these subgenera to generic rank. In doing this, however, he discarded the name *Omphalo-Lejeunea* and restored the original name *Omphalanthus.*

As thus restricted the genus consists of a single variable species, *O. filiformis,* which has a very wide distribution in the American tropics. This species may be described as follows:

OMPHALANTHUS FILIFORMIS (Swartz) Nees

Jungermannia filiformis Swartz, Prodr. Fl. Ind. Occ. 144. 1788.

Jungermannia birotunda Ehrh. Beitr. **4**: 45. 1789.

Jungermannia geminiflora Nees, in Martius, Fl. Bras. **1**^{1}: 354. 1833.

Phragmicoma filiformis Nees, Naturg. Eur. Leberm. **3**: 248. 1838.

Lejeunea filiformis Nees, in Montagne, Flor. Boliv. 64; d'Orbigny, Voy. dans l'Amér. Mérid. **7**^{2}. 1839.

Lejeunea geminiflora Nees, *l. c.* 66. 1839.

Omphalanthus geminiflorus Nees, in G. L. & N. Syn. Hep. 303. 1845.

Omphalanthus filiformis Nees, *l. c.* 304. 1845.

Lejeunea tenuifolia Tayl. Lond. Jour. Bot. **5**: 391. 1846.

Lejeunea (*Omphalo-Lejeunea*) *filiformis* Spruce, Hep. Amaz. et And. 87. 1884.

Pale yellowish-green, becoming brownish with age, growing in loose tufts: stems erect or ascending, with few rhizoids, 0.15 mm. in diameter, sparingly and irregularly branched, the branches obliquely to widely spreading, with smaller leaves than the stem but never microphyllous: leaves imbricated, the lobe attached by an almost longitudinal line, abruptly dilated from a narrow base, the inflated portion orbicular, 0.7 mm. long, convex and sometimes wrapped around the stem, almost concealing the underleaves, antical margin of lobe arching across or a little beyond the axis, strongly outwardly curved from the base to the rounded apex, postical margin also rounded, forming an angle of 90° or more with the keel, margin entire or minutely and indistinctly crenulate from projecting cells; lobule ovate in outline, 0.4 mm. long, 0.2 mm. wide, inflated throughout, sometimes constricted in the outer part, keel straight or nearly so, slightly decurrent, forming an angle of about 45° with the axis (and base of lobule), free margin revolute to apex, sinus straight or nearly so, forming an angle of about 90° with the free margin, apex rounded or very obtuse, indefinite in structure, hyaline papilla marginal, borne at about the middle of the sinus; cells of lobe more or less convex, averaging 13 μ in diameter at the margin, 18 μ in the middle and 29 μ at the base, trigones very large, triangular in outline with somewhat bulging sides, separated by small pits or occasionally confluent, intermediate thickenings infrequent and usually minute, cell-cavities substellate; ocelli none: underleaves contiguous to slightly imbricated, broadly orbicular, 0.75 mm. long, 0.9 mm. wide, plane or more or less convex from below, abruptly narrowed and very short-decurrent at the base, attached by a strongly arched line of insertion extending about one third the length of the underleaf, apex broad and rounded, margin as in the leaves: inflorescence dioicous: ♀ inflorescence borne on a more or less elongated branch, innovating on one side, rarely on both, the innovations simple or again floriferous; bracts obliquely spreading, complicate, unequally bifid, the lobe obovate, 0.75 mm. long, 0.4 mm. wide, rounded at the apex, margin entire or irregularly sinuate, lobule ligulate, the free portion sometimes very short, 0.3 mm. long, 0.05 mm. wide, rounded to obtuse at the apex, keel sharp, not winged; bracteole free, oblong to obovate, 0.6 mm. long, 0.4 mm. wide, rounded to emarginate at the broad apex, margin as in the bracts; perianth slightly exserted, obovoid or obconical, 0.85 mm. long, 0.55 mm. wide, gradually narrowed toward the base, rounded to truncate at the apex and abruptly narrowed to a small circular opening, beakless, terete or very obscurely triangular in cross-section, surface smooth: ♂ inflorescence occupying a short primary branch; bracts in two to ten pairs, imbricated, inflated at the base, deeply and subequally bifid with ovate-triangular obtuse lobes: capsule 0.5 mm. in diameter; spores irregular in form but mostly longer than broad, about 25 μ in short diameter, greenish-brown, surface bearing scattered circular patches of minute and indefinite radiating ridges, otherwise minutely verruculose; elaters measuring about 160 x 13 μ (PLATE 3, FIGURES 1–9).

On trees, banks and rocks. Puerto Rico, without definite locality, *Schwanecke*. Luquillo Mountains, *Sintenis* (*36*). El Yunque, *Evans* (*12, 54, 56*). The species is most at home at low elevations on the mountains and, according to Spruce, scarcely ascends to 2000 m. It has been recorded from the following West Indian Islands: Jamaica, the type locality, St. Kitts, Guadeloupe, Dominica, and Martinique. On the mainland its range extends from Mexico to Bolivia, and it has also been reported from the Galapagos Islands. Whether the species occurs outside the American tropics is doubtful. Many years ago it was reported from the East Indies by Montagne,* and has since been listed from Madagascar by Gottsche.† The East Indian record, however, does not seem to have been confirmed, and according to Spruce ‡ the specimens from Madagascar, so far as he had seen them, ought to have been referred to *Lejeunea* (*Euosmolejeunea ?*) *Montagnei* Gottsche.§

The genus *Omphalanthus* occupies a somewhat isolated position among the *Lejeuneae* of Puerto Rico. The loosely cespitose habit of its single species, the long and sparingly branched stems, the pale color and the terete perianth (FIGURE 1) will at once distinguish it from other genera with undivided underleaves. The structure of the lobule is less definite than is usual in the *Lejeuneae* The apex is blunt and the hyaline papilla, although retaining its marginal position, is displaced into the sinus (FIGURE 6). The nearest relative of the genus, as Spruce has pointed out, is *Peltolejeunea*, which has no known representatives in the West Indies. This genus agrees with *Omphalanthus* in color and general habit and in the structure of the lobule. The leaves, however, are more narrowed toward the apex and are often distinctly pointed, the leaf-cells have much smaller trigones, the underleaves are long-decurrent, and the perianth is distinctly five-keeled. *Peltolejeunea* is a tropical genus of which about eight species are at present known. Most of these occur in the mountains of South America; the others have been recorded from Africa or from the islands of the Pacific.

Omphalanthus filiformis is fully described by Spruce, and the

*G. L. & N. Syn. Hep. 305. 1845.

† Abh. Bremen Naturw. Ver. 7: 352. 1882.

‡ Pearson, Christiania Vidensk.-Selsk. Forh. 1892[8]: 4.

§ Ann. Sc. Nat. II. Bot. 19: 261. *pl. 9. f. 3.* 1843.

account of the antheridial spike, as given above, is adapted from his description. The species, however, in spite of its distinctness, has never been figured, and attention is therefore called to it again. Spruce was the first to reduce *O. geminiflorus* to a synonym of *O. filiformis*. In this he has been followed by later writers, including both Stephani and Schiffner, although the latter retains *geminiflorus* as the name of a variety. In the writer's experience the species occurs in numerous forms but these are too inconstant to be designated by formal names.

LOPHOLEJEUNEA

Lopholejeunea is one of the largest and most widely distributed genera of the *Lejeuneae Holostipae*, including between 30 and 40 recognized species. Most of these are confined to tropical regions, but the genus has also been reported from southern Florida, Chile, Japan and New Zealand. Of the species so far described, only six are at present known from America, one of these being the endemic *L. Anderssonii* Steph., of the Galapagos Islands. About a dozen species have been recorded from Asia and the East Indies and nearly as many from various islands of the Pacific. The remaining species are African. The genus is most at home at comparatively low altitudes. The majority of the species grow on the bark of trees or shrubs or on rotten logs, a few are occasionally found on rocks, and at least one species has been collected on living leaves.

In some cases the plants form pure depressed mats of considerable extent, but it is more usual to find them mixed with other *Lejeuneae*. The stems are prostrate, and the leaves remain closely appressed to the substratum even when dry. In sunny places, where the plants attain their best development, the walls of the cells are usually so deeply pigmented that they give a dark-brown or black color to the whole tuft; in shady localities the pigmentation tends to be less pronounced and the plants appear olive-green or even bright-green, the color of the chloroplasts showing through the walls. A glossiness in the leaves is also frequently apparent. The broad lobes spread widely from the axis and are more or less rounded at the antical base (PLATE 3, FIGURES 10, 12). They are usually plane or only slightly convex, but the apex, which is sometimes rounded and sometimes narrowed to a point, is often distinctly revolute. In nearly every species the margin of a normal leaf is entire but it tends to be toothed in the vicinity of a female inflorescence. The cells of the lobe resemble those described for *Ceratolejeunea*,* although the middle lamella is rarely distinct and the local thickenings of the wall are usually less conspicuous. Ocelli and hyaline cells are apparently never differentiated.

The lobule when well-developed consists of two subequal and fairly distinct portions, one inflated and the other plane and more or less appressed to the lobe (FIGURE 10). The inflated portion, or water-sac, is in the basal part of the lobule, extending for a variable distance along the keel, and is sometimes so strongly swollen that it bulges beyond the free margin. The plane portion occupies the outer part of the lobule and extends from the sac to the free margin. The latter is slightly separated from the lobe in the outer part of the sinus, thus leaving a narrow opening into the sac. In many cases the apical tooth cannot be clearly seen without dissection, not only because it is small and inconspicuous but also because it is bent inward toward the lobe. The tooth consists of a blunt projection usually composed of a single cell (FIGURE 16). The hyaline papilla arises either from the tooth itself or from a cell near it on the proximal side; in either case it is slightly displaced from the margin and is to be looked for on the surface of the lobule which is turned toward the lobe. If the sinus is traced to its outer extremity it is sometimes found to pass directly into the postical margin of the lobe and sometimes to end at some little distance from the margin. In the latter case the lobule is adnate to the lobe in the outer part, and the adnate portion is sometimes four or five cells across. A somewhat similar condition has been described for certain species of *Drepanolejeunea*.† In all the species of *Lopholejeunea* studied by the writer the free margin is entire, except for the apical tooth. In *L. eulopha* (Tayl.) Schiffn.,‡ however, according to Schiffner,§ it bears several long cilia,

* Bull. Torrey Club 32: 275. 1905.

† Bull. Torrey Club 30: 21. 1903.

‡ Engler & Prantl, Nat. Pflanzenfam. 1^3: 129. 1895. (= *Lejeunea eulopha* Tayl. Lond. Jour. Bot. 5: 391. 1846.)

§ Leberm. der "Gazelle" Exped. 28. 1890. The specimens upon which this observation was based were collected on the island of Amboina and showed female each composed of a single row of cells. Unfortunately the lobule is often poorly developed and fails to show some of the peculiarities which have been described.

The underleaves are broad and undivided, varying in outline from rotund to reniform (FIGURE 10). They are attached by a short and slightly arched line of insertion, and the margin, except sometimes in the vicinity of the inflorescence, is entire. The underleaves are usually plane throughout but the median region sometimes bulges slightly toward the substratum, and in certain species the margin is revolute to a greater or less extent. The rhizoids are sometimes abundant and sometimes very few; they grow out from the bases of the underleaves without the development of radicelliferous discs.

The inflorescence is usually autoicous but a few dioicous species have been described, and even in species which are normally autoicous unisexual individuals are not infrequent. The female branch is variable in length but is usually more or less elongated. In the majority of cases it is simple, occasionally it gives off a branch some distance behind the flower, and in very rare instances a true subfloral innovation is developed. The last condition, however, is doubtless abnormal and the absence of innovations may well be considered a reliable generic character. The bracts differ considerably from ordinary leaves and are either dentate or spinose in nearly every species (FIGURES 17, 18). The lobule sometimes consists of a minute tooth at the base of the lobe and is sometimes much larger (PLATE 4, FIGURE 9), marked variations in these respects being occasionally exhibited by a single species. The bracteole is usually undivided as in ordinary underleaves, but its margin may be either toothed or entire. As in other genera without subfloral innovations there is a gradual transition from normal leaves and underleaves to bracts and bracteoles, and for the sake of clearness it is perhaps advisable to restrict these latter terms to the floral leaves immediately surrounding the perianth.

The perianth in *Lopholejeunea* presents some of the most striking peculiarities of the genus (FIGURE 10). It is strongly com-

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flowers but no perianths. Since no allusion is made to them in Schiffner's "Conspect. Hepat. Archip. Indici," published in 1898, it is possible that they were incorrectly determined.

pressed, the lateral keels being very sharp. The antical surface is commonly plane or slightly concave, but occasionally bears a short and low keel. On the postical surface there are two sharp keels, although it would be equally correct to regard these as the two angles of a single broad and low keel. Each of the four sharp keels gives rise to two interrupted wings, which are deeply laciniate. In certain species the laciniae are so numerous that they almost conceal the remainder of the perianth; in other species they are fewer and appear like scattered teeth or spines. Aside from the laciniae the surface of the perianth is commonly smooth, and the apex is broad, truncate and distinctly rostrate.

The male inflorescence varies greatly in length, sometimes occupying a branch throughout its entire extent, sometimes being restricted to its terminal portion. The bracts are at first imbricated but afterwards tend to become more or less separated. They are subequally bifid and bear the antheridia in pairs. Bracteoles are to be found along the whole length of the spike.

Although the genus has not before been reported from Puerto Rico, three species occur in the collections examined by the writer. One of these is the abundant and widely distributed *L. Sagraeana* (Mont.) Schiffn., which may be considered the type of the genus; the second is referred to *L. Muelleriana* (Gottsche) Schiffn., the determination being based on the description given by Spruce and the specimens distributed in the Hepaticae Spruceanae; the third is apparently undescribed. All three species have been very sparingly collected on the island.

LOPHOLEJEUNEA SAGRAEANA (Mont.) Schiffn.*

Brownish or blackish-green, somewhat glossy, growing in depressed mats: stems prostrate, 0.1 mm. in diameter, irregularly pinnate, the branches widely spreading, simple or sometimes subdivided, usually with smaller leaves than the stem but rarely microphyllous: leaves loosely to closely imbricated, the lobe plane or somewhat convex, widely spreading, slightly falcate, oblong-ovate, 0.75 mm. long, 0.55 mm. wide, antical margin arching across or considerably beyond the axis, strongly outwardly curved to the broad and rounded apex, postical margin slightly curved, forming an obtuse angle with the keel, margin entire throughout; lobule

* For a full synonymy of this species, see EVANS, Bull. Torrey Club 32: 190. 1905.

ovate in outline, 0.25 mm. long, 0.2 mm. wide, the inflated portion conspicuous, occupying the inner half of the lobule and forming a hemispherical swelling often extending beyond the free margin, apical tooth rounded and often indistinct, sinus broad and shallow, adnate portion from one to three cells long; lobule sometimes poorly developed; cells of lobe plane or slightly convex, averaging 10 μ at the margin, 20 μ in the middle and $30 \times 20\,\mu$ at the base, middle lamella often distinct, trigones large, triradiate with rounded to pointed ends, intermediate thickenings occasional, circular to oval in outline, pits small and narrow, often obliterated by the confluence of the local thickenings, free walls of cells uniformly thickened: underleaves contiguous to imbricated, plane or with a slight median bulging, reniform, 0.35 mm. long, 0.5 mm. wide, rounded to subcordate at the base, apex broad and rounded, margin entire: inflorescence normally autoicous: ♀ branch variable in length but rarely much abbreviated; bracts widely spreading, the lobe falcate, suborbicular or broadly ovate-orbicular, 0.95 mm. long, 0.85 mm. wide, antical margin strongly arched (except near the base), apex broad and rounded, postical margin straight or slightly arched, margin usually bearing from ten to twenty coarse and irregular scattered teeth, the largest three or four cells long, broad at the base and blunt or sharp at the apex, lobule appressed to the lobe or explanate, very minute, reduced to a mere tooth at the base of the lobe, 0.15 mm. or less in length; bracteole free, broadly orbicular, 0.8 mm. long, 1 mm. wide, median region bulging, margin plane or nearly so, entire or vaguely and irregularly sinuate; perianth extending but little beyond the bracts, oval to obovate in outline, 0.75 mm. long, 0.55 mm. wide without the laciniae (0.95×0.95 mm. including the laciniae), beak short, antical face plane or nearly so, wings of keels deeply laciniate, the laciniae crowded, ovate to lanceolate from a somewhat narrowed base, acute, entire or sparingly and irregularly dentate or spinose-dentate, often attaining a size of 0.2×0.07 mm.: ♂ spike occupying a short branch or terminal on a longer branch; bracts in from two to fifteen pairs, shortly bifid, the lobule a little narrower and shorter than the lobe, inflated, obliquely spreading, both lobe and lobule rounded at the apex, keel arched; bracteoles distant to loosely imbricated, orbicular to broadly orbicular: mature sporophyte not seen (PLATE 3, FIGURES 10–20).

On the bark of trees and on rotten logs. Near Cayey, *Evans* (*85*). Between Cayey and Caguas, *Howe* (*1412*, *1413 p. p.*). Near Mayaguez, *Mrs. Britton & Miss Marble* (*649 p. p.*). Type locality, Cuba, *Ramon de la Sagra*. The species is widely distributed in the American tropics: it is already known from eight of the West Indian Islands, and on the mainland its range extends from subtropical Florida, through Mexico, to southern Brazil and Bolivia. It has also been reported from Africa and from the East Indies, but these records need confirmation.

The original figures of Montagne and the accompanying text * leave little doubt as to the more essential peculiarities of the type specimens. These evidently represent a somewhat slender form of the species and fail to show some of the characters which are described above. On account of its great variability *L. Sagraeana* has been the source of considerable confusion, and its relationship to *Lejeunea subfusca* Nees,† originally described from Java, is still a matter for discussion. According to Stephani ‡ the type specimen of *L. subfusca* represents the ordinary form of *L. Sagraeana*. For some reason, however, he maintains *L. Sagraeana* as the name of the species, in spite of the fact that Nees von Esenbeck's plant was published fifteen years earlier than Montagne's. These views of Stephani were never quite acceptable to Schiffner,§ who continues to regard *L. subfusca* as a well-marked variety of *L. Sagraeana* and who even implies that the two plants may be specifically distinct. Through the kindness of Count Solms the writer has had the privilege of examining two stems of *L. subfusca* from the Nees herbarium, one of which was taken directly from the type material. Unfortunately the specimens are both sterile, but their loose and delicate habit and certain peculiarities in their leaves would seem to indicate that they are amply distinct from *L. Sagraeana*. The lobe is clearly falcate and measures 0.6 × 0.4 mm., while the lobule is only 0.17 mm. long and 0.08 mm. wide. The water-sac occupies about half the lobule and extends outward from the base almost to the end of the keel. The basal part is the most strongly inflated, but apparently never bulges beyond the free margin. From the basal part the sac gradually narrows and opens outward by a flattened canal, bounded on the inside by the appressed portion of the lobule and on the outside by the adnate portion and by the outer part of the keel. The adnate portion is

* Ramon de la Sagra, Hist. Fis. Pol. y Nat. Cuba 9: 464. *pl. 18, f. 1.* 1845.

† G. L. & N. Syn. Hep. 315. 1845. (=*Jungermannia subfusca* Nees, Hep. Jav. 36. 1830.)

‡ Hedwigia 29: 16. 1890.

§ Bot. Jahrb. 23: 593. 1897. — Conspect. Hepat. Archip. Indici 296. 1898.

unusually long and sometimes measures four or five cells across, while the apical tooth, consisting of a single cell, can usually be demonstrated without dissection. Although the structure of this lobule is essentially the same as in *L. Sagraeana*, it is markedly different in appearance and shows no indication of the hemispherical basal swelling which has been described for that species. The underleaves of *L. subfusca* are distant and broadly orbicular, measuring 0.25 × 0.3 mm. The differential characters derived from the bracts have already been indicated by Schiffner and afford another reason why the two species should be kept apart.

In the Synopsis Hepaticarum a specimen of *Lejeunea subfusca* is quoted which was collected in Chile by Bertero. A portion of this specimen, also sent by Count Solms, has been studied by the writer and is evidently distinct from the Javan specimen. In all probability it represents a slender and sterile form of *L. Sagraeana* but is too fragmentary for positive determination. Many years later *Lejeunea subfusca* was doubtfully reported from Brazil by Spruce * and from Juan Fernandez by Mitten.† Since both of these records are considered untrustworthy, even by their authors, there seems to be no good reason for regarding the species as an American plant.

Several varieties of *L. Sagraeana* have been described. Some of these are based on differences in the size and form of the lobule, some on differences in habit. Whether these differences are constant or simply due to environmental conditions can hardly be determined at the present time. Slender and poorly developed forms when sterile sometimes resemble the following species so closely that it is impossible to determine them with certainty.

LOPHOLEJEUNEA MUELLERIANA (Gottsche) Schiffn.

Lejeunea Muelleriana Gottsche, Mex. Leverm. 184. 1863.

Lejeunea (*Lopho-Lejeunea*) *Muelleriana* Spruce, Hep. Amaz. et And. 121. 1884.

Lopholejeunea Muelleriana Schiffn. Bot. Jahrb. **23**: 599. 1897.

Brownish-green, usually paler and less robust than the preceding species, somewhat glossy, growing in depressed mats: stems

* Hep. Amaz. et And. 122. 1884.

† Challenger Rept. Bot. 1³: 88. 1884.

prostrate, 0.85 mm. in diameter, irregularly pinnate, the branches widely spreading, simple or sparingly subdivided, often with smaller leaves than the stem but not distinctly microphyllous : leaves contiguous to loosely imbricated, the lobe plane to slightly convex, widely spreading, somewhat falcate, ovate, 0.65 mm. long, 0.45 mm. wide, antical margin arching partially across to a little beyond the axis, more or less outwardly curved from the base to the rounded or bluntly pointed apex, postical margin slightly curved, forming an obtuse angle with the keel, margin entire throughout or vaguely and irregularly sinuate ; lobule ovate in outline, 0.25 mm. long, 0.15 mm. wide, the inflated portion less conspicuous than in *L. Sagraeana*, forming a flattened hemispherical swelling, rarely extending beyond the curved free margin, apical tooth rounded and often indistinct, sinus broad and shallow, adnate portion usually a single cell across ; lobule often rudimentary ; cells of lobe plane or nearly so, averaging 10 μ at the margin, 21 μ in the middle and 32 × 21 μ at the base, middle lamella not distinct, trigones smaller than in *L. Sagraeana*, triradiate with pointed ends, intermediate thickenings numerous, oval, sometimes two or three between two trigones, pits distinct, rarely obliterated : underleaves distant to contiguous, reniform, 0.25 mm. long, 0.35 mm. wide, rounded at the base, broad and rounded to truncate at the apex, margin entire : inflorescence normally autoicous : ♀ branch more or less elongated ; bracts obliquely spreading, usually somewhat complicate but sometimes explanate, the lobe scarcely falcate, ovate, 0.9 mm. long, 0.55 mm. wide, antical margin a little more curved than the postical, apex varying from rounded to apiculate or subacute, margin irregularly angular-dentate or sinuate, the teeth one or two cells long, broad at the base, rounded to acute at the apex ; lobule ligulate and often hardly distinguishable when explanate, 0.3 mm. long, 0.035 mm. wide, the free margin sometimes merging gradually into the lobe, sometimes tipped with an acute apex ; bracteole free, orbicular, 0.75 mm. long, slightly revolute near the base on one or both sides, otherwise plane or nearly so, apex rounded to slightly retuse, margin irregularly sinuate in upper part but not distinctly toothed ; perianth one third to one half exserted, obovate in outline, 1 mm. long, 0.7 mm. wide without the laciniae (0.95 mm. wide including the laciniae), beak short, antical face plane or nearly so, wings of keels sparingly but deeply laciniate, those of the postical keels usually shorter than the others, laciniae mostly subulate from a broad base, acute, entire or irregularly denticulate or dentate on the margins, maximum size about 0.1 × 0.05 mm., postical surface occasionally bearing one or more scattered paraphyllia in the upper part, similar to the laciniae, surface otherwise smooth : ♂ spike occupying a short branch or terminal on a longer branch; bracts mostly in from two to six pairs, obliquely spreading, shortly bifid, both divisions rounded at the apex or the lobe obtusely pointed, keel arched; bracteoles as in *L. Sagraeana*: mature sporophyte not seen (PLATE 4, FIGURES 1–8).

On trees. North slope of the Luquillo Mountains, *Heller* (*783*). El Yunque, *Evans* (*124*). Type locality, Mexico, *Müller*. The species has also been reported from the following stations: Martinique, *Bélanger*; Guiana, *Leprieur*; Venezuela (collector not named); Brazil, *Spruce*. To these Jamaica, *Evans*, may be added. According to Professor Lindau, of Berlin, the type specimen of *Lejeunea Muelleriana* is not to be found in the Gottsche herbarium.

Unfortunately the specimens from Brazil and Puerto Rico, which have been referred to *L. Muelleriana*, do not agree in all respects with the original description of the species, the main discrepancies being in the characters derived from the leaves. According to Gottsche the lobes are normally ovate and acute, although the statement is added that they are occasionally rounded at the apex. According to Spruce the lobes are frequently rounded at the apex, but he nevertheless intimates that they are normally more or less pointed. So far as the writer has observed, the specimens distributed by Spruce are nearly always characterized by rounded lobes, acute or even obtuse lobes being a marked exception. The bracts and subfloral leaves are more frequently narrowed at the apex, but even here rounded lobes are far from unusual. Judging from these specimens (with which those from Puerto Rico closely agree), the acute lobes described by Gottsche represent an exceptional variation rather than the normal condition of the species. However this may be, a considerable range of specific variation is to be expected in *Lopholejeunea*, and there seems to be no reason at present for attempting to segregate *L. Muelleriana* as defined above.

When compared with well-developed *L. Sagraeana* the present species is somewhat less robust, the leaves and underleaves tend to be less crowded, the lobules are more frequently rudimentary, and the local thickenings of the cell-walls are less conspicuous. Since these differences are purely relative they cannot always be relied upon, but fortunately they are supported by more constant differential characters derived from the floral leaves and perianths. In *L. Sagraeana* the bracts have widely spreading lobes, subrotund in outline and rounded at the apex, the bracteole is broader than long and plane or nearly so along the margin, the perianth is almost hidden by the bracts, except for the projecting laciniae, while the latter are densely crowded and usually broaden out from a narrow base. In *L. Muelleriana* the bracts have obliquely spreading lobes, ovate in outline and often distinctly narrowed toward the apex, the bracteole is orbicular and narrowly reflexed near the base, the perianth is more exserted, and the laciniae, which are much less numerous, usually taper from a broad base. In all probability the specimens from Brazil and Trinidad, which have been referred to *Lejeunea Sagraeana* γ of the Synopsis, represent a form of *L. Muelleriana*, a fact to which Gottsche has already called attention.*

Another close relative of *L. Muelleriana* is *Lejeunea* (*Lopholejeunea*) *Mariei* Besch. & Spruce,† a species known at present from the island of Guadeloupe only, where it was collected in 1877 by Ed. Marie. Through the kindness of Mr. Slater, the writer has been able to examine the type specimen of this species from the Spruce herbarium. It is about as large as *L. Muelleriana*, but its leaves are more strongly falcate and apparently always rounded at the apex. The lobule is rarely rudimentary and shows a somewhat larger water-sac, which extends outward from the axis rather than forward, very much as in *Lejeunea subfusca*. The adnate portion, however, is only one or two cells across. Several of these differences are noted by Spruce, but one of the characters of *L. Mariei* which he especially emphasizes, the dioicous inflorescence, seems to be inconstant, some of the plants included in the original material being clearly autoicous. The perianths of the two species are very similar, but the bracts of *L. Mariei* are distinguished by being entire or only slightly denticulate, the lobule is commonly more distinct, and the bracteole is plane.

Lopholejeunea Howei sp. nov.

Dull olive-green, growing in depressed mats: stems prostrate, 0.13 mm. in diameter, irregularly pinnate, the branches obliquely

* Mex. Leverm. 183. 1863.

† Bull. Soc. Bot. de France 36: clxxix. 1889.

to widely spreading, simple or sparingly subdivided, usually with smaller leaves than the stem but not microphyllous: leaves imbricated, the lobe convex, often revolute at the apex, widely spreading, falcate, oblong-ovate, 0.75 mm. long, 0.5 mm. wide, antical margin arching partially or wholly across the axis, strongly outwardly curved from the base to the apex, postical margin straight or slightly curved, forming an angle of 90° or more with the keel, apex broad, rounded to very obtuse, margin entire or nearly so; lobule ovate in outline, 0.35 mm. long, 0.2 mm. wide, the inflated portion occupying the basal half and forming a subhemispherical swelling occasionally extending beyond the free margin, apical tooth rounded and often obsolete, rarely apparent without dissection, sinus broad and shallow, adnate portion one cell across; cells of lobe plane to somewhat convex, averaging 16 μ at the margin, 28 μ in the middle and 35 μ at the base, trigones distinct but not conspicuous, triradiate with acute, sometimes constricted, rays, intermediate thickenings occasional, oval: underleaves contiguous to slightly imbricated, plane or somewhat revolute at the apex, reniform, 0.5 mm. long, 0.75 mm. wide, straight or very slightly decurrent at the base, apex broad, rounded or truncate, margin entire: inflorescence autoicous: ♀ branch more or less elongated, usually with several pairs of leaves; bracts obliquely spreading, unequally bifid and commonly complicate, the lobe ovate-oblong, 1.4 mm. long, 0.7 mm. wide, not falcate, often reflexed at the abruptly acute or apiculate apex, margin sharply and irregularly dentate especially in the upper part, the teeth averaging six on the antical margin and four on the postical, mostly one to four cells long and one or two cells wide at the base, lobule obcuneate from a narrow base, 0.6 mm. long, 0.2 mm. wide, acute or apiculate at the apex, margin entire; bracteole free, ovate, 1.35 mm. long, 0.85 mm. wide, bifid about one tenth with acute, triangular and often reflexed divisions separated by an acute to obtuse sinus, margin irregularly dentate as in the bracts, usually with from four to eight teeth on each side and from one to three in the sinus; subfloral underleaf undivided, commonly dentate along its broad apex; perianth about half-exserted, obovate in outline, 1.4 mm. long, 1 mm. wide, beak short, antical face plane or slightly depressed, wings of keels much interrupted, sparingly and irregularly dentate, the teeth rarely more than two or three cells long and one or two cells wide at the base, wings of postical keels shorter and more rudimentary than the others: ♂ spike occupying a short branch; bracts in about six pairs, strongly inflated, subequally bifid, complicate with a strongly arched keel, the divisions rounded to subacute at the apex, bracteoles similar to the underleaves but smaller: mature sporophyte not seen (PLATE 4, FIGURES 9–20).

On trees. Between Cayey and Caguas, *Howe* (*1413 p. p.*). growing mixed with *L. Sagraeana* and *Euosmolejeunea trifaria*. These specimens may be considered the type. A single plant of the species without perianths but with male and female flowers occurs mixed with the type specimen of *Lejeunea Mariei* from the island of Guadeloupe. It has also been collected by the writer in Jamaica and may therefore be expected from other localities in the West Indies.

This interesting species is named in honor of Dr. Marshall A. Howe, of the New York Botanical Garden, who first collected specimens with perianths (March, 1906). It differs from all other known species of *Lopholejeunea* in the possession of a bifid bracteole, but in other respects is a typical member of the genus. Among American species it is further aberrant because it bears teeth along the margin of the bracteole, but this second peculiarity has been described for at least three paleotropic species; namely, *L. eulopha*, of the Pacific Islands, *L. dentistipula* Schiffn., of Amboina, and *L. fimbriata* (Gottsche) Schiffn., of Madagascar, Australia and New Guinea. In these three species, however, the bracteole is broad and rounded at the apex.

L. Howei is about as robust as *L. Sagraeana* but differs not only from this species but also from *L. Muelleriana* in its color, which is olive-green rather than brown or black. It is also destitute of glossiness. In the characters derived from leaves, underleaves and cell-structure it agrees closely with *L. Muelleriana*, the lobes of the subfloral leaves showing an even stronger tendency to be sharp-pointed. More striking differences are to be found in the bracts and perianths, the lobules of the bracts being larger and more conspicuous and the wings of the perianth bearing fewer and smaller teeth. In old perianths these teeth show a tendency to break off, so that the keels appear either entire or irregularly denticulate. The differential characters derived from the bracteoles, which are perhaps the most important of all, have already been emphasized.

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Explanation of plates 1–4

As in the previous papers of this series the figures were drawn by the writer and prepared for publication by Miss Hyatt.

PLATE 1

Stictolejeunea squamata (Willd.) Schiffn. 1. Part of female plant with two perianths, postical view, × 25. 2. Part of branching stem with most of the underleaves removed to show the lobules and the bases of the branches, postical view, × 25. 3. Male inflorescence, postical view, × 25. 4. Two lobules, postical view, × 45. 5. Base of leaf, antical view, × 45. 6. Base of leaf subtending a branch, antical view, × 45. 7. Base of underleaf, × 45. 8. Cells from middle of lobe surrounding an ocellus, × 265. 9. Apex of a lobe with a hyaline border, × 200. 10. Apex of a lobe without a hyaline border, × 200. 11. Antical base of lobe showing large papilla, × 200. 12, 13. Apices of lobules, showing hyaline papillae displaced from the margin, × 200. 14–16. Bracts and bracteole from a single involucre, × 25. The figures were all drawn from specimens collected by the writer, figs. 1, 3, 14–16 from Jamaican specimens (*345*), the others from Puerto Rico specimens (*192*, *195*).

Neurolejeunea Breutelii (Gottsche) Evans. 17. Female branch with perianth, the innovations dissected away, postical view, × 35. 18. Part of stem, postical view, × 35. 19. Part of stem, antical view, × 35. 20. Cells from middle of lobe, × 265. 21–23. Bracts and bracteole from a single involucre, × 35. The specimens were all drawn from specimens collected by Duss in Guadeloupe (*1022*).

PLATE 2

Neurolejeunea catenulata (Nees) Schiffn. 1. Female branch with perianth, postical view, × 35. 2. Another female branch with perianth, the innovations dissected away, postical view, × 35. 3. Part of plant with a short female branch, postical view, × 25. 4. Leaf, antical view, × 35. 5. Cells from base of lobe with row of ocelli, × 265. 6. Apex of lobe, showing hyaline cells, × 200. 7. Apex of lobule, showing hyaline papilla, × 200. 8. Apex of another lobule, × 200. 9–11. Bracts and bracteole from a single involucre, × 35. 12. Perianth, postical view, × 35. The figures were all drawn from specimens collected by the writer, fig. 12 from a Jamaican specimen (*313*), the others from Puerto Rico specimens (*143*, *144*).

Ceratolejeunea portoricensis (Hampe & Gottsche) Evans. 13. Female branch with perianth and innovation, postical view, × 35. 14. Part of stem, antical view, × 35. 15. Cells from middle of lobe, those at right of figure drawn from a lower level to show the thin places in the vertical walls, × 265. 16. Apex of lobe with hyaline cells, × 200. 17. Antical margin of lobe, × 200. 18. Apex of lobule, × 200. 19. Stem-underleaf, × 35. 20–22. Bracts and bracteole from a single involucre, × 35. The figures were all drawn from the type specimen.

PLATE 3

Omphalanthus filiformis (Swartz) Nees. 1. Part of female plant with perianth and innovation, the underleaves dissected away, postical view, × 25. 2. Part of stem, postical view, × 25. 3. Part of stem, antical view, × 25. 4. Cells from middle of lobe, × 265. 5. Cells from antical margin of lobe, × 200. 6. Apex of lobule, × 200. 7–9. Bracts and bracteole from a single involucre, × 35. The figures were all drawn from Puerto Rico specimens collected by the writer (*56*).

Lopholejeunea Sagraeana (Mont.) Schiffn. 10. Part of a female plant with perianth, postical view, × 25. 11. Female branch with perianth, postical view, the underleaves and bracteole dissected away, × 25. 12. Part of stem, antical view, × 25. 13. Cells from middle of lobe, × 265. 14. Cells from base of lobe in cross-section,

$\times$ 265. 15. Cells from antical margin of lobe, $\times$ 200. 16. Apex of lobule, $\times$ 200. 17–19. Bracts and bracteole from a single involucre, $\times$ 25. 20. Transverse section through middle of perianth, $\times$ 25. The figures were all drawn from Cuban specimens collected by Underwood & Earle (*1145*).

PLATE 4

Lopholejeunea Muelleriana (Gottsche) Schiffn. 1. Female branch with perianth, postical view, $\times$ 25. 2. Female branch with perianth, antical view, $\times$ 25. 3. Cells from middle of lobe, $\times$ 265. 4. Apex of lobule, $\times$ 200. 5–7. Bracts and bracteole from a single involucre, $\times$ 25. 8. Transverse section through middle of perianth, $\times$ 25. The figures were all drawn from Puerto Rico specimens collected by the writer (*124*).

Lopholejeunea Howei Evans. 9. Part of plant with perianth, postical view, $\times$ 25. 10. Part of stem, the underleaves dissected away to show the lobules, postical view, $\times$ 25. 11. Part of stem, antical view, $\times$ 25. 12. Cells from middle of lobe, $\times$ 265. 13. Apex of lobule, $\times$ 25. 14–16. Bracts and bracteole from a single involucre, $\times$ 25. 17, 18. Subfloral leaves, $\times$ 25. 19. Subfloral underleaf, $\times$ 25. 20. Transverse section through middle of perianth, $\times$ 25. The figures were all drawn from the type specimen.

Studies on the Rockv Mountain flora — XVII

Per Axel Rydberg

Pedicularis siifolia

Perennial with a rootstock; stem glabrous, 3–6 dm. high, leafy; leaves pinnately divided to the midrib, glabrous, 5–15 cm. long; divisions lanceolate, narrowed at the base, 1–4 cm. long, more or less doubly serrate-dentate; spike short, 3–8 cm. long; bracts linear, oblong, or lanceolate, entire or slightly toothed; calyx glabrous or with a few scattered hairs, 8–9 mm. long, its lobes lanceolate; corolla yellowish, nearly 2 cm. long; galea about 8 mm. long, curved, upper portion helmet-shaped with a short conical beak; lip 4 mm. long, rather deeply 3-cleft with rounded lobes.

This species is somewhat intermediate between *P. Canbyi* and *P. bracteosa.* In habit it resembles closely the latter, but the corolla is that of the former, having an evident although short beak. It grows in the mountains of western Montana and Idaho at an altitude of 600–1200 m.

Montana: Grant Creek, June 7, 1897, *M. J. Elrod and assistants 97.*

Adenostegia ciliosa

Annual; stem more or less branched, puberulent, purplish, 1.5–2 dm. high; leaves 2–3 cm. long, finely puberulent, 3–5-cleft into filiform divisions; flowers in small headlike clusters; bracts similar to the leaves but with broader bases and more or or less hirsute-ciliate with white flat hairs; calyx nearly 1.5 cm. long, more or less ciliate; its divisions about 5-ribbed; corolla about 15 mm. long; galea 5–6 mm. long, hooded at the apex; lip nearly as long, pubescent without; stamens 4, anthers 2-celled, sparingly short-bearded.

This species is probably most closely related to *A. ramosa* Nutt., but is easily distinguished by the ciliate bracts and calyces. It grows on dry mesas at an altitude of about 2000 m.

Wyoming: Spread Creek, 1897, *Frank Tweedy 545.*

Castilleja arcuata

Perennial, more or less tufted at the base; stems erect, strict, usually simple, 2–4 dm. high, shining, yellow or tinged with purple, glabrous or short-villous in the inflorescence; leaves narrowly linear, 2–6 cm. long, 1–3 mm. wide, glabrous or the lower sparingly white-villous; bracts brownish, 1–2 cm. long, 3-cleft with lanceolate lobes, white-villous with short hairs; calyx 12–15 mm. long, deeply cleft below, less deeply so above, its lobes lanceolate, about 1 mm. long; corolla 2.5–3 cm. long, at last strongly curved, greenish with yellow margins; galea 12–15 mm. long; lip about 3 mm. long, with linear-lanceolate lobes.

This species is related to *C. cognata* and *C. linariaefolia.* From the former it differs in the color of the bracts, different pubescence and the more arching corolla, from the latter in the color of the bracts, the lower habit and the smaller corolla. It grows in meadow land with alkaline soil.

UTAH: South end of Fish Lake, August 10, 1905, *Rydberg & Carlton 7508.*

Castilleja magna

Perennial; stem a meter or so high, glabrous and shining, angled; leaves lanceolate, 4–6 cm. long, glabrous, 5-ribbed and reticulate, more or less acuminate; inflorescence short and dense; bracts ovate, entire, tipped with crimson, as well as the axis of the inflorescence viscid-ciliate; calyx about 2.5 cm. long, cleft halfway down both above and below, its lobes lanceolate, acuminate, 4–5 mm. long; corolla 4–5 cm. long, greenish, tinged with crimson and with crimson margins; galea fully 2 cm. long; lip about 3 mm. long, its lobes lanceolate.

This species somewhat resembles *C. rhexifolia,* but is a taller plant, with smaller bracts and much larger corolla. The latter is of about the size of that of *C. Suksdorfii,* which however is a much smaller and more pubescent plant and has narrow leaves.

BRITISH COLUMBIA: Trail above Carbonate, 1904, *Charles H. Shaw 205.*

Castilleja Leonardi

Perennial, with a short woody caudex; stems several, 2–3 dm. long, more or less viscid-villous; leaves ovate-lanceolate or oblong-lanceolate, 1.5–3 cm. long, densely puberulent, 3-ribbed, acute or acuminate; bracts broadly ovate or obovate, rounded at the apex, about equaling the flowers, densely pubescent, entire, tipped with crimson; calyx 1.5 cm. long, densely puberulent, equally cleft above and below, its lobes ovate, 1.5–2 mm. long, obtuse; corolla 2 cm. long or less, densely puberulent; galea about 1 cm. long; lower lip about 2 mm. long, its lobes lanceolate.

This species is related to *C. lauta* and *C. rhexifolia.* From the former it differs in the broad leaves and dense pubescence, and from the latter in the small size of both the plant and the flower, the thick leaves and more copious pubescence.

UTAH: Head of American Fork Cañon, 1885, *F. E. Leonard 151* in part (type); mountains around the south fork of Big Cottonwood Creek, 1905, *Rydberg & Carlton 6592.*

Castilleja humilis

Perennial, with a short woody caudex; stems several, about 2 dm. high, glabrous below, somewhat viscid-pubescent above; leaves oblong to elliptic-lanceolate or the uppermost ovate, 2–3 cm. long, obtuse or acute, finely puberulent; bracts entire, obovate, tipped with dark crimson, a little shorter than the corollas; inflorescence short and dense; calyx densely puberulent, 10–12 mm. long, equally cleft above and below, its lobes ovate, obtuse, about 1.5 mm. long; corolla about 15 mm. long, densely puberulent, greenish with purple margins; galea 7–8 mm. long; lip 2 mm. long, its lobes lanceolate, acuminate.

In habit this species most resembles *C. rhexifolia*, but the plant is much smaller and the corolla of about half the size. It grows in alpine woods.

WYOMING: Medicine Bow Mountains, Albany County, 1900, *Aven Nelson 7919.*

Castilleja variabilis

Perennial with a rootstock; stems usually single, more or less pubescent, 4–8 dm. high; leaves linear-lanceolate or lanceolate, 4–6 cm. long, 3-ribbed, puberulent and more or less short-hirsute, rarely glabrous; bracts lanceolate, deeply 3-cleft, greenish at the base, otherwise yellow with scarlet or brick-red tips or sometimes almost wholly brick-red; calyx viscid-villous, about 2.5 cm. long, tinged with yellow; corolla yellowish-green with scarlet or yellow margin, about 4 cm. long; galea nearly 2 cm. long; lip dark-green, 3 mm. long, with lanceolate lobes.

This species somewhat resembles *C. lanceolata*, but has larger flowers and differently colored bracts. These are nearly of the same color as those of *C. lutescens* and *C. desertorum*, but both of these species have smaller flowers and 3-cleft upper leaves. *C. variabilis* grows in mountain valleys and on hillsides, at an altitude of 2500–3000 m.

UTAH: Big Cottonwood Cañon, below Silver Lake, 1905, *P. A. Rydberg 6773* (type) and *6800;* divide between Big Cottonwood Cañon and Heber Valley, 1905, *Rydberg & Carlton 6646;* Big Cottonwood Cañon, 1905, *A. O. Garrett, 1504.*

Castilleja Vreelandii

Perennial with a rootstock; stem usually single, 6–8 dm. high, glabrous or nearly so, shining; leaves lanceolate, 3–5-ribbed, glabrous or nearly so, 4–6 cm. long, somewhat acuminate; bracts lanceolate, usually 3-lobed with acute lobes, tipped with crimson; calyx 2–2.5 cm. long, tinged with crimson, equally cleft, viscid-villous below, puberulent above, its lobes lanceolate, acute, 6–8 mm. long; corolla dark-green with purplish margins; galea about 2 cm. long; lower lip 2 mm. long, with lanceolate teeth.

This species is related to *C. lanceolata*, but differs in the larger flowers and the broader, almost glabrous leaves. It grows in the mountains from Montana and Idaho to Wyoming and Utah. As the type is regarded the following:

MONTANA: Divide between McDonald and Camas Lakes, 1901, *F. K. Vreeland 1000.*

Castilleja purpurascens

Perennial with a short caudex; stems several, 1–3 dm. high, glabrous or slightly puberulent, villous above, usually dark-purple; leaves narrowly linear, finely puberulent, 3–5 cm. long, 2–3 mm. wide; inflorescence short and dense; bracts lanceolate, acute or obtuse, the lower usually entire, the upper more or less cleft, tipped with crimson; calyx 15–20 mm. long, more or less villous, especially towards the base, equally cleft, its lobes 2–3 mm. long, obtuse; corolla 2.5–3 cm. long, green with crimson margins; galea about 1 cm. long; lower lip 3 mm. long, with narrowly lanceolate lobes.

This is probably most closely related to *C. Tweedyi* and *C. miniata*, but differs in the lower habit, the darker coloration of the bracts, the narrow leaves, obtuse calyx-lobes, and usually purplish stem.

BRITISH COLUMBIA: Flood-plains of Kicking Horse, 1904, *H. Peterson 11* (type).

ALBERTA: National Park, Banff, 1897, *Mr. & Mrs. C. Van Brunt 40;* Pipestone Pass, 1904, *J. Macoun 67803.*

Castilleja viscida

Cespitose perennial with a short woody caudex; stems 1–3 dm. high, viscid- or glandular-puberulent and with scattered crisp white hairs; leaves 1.5–3 cm. long, 3–5-cleft at the middle, densely glandular-puberulent, the body lanceolate, 3-ribbed, the lobes narrowly lanceolate and directed forward; bract similar to the leaves, tipped with crimson or scarlet; calyx equally deeply cleft above and below, 18–20 mm. long, its lobes lanceolate, 5 mm. long, acuminate or acute; corolla about 2.5 cm. long, dark-green, with crimson margin; galea about 1 cm. long; lip 3 mm. long, its lobes lanceolate.

This species is related to *C. hispida*, *C. Bradburyi* and *C. rupicola.* From the first two it differs in the lower habit and viscid or glandular pubescence, and from the last one in the shorter galea. It grows in the mountains among rocks at an altitude of 2700–3300 m.

UTAH: Mountains near the headwaters of Big Cottonwood Creek, 1905, *Rydberg & Carlton 6593* (type), *6565*, *6540*, *6554*, *6635* and *6546*; Mount Nebo, *no. 7703*, *7750* and *7755*.

Castilleja ampliflora

Perennial, cespitose and somewhat woody at the base; stems 3–4 dm. high, usually branched, ascending, puberulent and somewhat villous; most of the leaves entire, lanceolate, 2–3 cm. long with a short and rather dense pubescence; the upper 3–5-lobed, the middle lobe being broad and the lateral ones small; bracts 3-lobed with a broad rounded middle lobe, crimson, 1–1.5 cm. long; calyx 1.5–2 cm. long, villous, equally cleft above and below, its lobes 3–4 mm. long; corolla nearly 3 cm. long, more turgid than usual; galea fully 1.5 cm. long; lip 3 mm. long, with lanceolate lobes.

This is perhaps most closely related to *C. Bradburyi*, but the stems are more branched, the corolla more turgid, the leaves more inclined to be entire, and the galea fully as long as the corolla-tube. It grows at an altitude of 1150–1350 m.

MONTANA: Divide between McDonald and Camas Lakes, July 29, 1901, *F. K. Vreeland 995*.

Castilleja gracillima

Perennial with a rootstock; stems usually solitary, slender, purplish, 2–4 dm. high, sparingly villous; leaves linear-lanceolate, 2–4 cm. long, 3-ribbed, sparingly short-villous; bracts ovate, entire, toothed or 3-cleft, rose or brownish, puberulent, villous-ciliate; calyx about 15 mm. long, equally cleft above and below, its lobes lance-oblong, obtusish, 3 mm. long; corolla purplish slightly longer than the calyx; galea 8 mm. long; lip about 3 mm. long, its lobes ovate.

This species is closely related to *C. pallida*, but differs in the leaves, which are shorter, neither long-attenuate nor falcate, and in the different color of the bracts and corolla.

In mountain meadows especially on the geyser formations at an altitude of 2000–2700 m.

WYOMING: Lower Geyser Basin, Yellowstone Park, 1897, *Rydberg & Bessey 4964* (type); Lone Star Geyser Basin, *no. 4961*; Upper Hoback Basin, 1900, *C. C. Curtis*.

MONTANA: Mountains near Indian Creek, 1897, *Rydberg & Bessey 4967*.

ALBERTA: Vicinity of Banff, 1899, *W. C. McCalla 2187*.

Castilleja parvula

Cespitose perennial with a short caudex; stems many, 5–15 cm. high, puberulent; leaves lanceolate, 1–2 cm. long, puberulent; bracts ovate, dark brownish-crimson, finely puberulent, entire or with short lobes; calyx 12–14 mm. long, puberulent, equally cleft above and below, its lobes oblong, obtuse, 2–3 mm. long; corolla 17–18 mm. long, greenish with purplish margins; galea about 7 mm. long; lip 2.5–3 mm. long, its lobes lanceolate.

This species is closely related to *C. occidentalis*, but differs in the bracts, which are darker, of a deep crimson shade and not at all villous, and also in the corolla, which is decidedly greenish and with a shorter lip. It grows among rocks on high mountains, at an altitude of nearly 3000 m.

UTAH: Mountains north of Bullion Creek, near Marysvale, 1905, *Rydberg & Carlton 7158* (type) and *7090*.

Castilleja pulchella

Perennial with a cespitose caudex; stems 5–15 cm. high, ascending, more or less villous especially above; leaves 1–4 cm. long; the lower entire and linear-lanceolate, the upper broader and 3-cleft, puberulent and slightly villous; lobes linear-lanceolate, attenuate; bracts elliptic, usually 3-cleft, the middle lobe broad and rounded, tinged with brownish, villous; calyx yellowish, tipped with brownish, about 18 mm. long; lobes very short and rounded; corolla slightly exserted; galea 7 mm. long; lip 5 mm. long, its lobes lanceolate, obtuse.

This species is intermediate between *C. lutea* and *C. occidentalis*.

It has the habit, pubescence and coloration of the latter but the leaves, bracts and calyx-lobes of the former; the form of the corolla is intermediate between those of the two. *C. pulchella* grows on high mountains at an altitude of 2500–3300 m.

MONTANA: Mountains near Indian Creek, 1897, *Rydberg & Bessey 4967* (type); Electric Peak, *no. 4968*.

WYOMING: Big Horn Mountains, 1899, *Tweedy 2345;* Dome Lake, 1896, *Aven Nelson 2435;* Teton Forest Reserve, 1897, *Tweedy 247*.

Castilleja Pecten

Perennial; stem stout, 4–5 dm. high, puberulent throughout; lower leaves linear, entire, 5–6 cm. long, puberulent; the upper 3–5-cleft with linear divisions; bracts rhombic-obovate or broadly cuneate in outline, almost pectinately cleft into linear divisions, puberulent, upper portion yellowish or the tips brownish; calyx about 2 cm. long, puberulent, equally cleft above and below; lobes lanceolate, about 3 mm. long; corolla a little over 2 cm. long; galea 8–9 mm. long; lip about 4 mm. long, its lobes oblong.

In general habit and coloration it resembles somewhat *C. desertorum* and *C. lutescens*, but the lower lip is nearly half as long as the galea and of different shape, and the bracts are peculiar. The structure of the corolla places this species nearest to *C. fasciculata*, but it is a much larger plant.

IDAHO: Beaver Cañon, 1895, *C. L. Shear 3041* (type) and *3038*.

Lupinus marianus

Stem 5–10 dm. high, striate, hirsute-villous with rather short hairs, slender, leafy; stipules setaceous; petioles 4–8 cm. long, or those of the basal leaves even 2 dm. long, hirsute-villous; leaflets 6–8, narrowly oblanceolate, 3–7 cm. long, acute, glabrous above, appressed, short-hairy beneath; inflorescence lax, 1–1.5 dm. long; pedicels 4–5 mm. long; calyx villous, gibbous but not spurred at the base on the upper side; lips lanceolate, the upper 7 mm., the lower 8 mm. long; bracts linear-subulate, longer than the calyx, deciduous; banner 8–10 mm. long, light-blue or white with a darker spot; wings light-blue or white, 10–12 mm. long; legume 3–4 cm. long, 8–9 mm. wide, densely pubescent.

In habit resembling *L. pseudoparviflorus* and *L. laxiflorus*, but differing in the spreading pubescence of the stem. This character would associate it with *L. amplus* and *L. ornatus glabratus* S. Wats. From the former it differs in the lax spike, slender stem, and the paler and smaller corolla; from the latter in the long linear-subulate bracts and narrow leaflets.

UTAH: Along Bullion Creek, above Marysvale, July 21, 1905, *Rydberg & Carlton 7024* (type) and *7025*.

Lupinus stenophyllus (Nutt.)

Lupinus foliosus stenophyllus Nutt.; T. & G. Fl. N. Am. 1: 377 (synonym). 1840.

Stem slender, probably 1 m. high, finely silky-strigose; stipules small, subulate; petioles of the stem-leaves about 3 cm. long, strigose; leaflets about 5, narrowly linear-oblanceolate, about 3 cm. long, 4 mm. wide, usually conduplicate, acute, green, glabrous above, sparingly silky-strigose beneath; raceme about 1 dm. long, lax, more or less one-sided; bracts lanceolate, shorter than the calyx, deciduous; calyx densely silky-strigose, more or less spurred at the base; upper lip ovate, 4 mm. long, the lower lanceolate, 6 mm. long; corolla light-blue, 7–8 mm. long; banner slightly shorter than the broad wings; fruit unknown.

This species has been included in *L. laxiflorus* and *L. tenellus*. It resembles the latter in habit but differs in the spurred calyx and green leaves. From the former it differs in the narrower leaves, glabrous above, and the smaller flowers. The type was collected on the "Oregon Plains" by Nuttall.

Lupinus laxispicatus

Perennial; stems 3–4 dm. high, slender, striate, sparingly strigose; stipules small, lanceolate; petioles strigose, 5–15 cm. long; leaflets 7–10, narrowly oblanceolate, acute, green, glabrous above, strigose beneath, 4–5 cm. long, about 6 mm. wide; inflorescence lax, rather few-flowered; bracts lanceolate, shorter than the calyx, deciduous; calyx grayish silky-strigose, gibbous; lips lanceolate, the upper 6 mm., the lower 7 mm. long; corolla blue, about 10 mm. long; banner only slightly shorter than the wings.

This species is nearest related to *L. Scheuberae*, which however has broader leaves, larger flowers and the upper lip of the calyx is ovate and much shorter than the lower. *L. laxispicatus* grows on high mountains.

IDAHO: Kootenai County, July, 1887, *J. H. Sandberg*.

Lupinus Macounii

Perennial with a short caudex; stems several, 3–6 dm. high, silky-strigose, somewhat branched; stipules lance-subulate; petioles

2–5 cm. long, strigose; leaflets about nine, linear-oblanceolate, 2–3 cm. long, usually conduplicate, silky-strigose on both sides; racemes dense, 5–10 cm. long; bracts narrowly lanceolate, not exceeding the buds, deciduous; calyx gibbous at the base, short-silky with spreading hairs; lower lip lanceolate, 6–7 mm. long, the upper hardly 4 mm. long, ovate; corolla 8–9 mm. long, dark-blue, the banner with a lighter spot, somewhat shorter than the wings; legume densely silky, villous, about 2 cm. long, 6 mm. broad, 3–4-seeded.

The type was labeled *L. argenteus argophyllus.* Its relationship is closer however to the true *L. argenteus*, differing in the smaller, darker flowers, the spreading pubescence on the calyx and pedicels and above all in the shorter upper lip of the calyx. It grows at an altitude of 1000–2500 m.

SASKATCHEWAN: Cypress Hills, 1894, *John Macoun 4070* (type in herb. Columbia Univ.).

MONTANA: Spanish Peaks, 1896, *Flodman 629* (in part).

WYOMING: Big Horn Mountains, 1899, *Tweedy 2363;* Leckie, 1901, *Merrill & Wilcox 759.*

Lupinus subulatus

Perennial with a short caudex; stem 4–5 dm. high, densely silky-strigose, striate, leafy; stipules subulate; petioles silky-strigose, 3–6 cm. long; leaflets 7–10, narrowly oblanceolate or linear-oblanceolate, densely appressed, silky on both sides, 2–4 cm. long, cuspidate or mucronate; raceme dense, 1–1.5 dm. long; bracts subulate-setaceous, much exceeding the buds; calyx appressed silky-canescent, scarcely gibbous; lower lip 8 mm. long, narrowly lanceolate, the upper ovate-lanceolate, 6 mm. long; corolla dark-blue with keel and a spot on the banner light-colored, about 1 cm. long; petals subequal, banner rather densely pubescent without.

This is related to *L. holosericeus*, *L. canescens*, and *L. oreophilus*, but easily distinguished by the long subulate-setaceous bracts.

MONTANA: Columbia Falls, June 3, 1897, *R. S. Williams* (type).

WASHINGTON: Spokane, 1898, *Piper 2823;* also 1892, *Henderson.*

Lupinus flavicaulis

Perennial with a short caudex; stems several, with erect branches, densely pubescent with short yellowish spreading hairs, almost velutinous, 3–5 cm. high; stipules subulate; petioles 2–4 cm. long, velutinous; leaflets 7–10, narrowly oblanceolate, usually conduplicate, densely silky on both sides, acute, 2–4 cm. long; racemes dense, 5–10 cm. long; bracts subulate, shorter than the buds; calyx gibbous, villous; lower lip lanceolate, 7 mm. long; upper lip ovate, 5–6 mm. long; corolla about 10 mm. long, light-purple or pink; banner with a darker spot, pubescent without; legume 2–2.5 cm. long, 7 mm. wide, densely silky-villous, 3–4-seeded.

In general habit, size, form, and color of the corolla and leaflets, this resembles *L. decumbens* very closely, but differs in the dense, short, spreading pubescence of the stem and the denser, longer, looser pubescence of the leaves. These characters place it in the same group as *L. Bakeri* and *L. dichrous*, which it otherwise little resembles. It grows on dry plains and hills.

WYOMING: Snake River, 1894, *Aven Nelson 1098* (type in herb. Columbia Univ.); Evanston, 1882, *N. L. Britton.*

UTAH: Divide, 1898, *Isabel Mulford 268.*

Lupinus macrostachys

Perennial with a short caudex; stem 5–10 dm. high, puberulent and with long silky spreading or reflexed hairs; stipules setaceous; petioles short-pubescent with spreading hairs, 2–10 cm. long; leaflets 7–8, linear-oblanceolate, acuminate, 3–6 cm. long, appressed-silky on both sides, grayish-green; raceme dense, 2–3 dm. long; bracts lanceolate, acuminate. merely equaling the buds; calyx velutinous, gibbous; lower lip broadly lanceolate, obtuse, about 8 mm. long; upper lip ovate, almost as long; corolla 10–12 mm. long, dirty-white, tinged with blue; banner with a darker spot; legumes fully 2 cm. long, densely silky-villous, 4–5-seeded.

This species is related to *L. leucophyllus*, from which it differs in the less dense and strictly appressed silky pubescence (scarcely canescent) and the color of the flowers. In *L. leucophyllus* they are rather light-blue or pink with darker striations (rarely white), the banner with a lighter spot. It grows at an altitude of about 1000 m.

MONTANA: Jocko Creek, 1901, *D. T. MacDougal 253* (type in herb. N. Y. Bot. Gard.).

Lupinus roseolus

Perennial with a cespitose caudex; stems ascending or decumbent, about 1 dm. high, sparingly strigose, 3–5-leaved, slender;

stipules setaceous; petioles 1–3 cm. long, slender, usually red-tinged; leaflets about 7, narrowly linear-oblanceolate, acute, 1–2 cm. long, sparingly silky, short-strigose; raceme 2–4 cm. long; bracts subulate, shorter than the buds; calyx gibbous, silky with short spreading hairs; lips broadly lanceolate, subequal, 5–6 mm. long; corolla nearly white, tinged with rose, about 8 mm. long; pod densely silky, perhaps 1.5 cm. long when fully developed.

This resembles *L. argenteus* in the form and color of the flowers. It has also the peculiar hue and pubescence of that species, but it is a much smaller plant and of a different habit. The latter will place it near *L. Lyallii.* It is an alpine plant growing at an altitude of 3000 m.

WYOMING: Continental Divide, Buffalo Fork, August 1897, *F. Tweedy 270.*

Lupinus scaposus

Annual, with sessile clasping cotyledons; stem branched at the base, 1–1.5 cm. high, sparingly ciliate; stipules lanceolate, acuminate; petioles 3–5 cm. long, ciliate, slender; leaflets about 7, spatulate, 1 cm. long, sparingly silky-hirsute on both sides or glabrous above; peduncles longer than the leaves, ciliate; raceme short, 1–4 cm. long; bracts lanceolate, short; calyx ciliate, the lower lip broadly lanceolate, entire, 5 mm. long, the upper 2-cleft, ovate; corolla purplish, 6 mm. long, paler at the base; banner shorter than the wings; legume ciliate, 1 cm. long, 6 mm. wide, 2-seeded.

In habit mostly resembling *L. brevicaulis* but more evidently caulescent, with longer peduncles. The most distinctive characters, however, are the different calyx and its entire lower lip. This associates it with *L. pusillus*, from which it differs in the long peduncles and smaller flowers.

COLORADO: Glenwood Springs, 1899, *Geo. E. Osterhout.*

Lupinus rubens

Annual, with sessile, clasping cotyledons; stem ciliate, tinged with red, branched near the base, about 1 dm. high; petioles densely ciliate, 2–4 cm. long; leaflets 6–7, spatulate, 1–1.5 cm. long, ciliate on both sides or glabrous above, acute; raceme lax, 5–10 cm. long, overtopping the leaves; bracts minute, subulate; calyx ciliate, the lower lip lanceolate, 5 mm. long, the upper barely 3 mm. long; corolla 7 mm. long; banner dark-purple with a yellow spot; wings and keel lighter, tinged with lilac.

This species is related to *L. pusillus*, but differs in the more elongated racemes, which much exceed the leaves, the smaller flowers of a different color and the short upper lip of the calyx.

UTAH: Southern Utah, 1874, *Parry 41* (type in herb. Columbia Univ.); St. George, 1877, *Palmer 86*.

Trifolium confusum

Perennial with a rootstock; stems erect, simple, 2–3 dm. high, glabrous below, sparingly strigose above; stipules ovate, acute, about 2 cm. long, glabrous, veiny; leaflets of the lower leaves oval and rounded at the apex, of the upper ones lanceolate, and acute, 2–3 cm. long, finely denticulate, glabrous or nearly so; peduncles 5–7 cm. long; head globose; flowers reflexed in fruit; calyx-tube 2 mm. long, glabrous except the villous margin; teeth villous, 4–5 mm. long, subulate-setaceous; corolla rose or purplish, 13–15 mm. long; ovary 4-ovuled; legume sparingly hairy, stipitate.

This species belongs to the *T. longipes* group. It is probably most nearly related to *T. Rydbergii* and *T. pedunculatum*. From the former it differs in the nearly glabrous calyx-tube and the rose-colored and larger corollas; from the latter in the larger and reflexed flowers. It differs from *T. longipes* and *T. Rusbyi* in its different habit and nearly glabrous calyx.

SOUTHERN UTAH: 1874, *C. C. Parry 35* (type in herb. Columbia Univ.).

Trifolium Aitonii

Perennial with a rootstock; stem 3–4 dm. high, glabrous below, strigose above; stipules ovate, short-acuminate, about 2 cm. long, veiny; leaflets ovate, thin, obtuse or rounded and mucronate at the apex, finely denticulate, 2–4.5 cm. long, glabrous above, sparingly hairy beneath; peduncles several, 1–2 dm. long; heads globose; flowers reflexed in fruit on pedicels 2–3 mm. long; calyx pubescent throughout; tube 2 mm. long; teeth subulate, about 4 mm. long; corolla about 12 mm. long; legume stipitate, strigose, about 2-seeded.

This species is related to *T. latifolium*, from which it differs mainly in the different habit, larger size, longer peduncles and larger ovate instead of oval or obovate leaflets.

IDAHO: Palouse County, 1892, *G. B. Aiton 65* (type in herb. N. Y. Bot. Gard.).

Trifolium uintense

Trifolium dasyphyllum S. Wats. Bot. King Exp. 60, in part. 1871. Not *T. dasyphyllum* Torr.

Cespitose, subacaulescent perennial; stipules large and scarious; petioles 1–4 cm. long, sparingly strigose; leaflets oblanceolate, broadest above the middle, acute and mucronate, entire, 1–2 cm. long, sparingly pubescent or glabrate above; peduncle about 6 cm. long, sparingly strigose; head obovate, rather few-flowered; bracts lanceolate, 5–8 mm. long, 3-nerved, slightly if at all scarious-margined; calyx only slightly pubescent; tube 2.5 mm. long; teeth subulate-setaceous, about 7 mm. long; corolla purple, about 15 mm. long; ovary pubescent, about 6-ovuled.

This is a member of the *T. dasyphyllum* group, but differs from its relatives in the broader, decidedly oblanceolate leaflets and the 3-nerved bracts.

UTAH: Uintas, 1869, *S. Watson 241* (type in herb. Columbia Univ.).

Trifolium inaequale

Cespitose glabrous perennial, with very short stems; stipules ovate, short-acuminate, about 1 cm. long; petioles 3–10 cm. long, glabrous; leaflets oblanceolate or oblong, acute or obtuse, minutely denticulate, rather fleshy, 1.5–3 cm. long; peduncles 1–2 dm. long; heads sub-globose; bracts ovate or lanceolate, 5–7 mm. long, usually shorter than the calyces, usually cleft or toothed at the apex; calyx glabrous; tube 3 mm. long; teeth unequal, the upper 2–2.5 mm., the lower 3.5–4 mm. long, lance-subulate; corolla purple, about 1.5 cm. long; ovary 4-ovuled; legume glabrous, stipitate.

This is related to *T. Parryi* and *T. montanense*. From the former, it differs in the decidedly unequal calyx-teeth, the narrower and smaller, ovate instead of obovate, bracts and stipules, and the less sharply denticulate leaflets; from the latter in the larger size and the ovate instead of obovate bracts.

UTAH: Bear River Cañon, 1869, *S. Watson 243* (type in herb. Columbia Univ.); Dyer Mine, Uintah Mountains, 1902, *Goodding 1244*.

Tium variegatum

Perennial with a taproot and short cespitose caudex; stems numerous, strigose, more or less mottled with purplish-brown; stipules triangular or deltoid, 4 mm. long, distinct; leaves 5–8 cm. long; leaflets obovate to nearly orbicular, rounded or retuse at the apex, thick, sparingly strigose, soon glabrate, 5–10 mm. long; peduncles 4–7 cm. long; raceme short, 1–2 cm. long, in fruit 3–6 cm. long, 5–15-flowered; calyx black-hairy; tube 2–2.5 mm. long; teeth subulate, 1–2 mm. long; corolla ochroleucous; banner 6–7 mm. long; wings and keel 5 mm. long; pod scarcely stipitate, about 2 cm. long, 4 mm. broad, oblong, tapering at both ends, slightly arcuate, sulcate on the lower suture except at the ends, acute on the upper suture, mottled with purplish-brown and minutely strigose.

This is perhaps most nearly related to *T. sparsiflorum* (A. Gray) Rydb., but is a much larger and coarser plant. The latter species has usually smaller leaves, smaller corolla, white and tinged with violet, strongly oblique calyx and pods of about half the length, more curved and more distinctly stipitate.

COLORADO: Platte Cañon, May 19, 1894, State Agricultural college, Colorado, distribution *no. 15* (type in herb. N. Y. Bot. Garden).

Hamosa atratiformis

Perennial; stem 2–3 dm. high, erect, branched, strigose; stipules triangular, strigose, 1–2 mm. long; leaves 3–5 cm. long; leaflets 13–19, oblong, strigose below, glabrous above, 4–6 mm. long; peduncles 5–7 cm. long: raceme lax, 2–3 cm. long; calyx black-strigose; tube about 2 mm. long; teeth subulate, 1 mm. long; corolla ochroleucous, about 7 mm. long; pod linear, straight, minutely strigillose.

This is closely related to **H. atrata** (*Astragalus atratus* S. Wats. Bot. King Exp. 69. 1871), but differs in the short leaves and the smaller flowers, which are scarcely more than half as long as in that species.

SOUTHERN UTAH: 1874, *C. C. Parry 47* (type in herb. Columbia Univ.).

Xylophacos aragalloides

Cespitose perennial; stems 1 dm. or less long, decumbent at the base, densely white-strigose; stipules scarious, strigose, triangular, with a subulate acumination, 5–8 mm. long; leaves 10–15 cm. long; leaflets 11–19, lanceolate to elliptic, silky-canescent, 5–12 mm. long, acute; peduncles about 1 dm. long; raceme short, 4–10-flowered; calyx ascending, strigose with black and white hairs; tube cylindric, about 8 mm. long; teeth subulate, 3–4 mm. long; corolla purplish, about 2 cm. long; legume lunate, about 4 cm. long, tapering at both ends, rather deeply sulcate below, transversely reticulate, sparingly strigose; upper suture prominent.

This species is related to *X. amphioxys* (A. Gray) Rydb., but differs in the long subulate instead of triangular calyx-teeth, in the banner much exceeding the wings, and in the narrower leaflets.

UTAH: St. George, 1880, *M. E. Jones 1633* (type in herb. Columbia Univ.); 1877, *Dr. E. Palmer 101.*

Homalobus uniflorus

Pulvinate-cespitose perennial with a much-branched caudex; stipules ovate, scarious, ciliate; leaves reduced to oblanceolate or linear-spatulate phyllodia, appressed silky-canescent, 1–2 cm. long, 1–3 mm. wide; peduncles 1–2 cm. long, usually 1-flowered; calyx silky-canescent; tube campanulate, 2 mm. long; teeth subulate, of about the same length; corolla dark bluish-purple, 8 mm. long.

This species is closely related to *H. simplicifolius* and *H. brachycarpus* Nutt. From the former it differs in the dark bluish-purple, not ochroleucous corolla; the elongated peduncles, the longer and broader leaves, and the comparatively longer calyx-lobes; from *A. brachycarpus* it is distinguished by its solitary flowers and darker corolla.

WYOMING: Evanston, 1897, *Aven Nelson 2971* (type in herb. N. Y. Bot. Gard.).

HOMALOBUS CAMPESTRIS Nutt.; T. & G. Fl. N. Am. **1**: 351. 1838.
Astragalus campestris A. Gray, Proc. Am. Acad. **6**: 229, in part. 1866. Not *Astragalus campestris* L. 1753.
Astragalus convallarius Greene, Erythea **1**: 207. 1893.

There has been a confusion concerning the identity of this species, evidently because Dr. Gray, when he transferred the species to *Astragalus*, had in mind something entirely different from Nuttall's *Homalobus campestris*. All the specimens of this species (except the type and one more) in the herbaria of the New York Botanical Garden and Columbia University have been referred to *H. junceus*. *H. campestris* is also closely related to that species, differing in the black-hairy calyx, the longer calyx-lobes, and the pod, which tapers gradually to the base. The black-hairy calyx and the shape of the pod it has in common with *Homalobus junciformis* (A. Nelson) Rydb., but it has longer calyx-teeth and narrower and longer leaflets. In both *H. junceus* and *H. junciformis* the calyx-teeth are triangular, about as broad as long. All three species have rootstocks, or a deep-set root and the stems branching below ground, the corollas are ochroleucous, the keel curved from near the base and without any purple. What Dr. Gray and many later writers regarded as *Astragalus campestris* is a combination of several species characterized by a cespitose caudex or strongly-branched rootstocks, white, pink- or purple-tinged corollas, and the keel curved only at the tip and with a dark-purple tip. The aggregate consists of *Homalobus decurrens* Rydb., *H. hylophilus* Rydb., *H. tenuifolius* Nutt., *H. divergens* Blankinship (*H. camporum* Rydb.), and other species.

The range of *H. campestris* seems to be limited to Wyoming, northern Colorado and northeastern Utah.

Homalobus oblongifolius √

Homolobus hylophilus Rydb. Bull. Agr. Exp. Sta. Colo. **100**: 210, in part. 1906.

Perennial with a cespitose caudex; stems ascending, branched, 2–3 dm. high, glabrous or nearly so; stipules ovate, scarious, 4–5 mm. long; leaves 8–10 cm. long; leaflets 11–19, usually oblong, but varying from elliptic to linear-oblong, 1–2 cm. long, 3–6 mm. wide, glabrous above, sparingly strigose beneath, rounded at the apex; peduncles 5–10 cm. long; raceme short, 3–5 cm. long, 5–10-flowered; bracts lanceolate, scarious, 1 mm. long; calyx strigose with black hairs; tube campanulate, 2–2.5 mm. long; teeth subulate, fully 1 mm. long; corolla 1 cm. long, white, tinged with purple; keel with a narrow dark-purple tip; legumes 2–2.5 cm. long, strigose, 4 mm. wide; the lower suture strongly curved, the upper straight or slightly upturned towards the apex.

This species was included in *H. hylophilus* in my Flora of Colorado, *i. e.*, as far as the Colorado specimens are concerned. It resembles *H. hylophilus*, but the leaflets are thicker and the pod decidedly strigose and of another shape. In *H. hylophilus* the legume is straight and glabrous from the beginning. *H. oblongifolius* is found as far as known only in the mountains of Colorado, while *H. hylophilus* belongs to Montana, northern Wyoming and Idaho.

COLORADO: Cerro Summit, 1901, *Baker 409* (type); Leadville, 1884, *M. E. Jones;* North Park, near Teller, 1884, *C. S. Sheldon 108;* Marshall Pass, *M. E. Jones.*

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE
(1901-1905)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editoi to errors or omissions their kindness will be appreciated.

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Adams, C. C. Postglacial origin and migrations of the life of the northeastern United States. — I. Jour. Geogr. **1**: 303–310. S 1902; — II. Jour. Geogr. **1**: 352–357. O 1902. [Illust.]

Arthur, J. C. Three edible toadstools. Ind. Agric. Exp. Sta. Bull. 98: 43–57. *pl. 1–7.* 1904.

Atkinson, G. F. The genera *Balansia* and *Dothichloe* in the United States, with a consideration of their economic importance. Jour. Myc. **11**: 248–267. *pl. 81–88.* 22 D 1905.

Brand, A. Ueber einige Symplocaceen des Herbier Delessert. Ann. Conserv. & Jard. Bot. Genève **7–8**: 277–287. 15 Ap 1904.

Briquet, J. *Verbenaceae* Balansanae paraguarienses, ou énumération critique des Verbenacées récoltées par B. Balansa au Paraguay de 1874–1877 et de 1878–1884. Ann. Conserv. & Jard. Bot. Genève **7–8**: 288–319. 1 My 1904.

Includes descriptions of new species in *Verbena* (3), *Lantana* (2), and *Lippia* (7).

Buchenau, F. *Alismataceae.* Das Pflanzenreich 4^{15}: 1–66. *f. 1–19.* 25 Au 1903.

Buchenau, F. *Butomaceae.* Das Pflanzenreich 4^{16}: 1–12. *f. 1–5.* 25 Au 1903.

Buchenau, F. *Scheuchzeriaceae.* Das Pflanzenreich 4^{14}: 1–20. *f. 1–9.* 25 Au 1903.

Cardot, J. Mousses et coup d'oeil sur la flore bryologique des Terres magellaniques. 1–48. *pl. 1–14.* 1 S 1901.

Expédition Antarctique Belge: Résultats du voyage du S. Y. Belgica: Rapports scientifiques: Botanique.

Chester, F. D. & Smith, C. O. Notes on fungous diseases in Delaware. Del. Agric. Exp. Sta. Bull. 63: 17–32. *pl. 1–3.* 1 F 1904.

Clements, F. E. Formation and succession herbaria. Univ. Stud. [Univ. of Nebraska] **4**: 329–355. O 1904.

Clinton, G. P. Diseases of plants cultivated in Connecticut. Rep. Conn. Agric. Exp. Sta. **1903**: 279–370. *pl. 9–28.* [1904.]

Cogniaux, A. *Orchidaceae* — VI. Flora Bras. 125: 181–384. *pl. 50–81.* 15 My 1901.

Includes descriptions of new species in *Epidendron* (2), *Brassavola, Sophronitis,* and *Elleanthus* (2).

Cogniaux, A. *Orchidaceae* — VII. Flora Bras. 126: 381–664. *pl. 82–119.* 15 D 1902.

Conard, H. S. *Nymphaea* (sub.-gen. *Brachyceras* Casp.) in Africa. Ann. Conserv. & Jard. Bot. Genève **7–8**: 18–20. 15 My 1903.

With a description of *N. calliantha* sp. nov.

Conzatti, C. Taxinomia de las Orquídeas mexicanas. Mem. Soc. Ci. Ant. Alzate **21**: 249–272. "1904." [1905.]

Coville, F. V. List of publications of the Division of Botany. U. S. Dept. Agric. Bot. Circ. 30: 1–10. My 1901.

Cummings, M. B. Fertilization problems: a study of reciprocal crosses. Maine Agric. Exp. Sta. Bull. 104: 81–100. *f. 10–18.* Je 1904.

Dalla Torre, K. W. von & Harms, H. Genera *Siphonogamarum* ad systema Englerianum conscripta. 1: 1–80. 1900; 2: 81–160. 1900; 3: 161–240. 1901; 4: 241–320. 1901; 5: 321–400. 1903; 6: 401–480. 1904.

Dewey, L. H. Canada thistle (*Carduus arvensis* (L.) Robs.). U. S. Dept. Agric. Bot. Circ. 27: 1–14. *f. 1–4.* Revised ed. Je 1901.

Dudley, W. R. Zonal distribution of trees and shrubs in the southern Sierra. Sierra Club Bull. **3**: 298–312. *f. 1–6.* Je 1901.

Durand, T. & Jackson, B. D. Index kewensis plantarum phanerogamarum: supplementum primum. 1: 1–120. [Brussels, 1902]; 2: 121–224. Brussels, [1902]; 3: 225–328. Brussels, [1903].

Eisen, G. The fig: its history, culture and curing, with a descriptive catalogue of the known varieties of figs. U. S. Dept. Agric. Pomology Bull. 9: 1–317. *pl. 1–15 + f. 1–93.* "1901." [F 1902.]

Emerson, R. A. Heredity in bean hybrids (*Phaseolus vulgaris*). Ann. Rep. Neb. Agric. Exp. Sta. **17**: 33–68. 1904.

Engelhardt, H. Bemerkungen zu chilenischen Tertiärpflanzen. Abh. Nat. Ges. Isis **1905**: 69–72. *pl. 1.* 1905.

Includes a description of *Erythroxylon Reichei* sp. nov.

Engler, A. Ueber floristische Verwandtschaft zwischen dem tropischen Afrika und America, sowie über die Annahme eines versunkenen brasilianisch-äthiopischen Continents. Sitz.-ber. Preuss. Akad. Wiss. **1905**: 180–231. 16 F 1905.

Grosser, W. *Cistaceae.* Das Pflanzenreich 4[193]: 1–161. *f. 1–22.* 19 My 1903.

Halsted, B. D. Report of the botanist. Ann. Rep. N. J. Agric. Exp. Sta. **24**: 459–554. *pl. 1–14.* 1904.

Heering, W. Die *Baccharis*-Arten des Hamburger Herbars. Jahrb. Hamb. Wiss. Anst. Beih. **21**[3]: 1–46. 1904.

Hitchcock, A. S. Bermuda grass. U. S. Dept. Agric. Agrost. Circ. 31: 1–6. *f. 1, 2.* [Ap] 1901.

Holway, E. W. D. Notes on *Uredineae*. IV. Jour. Myc. **11**: 268. 22 D 1905.

Hopkins, C. G. Nitrogen bacteria and legumes. Ill. Agric. Exp. Sta. Bull. 94: 305–328. *f. 1–5.* F 1904.

Hume, H. H. Anthracnose of the pomelo. Fla. Agric. Exp. Sta. Bull. 74: 157–172. *pl. 1–4.* 1904.

Hume, H. H. Potato diseases. Fla. Agric. Exp. Sta. Bull. 75: 177–198. *pl. 1–4.* 1904.

Kearney, T. H. & Cameron, F. K. Some mutual relations between alkali soils and vegetation. 1–78. [F] 1902.

U. S. Dept. Agric. Rep. No. 71.

Koehne, E. *Lythraceae.* Das Pflanzenreich 4[216]: 1–326. *f. 1–59.* 9 O 1903.

Loew, O. Catalase, a new enzym of general occurrence, with special reference to the tobacco plant. 1–47. [Mr] 1901.

U. S. Dept Agric. Rep. No. 68.

Longyear, B. O. Fungous diseases of fruits in Michigan. Mich. Agric. Exp. Sta. Special Bull. 25: 1–68. *f. 1–42.* Mr 1904.

MacKay, A. H. Phenological observations in Nova Scotia and Canada, 1902. Proc. & Trans. Nova Scotian Inst. **11**: 144–157. O 1904.

Merrill, E. D. Some Arizona grasses. U. S. Dept. Agric. Agrost. Circ. 32: 1–10. 22 Ap 1901.

New species are described in *Panicum*, *Bouteloua* and *Leptochloa*.

Metcalf, H. A soft rot of the sugar-beet. (*Bacterium teutlium* Metcalf.) Ann. Rep. Neb. Agric. Exp. Sta. **17**: 69–116. *f. 1–6.* 1904.

Mez, C. *Theophrastaceae.* Das Pflanzenreich 4^{236a}: 1–48. *f. 1–7.* 19 My 1903.

Monahan, N. F. The influence of the atmospherical electrical potential on plants. Ann. Rep. Mass. Agric. Exp. Sta. **16**: 31–36. *f. 1.* 1904.

Morgan, A. P. North American species of *Marasmius* (continued). Jour. Myc. **11**: 233–247. 22 D 1905.

Includes a description of *M. nuptialis* sp. nov.

Mutchler, F. On the structure and biology of the yeast plant. (*Saccharomyces Cerevisiae.*) Jour. Med. Research **14**: 13–50. *pl. 3.* N 1905.

Nelson, E. Native and introduced saltbushes. Wyo. Agric. Exp. Sta. Bull. 63: 1–19. Au 1904. [Illust.]

Paddock, W. Large potato vines and no potatoes. Colo. Agric. Exp. Sta. Bull. 92: 1–8. *pl. 1, 2.* 1904.

Pammel, L. H. The cedar apple fungi and apple rust in Iowa. Iowa Agric. Exp. Sta. Bull. 84: 1–36. *f. 1–11.* 1905.

Pampanini, R. Description d'une nouvelle Cunoniacée du Brésil. Ann. Conserv. & Jard. Genève **7–8**: 328, 329. 1 My 1904.

Belangera Chaberti sp. nov.

Pilger, R. *Taxaceae.* Das Pflanzenreich 4^{5}: 1–124. *f. 1–24.* 8 D 1903.

Porter, T. C. Catalogue of the *Bryophyta* and *Pteridophyta* found in Pennsylvania. 1–66. Boston, 1904.

Rolfs, F. M. Potato failures: a second report. Colo. Agric. Exp. Sta. Bull. 91: 1–33. *pl. 1–5.* 1904.

Schumann, K. *Zingiberaceae.* Das Pflanzenreich 4^{46}: 1–458. *f. 1–52.* 4 O 1904.

Scribner, F. L. List of publications of the Division of Agrostology. U. S. Dept. Agric. Agrost. Circ. 36: 1–8. [Jl] 1901.

Scribner, F. L. & Ball, C. R. Miscellaneous notes and descriptions of new species. U. S. Dept. Agric. Agrost. Bull. **24**: 39–50. *f. 14–23.* 9 Ja 1901.

With new species in *Andropogon* (2), *Panicum*, *Aristida* (2), *and Elymus* (4).

Scribner, F. L. & Merrill, E. D. Notes on *Panicum nitidum* Lam., *Panicum scoparium* Lam., and *Panicum pubescens* Lam. U. S. Dept. Agric. Agrost. Bull. **24**: 31–38. *f. 8–13.* 9 Ja 1901.

Scribner, F. L. & Merrill, E. D. Some recent collections of Mexican grasses. U. S. Dept. Agric. Agrost. Bull. **24**: 5–30. *f. 1–7.* 9 Ja 1901.

New species are described in *Tripsacum*, *Andropogon*, *Paspalum* (2), *Panicum* (2), *Muhlenbergia*, *Agrostis*, *Tristachya*, *Leptochloa*, and *Elymus*.

Selby, A. D. Tobacco diseases and tobacco breeding. Ohio Agric. Exp. Sta. Bull. 156: 87–114. *f. 1–3 + pl. 1–8.* N 1904.

Sheldon, J. L. A corn mold (*Fusarium moniliforme* n. sp.). Ann. Rep. Neb. Agric. Exp. Sta. **17**: 23–32. 1904. [Illust.]

Sheldon, J. L. Diseases of melons and cucumbers during 1903 and 1904. W. Va. Agric. Exp. Sta. Bull. 94: 119–138. *pl. 1–5.* D 1904.

Shriver, H. List of wild flowers and trees in vicinity of Cumberland, Maryland. 1–38. Cumberland, Md., 1901.

Starnes, H. N. The plum in Georgia. Ga. Agric. Exp. Sta. Bull. 67: 235–285. *pl. 1–4 + f. 1–19.* D 1904.

Stephani, F. Hépatiques. 1–6. 1 S 1901.

Expédition Antarctique Belge: Résultats du voyage du S. Y. Belgica: Rapports scientifiques: Botanique.

Stevens, F. L. The history of the tobacco wilt in Granville County, North Carolina. U. S. Dept. Agric. Off. Exp. Sta. Bull. **142**: 166–168. 1904.

Stone, G. E. The influence of current electricity on plant growth. Ann. Rep. Mass. Agric. Exp. Sta. **16**: 13–30. *f. 1, 2.* 1904.

Sturgis, W. C. Remarkable occurrence of *Morchella esculenta* (L.) Pers. Jour. Myc. **11**: 269. 22 D 1905.

Sudworth G. B. Charles Mohr. 1824–1901. Proc. Wash. Acad. Sci. **5**: 403–405. 4 F 1904.

Sumstine, D. R. Another fly agaric. Jour. Myc. **11**: 267, 268. 22 D 1905.

Thiselton-Dyer, W. T. Index kewensis plantarum phanerogamarum: supplementum secundum. 1–104. Oxford, 1904.

Van Hook, J. M. Diseases of ginseng. Cornell Univ. Agric. Exp. Sta. Bull. 219: 163–186. *f. 18–42.* Je 1904.

Waldron, L. R. Weed studies. N. Dak. Agric. Exp. Sta. Bull. 62: 437–457. *f. 1–5.* N 1904.

Whetzel, H. H. Onion blight. Cornell Univ. Agric. Exp. Sta. Bull. 218: 135–161. *f. 1–17.* Ap 1904.

Winkler, H. *Betulaceae.* Das Pflanzenreich 4^{61}: 1–149. *pl. 1, 2* + *f. 1–28.* 17 Je 1904.

Winton, A. L. The anatomy and microscopic identification of the fruits of darnel and chess. Rep. Conn. Agric. Exp. Sta. **1903**: 165–174. *f. 1–8.* [1904.]

Winton, A. L. The anatomy of certain oil seeds, with especial reference to the microscopic examination of cattle foods. Rep. Conn. Agric. Exp. Sta. **1903**: 175–198. *f. 9–26.* [1904.]

Wood, L. H. Report on the region between the Northern Pacific Railroad and the Missouri river. Its topography, climate, vegetation, irrigation possibilities and coal deposits. State Geol. Surv. No. Dak. Bienn. Rep. **3**: 41–125. *pl. 8–24* + *map.* 1904.

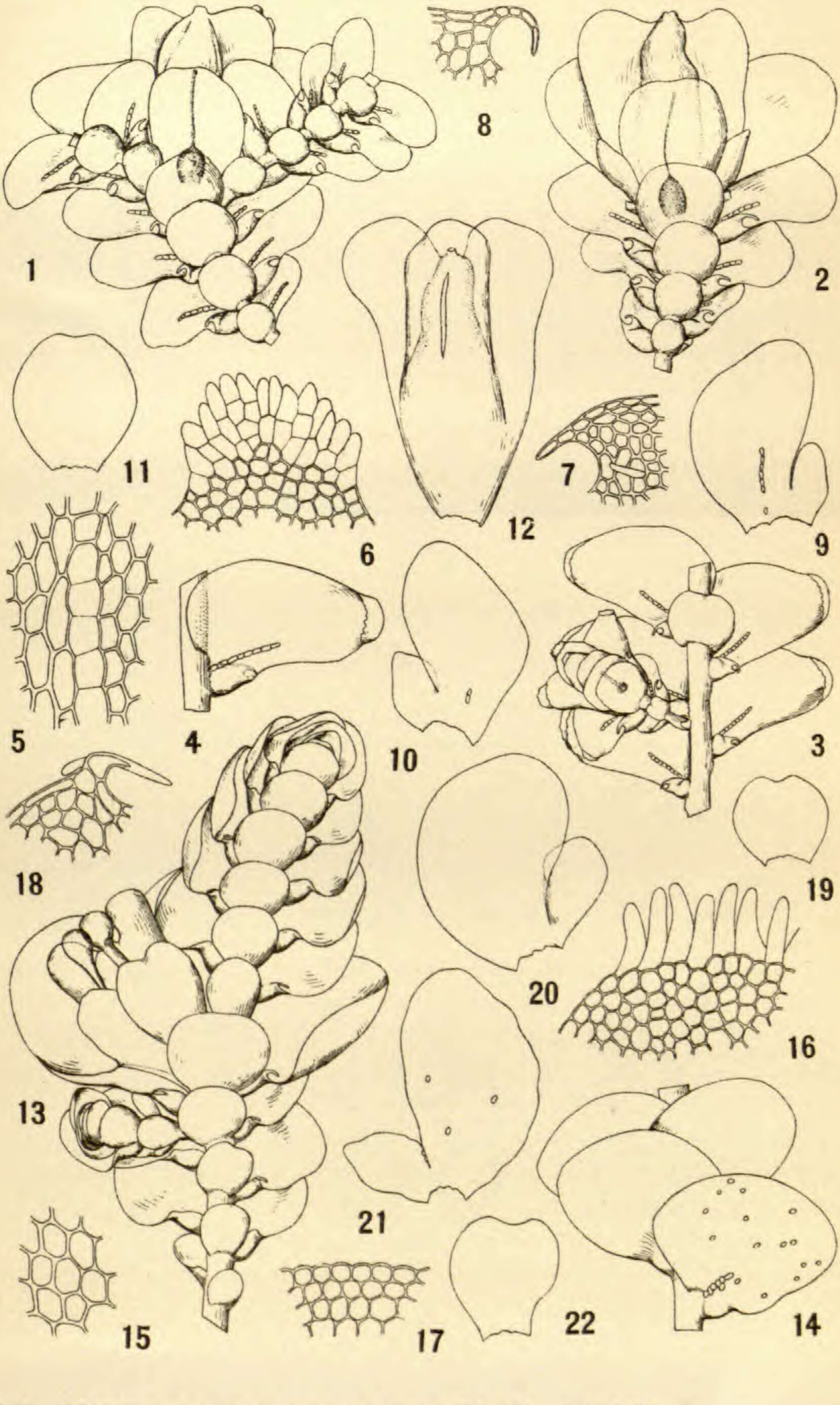
Vegetation in the region, pages 80–87.

Woods, A. F. Observations on the mosaic disease of tobacco. U. S. Dept. Agric. Pl. Ind. Bull. **18**: 1–24. *pl. 1–6.* 15 My 1902.

Wooton, E. O. Native ornamental plants of New Mexico. N. Mex. Agric. Exp. Sta. Bull. 51: 1–40. 1904. [Illust.]

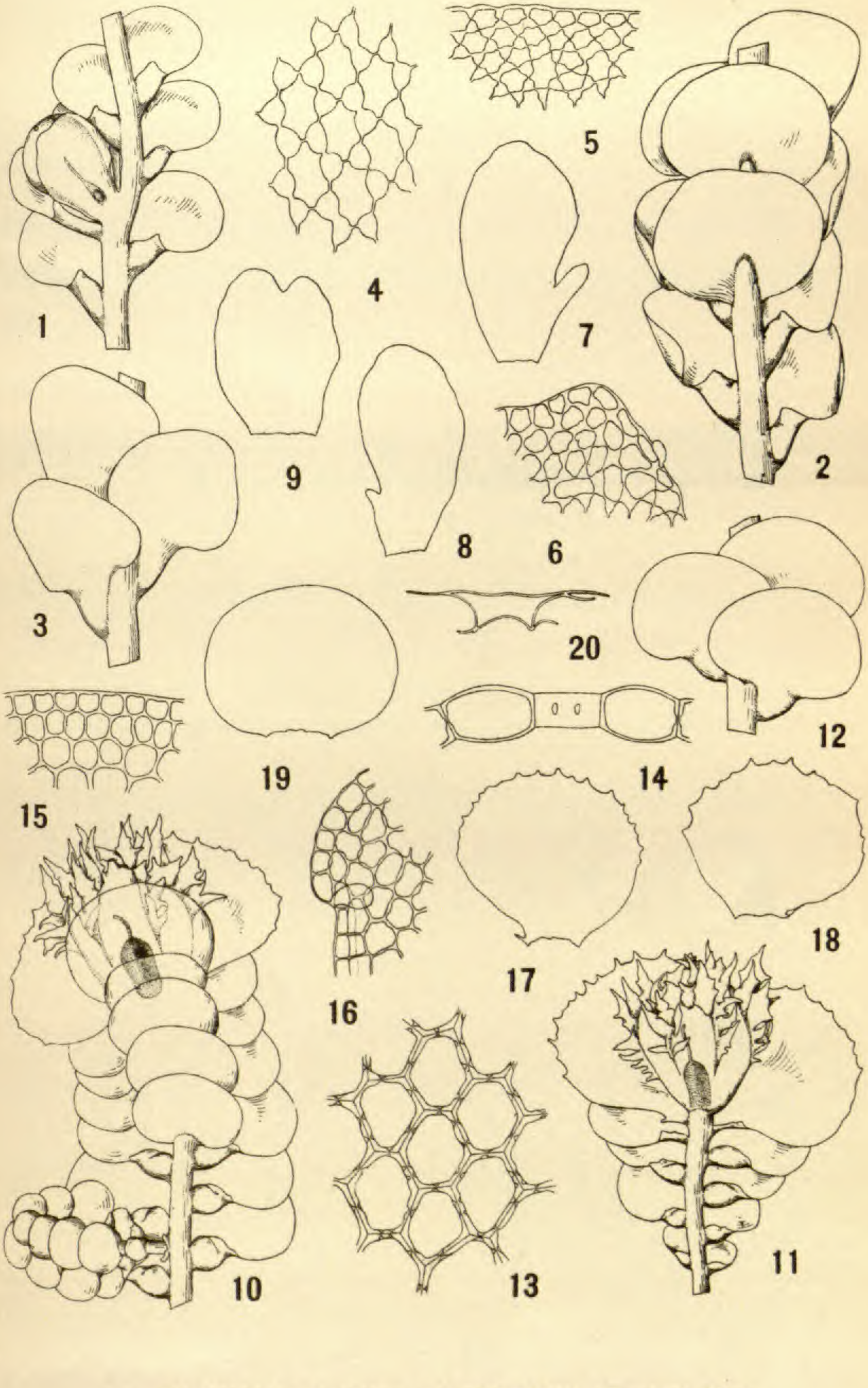
1-16. STICTOLEJEUNEA SQUAMATA (Willd.) Schiffn.

17-23. NEUROLEJEUNEA BREUTELII (Gottsche) Evans.

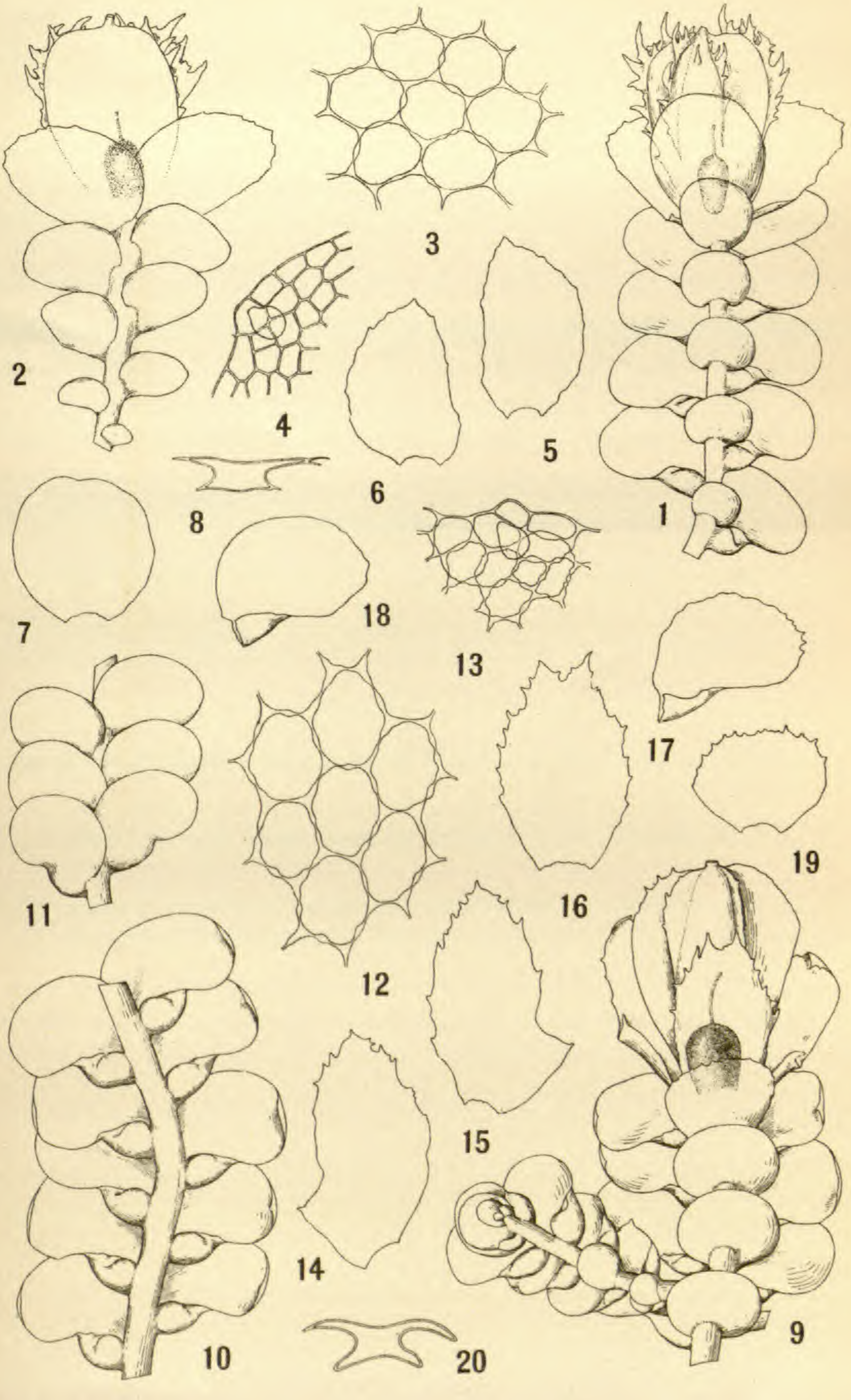


1-12. NEUROLEJEUNEA CATENULATA (Nees) Schiffn.

13-22. CERATOLEJEUNEA PORTORICENSIS (Hampe & Gottsche) Evans.



1-9. OMPHALANTHUS FILIFORMIS (Swartz) Nees.
10-20. LOPHOLEJEUNEA SAGRAEANA (Mont.) Schiffn.



1-8. LOPHOLEJEUNEA MUELLERIANA (Gottsche) Schiffn.

9-20. LOPHOLEJEUNEA HOWEI Evans.

North American Flora

THIS work is designed to present descriptions of all plants growing, independent of cultivation, in North America, here taken to include Greenland, Central America, the Republic of Panama, and the West Indies, except Trinidad, Tobago, and Curaçao and other islands off the north coast of Venezuela, whose flora is essentially South American.

It will be published in parts at irregular intervals by the New York Botanical Garden through the aid of the income of the David Lydig Fund bequeathed by Charles P. Daly.

It is planned to issue parts as rapidly as they can be prepared, the extent of the work making it possible to commence publication at any number of points. The completed work will form a series of volumes with the following sequence:

Volume 1. Mycetozoa, Schizophyta, Diatomaceae.
Volumes 2 to 10. Fungi.
Volumes 11 to 13. Algae.
Volumes 14 and 15. Bryophyta.
Volume 16. Pteridophyta and Gymnospermae.
Volumes 17 to 19. Monocotyledones.
Volumes 20 to 30. Dicotyledones.

The preparation of the work has been referred by the Scientific Directors of the Garden to a committee consisting of Professors L. M. Underwood and N. L. Britton.

Professor George F. Atkinson of Cornell University, Professors Charles R. Barnes and John M. Coulter of the University of Chicago, Mr. Frederick V. Coville of the United States Department of Agriculture, Professor Edward L. Greene of the United States National Museum, Professor Byron D. Halsted of Rutgers College and Professor William Trelease of the Missouri Botanical Garden have consented to act as an advisory committee.

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Volume 7, Part 2, commencing the Uredinales, by J. C. Arthur, is in press.

Volume 22, Part 1, including Podostemonaceae by George V. Nash, Crassulaceae by N. L. Britton and J. N. Rose, and Penthoraceae and Parnassiaceae by P. A. Rydberg, was issued May 22, 1905.

Volume 22, Part 2, including Saxifragaceae and Hydrangeaceae by J. K. Small and P. A. Rydberg, Cunoniaceae, Iteaceae and Hamamelidaceae by N. L. Britton, Pterostemonaceae by J. K. Small, Altingiaceae by Percy Wilson and Phyllonomaceae by H. H. Rusby, was issued Dec. 18, 1905.

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CONTENTS

Two new species of Aytonia from Jamaica. (Plates 5 and 6.) CAROLINE COVENTRY HAYNES 57

Studies in North American Peronosporales — I. The genus Albugo. GUY WEST WILSON 61

Some Lactarii from Windham County, Vermont. GERTRUDE SIMMONS BURLINGHAM 85

New species of fungi . . . . CHARLES HORTON PECK 97

INDEX TO AMERICAN BOTANICAL LITERATURE 105

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BULLETIN

OF THE

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FEBRUARY, 1907

Two new species of Aytonia from Jamaica

CAROLINE COVENTRY HAYNES

(WITH PLATES 5 AND 6)

Aytonia Evansii sp. nov.

Thallus light-green, with a narrow purple margin, plane, ovate to linear-oblong, lingulate, 10–14 mm. × 4–7 mm., innovating from apex or laterally from costa, or dichotomous; margins of thallus elevated, undulate, crisped; width of thallus in cross-section eight times that of maximum height; the epidermal cells somewhat quadrate with distinct trigones, cuticle finely granulate; the stomata small, not elevated above thallus, 4 or 5 cells around the pore in 1 or 2 concentric series; ventral scales vinous-purple, imbricated, scarcely decurrent, lunate or obliquely ovate, reaching beyond thallus and reflexed only at notched apex, well-developed and persistent, however, from base of thallus to apex, tapering gradually to a long lanceolate occasionally geminate point, margins entire: oil-bodies completely filling isolated cells occurring generally through the thallus excepting in epidermal layer: monoicous: ♀ receptacles usually several in a series: androecium situated directly behind ♀ receptacle, furcate, surrounded with purple lanceolate or linear paleae 2–7 cells in maximum width: peduncle 5 mm. long: carpocephalum 2–3-lobed, generally maturing two opposite sporogonia, concave at apex, scales of the carpocephalum lanceolate or linear-lanceolate, 5–12 cells in maximum width, nearly hyaline: spores averaging 87 μ, yellow or brownish, enveloped in a very loose reticulate-rugose exospore: elaters 2–4-spiral, attenuate at ends 223–306 μ in length, 13 μ in maximum width. (PLATE 5.)

The above description has been drawn from material collected on banks, near Portland Gap, Blue Mountains, Jamaica, July 21, 1903, *A. W. Evans 213*.

[The BULLETIN for January 1907 (34: 1–56, *pl. 1–4*) was issued 27 F 1907.]

Plagiochasma elongatum Lindenb. & G., from Mexico, known to the writer only through descriptions, appears to resemble the Jamaican plant but the latter differs in possessing a shorter and broader frond which is 10–14 mm. long while that of *P. elongatum* reaches 35 mm.; *P. elongatum* has only 2–3 cells around pore, the Jamaican plant 4–5 cells; the ventral scales of *Aytonia Evansii* taper gradually, while those of *Plagiochasma elongatum* are described by Stephani * as abruptly attenuate to the appendiculum.

Aytonia jamaicensis sp. nov.

Thallus light-green with a narrow purple margin, somewhat plane or broadly canaliculate, ovate to linear-oblong, 5–18 mm. × 5–6 mm., innovating from the apex and from the side of the costa; margins of thallus elevated undulate-crenulate and slightly crisped; width of thallus in cross-section six times that of maximum height; the epidermal cells generally quadrate, showing small trigones; the stomata large, elevated, with 5–8 cells around the pore in 2–4 concentric series: ventral scales vinous-purple, strongly decurrent and approximate in the median ventral line, imbricated, broadly lunate or ovate, projecting beyond margin of thallus only at notched apex, reflexed over the growing point; appendicula ovate-lanceolate, occasionally geminate, strongly constricted, 7–12 cells in maximum width, with a uniseriate apiculum of 1–3 cells in length, margins subentire, undulate-crenate or sparingly toothed: oil-bodies completely filling isolated cells in the colorless stratum of thallus: monoicous: ♀ receptacles usually several in a series on an apical innovation in front of androecium: scales of androecium deltoid or cuneate-ovate: peduncle 11–16 mm. long: carpocephalum 2–4-lobed, generally maturing two opposite sporogonia and then concave or transversely furrowed above or sometimes slightly convex; scales of the carpocephalum lanceolate or linear-lanceolate, 5–14 cells in greatest width, often acuminate with a constriction near the apex: spores averaging 85 μ, yellow or brownish, enveloped in a very loose reticulate-rugose exospore, this easily detachable, spore after removal of exospore averaging 46 μ: elaters 2–3-spiral, occasionally forked, somewhat attenuate at ends, 255–374 μ long, 8 μ in maximum width. (PLATE 6.)

The above description has been drawn from material collected at Chestervale, Jamaica, February, 1903, *L. M. Underwood 1173* (type) and *1177* [both mixed with *Reboulia hemisphaerica*].

* FRANZ STEPHANI. Species Hepaticarum. Bulletin de l'Herbier Boissier **6**: 785. 1898.

The species is related to *Plagiochasma Wrightii* Sulliv., which shows the following differing characteristics: stomata not so much elevated, the 5–8 cells around the pore being in 2 or 3 concentric series; appendicula not so much constricted, narrower, margins always entire; peduncle shorter, 2–4 mm. (?); scales of the carpocephalum never constricted; spore distinctly tetrahedral and winged, exospore not so loose. Type duplicate of *P. Wrightii* from Texas in Herbarium Underwood shows 5–8 cells around pore instead of 6 cells as given by Herr Stephani in his *Species Hepaticarum*.

These two Jamaican species differ from each other in shape and size of stomata, form of ventral scales and their appendicula, the position of androecium and in the character of the cuticle.

The above work was done under the supervision of Dr. Marshall A. Howe to whom I am deeply grateful. Thanks are also due Professors Underwood and Evans for allowing me to study their material.

NEW YORK BOTANICAL GARDEN.

Explanation of plates 5 and 6

PLATE 5. *Aytonia Evansii* sp. nov.

1 and 2. Plant, natural size.
3. Outline of cross-section of thallus, × 9.
4. Median cross-section of thallus showing stomata, × 55.
5. Stoma, × 242.
6. Plant, showing two immature carpocephala and androecium, × 6.
7. Plant, showing nearly mature carpocephalum, with peduncle 4 mm. long, and androecium, × 6.
8 and 9. Ventral scales, × 13.
10. Ventral scale showing geminate appendicula, × 13.
11–13. Scales from the carpocephalum, × 13.
14. Scale from the carpocephalum showing cells, × 55.
15. Surface view of stoma; epidermal cells and trigones, × 360.
16. Spore, inner face, × 250.
17. Spore, outer face, × 250,
18. Spore, optical section, × 242.
19. Elater, 3-spiral, × 175.
20. Elater, 2-spiral, × 175.
21. Oil-body completely filling cell, × 250.
22. Scale from androecium, × 55.

PLATE 6. *Aytonia jamaicensis* sp. nov.

1. Plant, natural size.

2 and 3. Outlines of cross-sections of thallus, × 9.

4. Median cross-section of thallus showing stoma, × 55. The fungal hyphae shown here in certain cells were found inalmost all specimens examined and occur generally through the ventral portions of the thallus.

5. Stoma, × 242.

6 and 7. Upper and lower sides of a single immature carpocephalum, × 6.

8 and 9. Opposite sides of a single carpocephalum with two mature sporogonia, no. 8 showing upper portion of peduncle, × 6.

10 and 11. Opposite sides of a single carpocephalum showing the mature sporogonia, a third abortive one, and upper portion of peduncle, × 6.

12. Ventral scale showing geminate appendicula, × 17.

13. Ventral scale showing single appendiculum, × 17.

14–17. Scales from the carpocephalum, × 13.

18 and 19. Scales from the carpocephalum showing cells, × 55.

20. Surface view of stoma, × 360.

21. Surface view of epidermal cell and trigones, × 250.

22. Spore, inner face, × 250.

23. Spore, outer face, × 250.

24. Spore, optical section, × 242.

25. Elater, 2-spiral, × 182.

26. Elater, 3-spiral, × 175.

27. Oil-body completely filling cell, × 250.

28. Scale from androecium, × 55.

Studies in North American Peronosporales — I. The genus Albugo

Guy West Wilson

The North American species of *Peronosporales* offer a rich field for investigation. Containing as this order does some of the worst fungous pests of the farm and garden, extensive studies of certain species were undertaken at an early date in our mycological history, yet our present knowledge of the group is very fragmentary. The greater part of the printed information concerning it consists of notes on various species scattered through articles of a general mycological nature. Some species have been made the subject of independent articles, while few papers deal with a considerable number of species. Only two of these are comprehensive in scope. One is a series of notes by Swingle * upon the specimens in the herbarium of the Division of Vegetable Pathology, the other is Dr. Farlow's monograph,† which includes thirty-eight species and requires less than an octavo page for a complete host index. Since then the number of species credited to North America has almost doubled and the list of hosts increased many fold.

The genus *Albugo* constitutes the family *Albuginaceae*, the species of which bear a superficial resemblance to the *Uredinales*, from which they are readily distinguished by the light color and glistening appearance of the sorus and by the unsculptured conidia which are borne in chains. More marked points of difference, but not so readily observed, are the germination of all spores by zoöspores instead of by germ-tubes, and the production of sexual oöspores.

The oöspores of all the North American species have been studied, in the preparation of the present paper. Upon the basis of oöspore-characters the species fall into two well-defined groups. The first of these includes the North American *A. candida*, *A. Ipomoeae-panduranae* and *A. Lepigoni*, and the foreign *A. sibirica* and *A. tropica*. This group is characterized by having the epispore of the

* Jour. Myc. 7 : 109–130. 1892.

† Bot. Gaz. 8 : 306–325, 327–337 ; 9 : 37–40. 1883–84.

oöspore tuberculate or ridged. According to the investigations of Zalewski * and Stevens † this is the more specialized group. The former author points out the more complex character and apparently more complete development of the epispore, while the latter deals with cytological phenomena only. The second group of species is characterized by a reticulate epispore and contains the remaining species of which the oöspores are known, and in all probability the two species in which they are at present unknown. There are three or four well-defined types of reticulation represented, all of which are found among the American species. The first of these is represented by *A. Bliti* and *A. platensis* and may be considered typical of this group. The reticulations are very evident, the meshes large and the areolae deep and unoccupied by any elevations. The pattern is often somewhat imperfectly developed. From this type the other species vary in a striking manner, yet the primary characters remain the same. In *A. Tragopogonis* and *A. Swertiae* the areolae are not so deep and the reticulations are crested at their angles with more or less prominent tubercles. In *A. Portulacae* the variation takes the form of tubercles within the areolae while the reticulations themselves are similar to those of *A. Bliti.* Unique within the genus is *A. occidentalis,* which has the epispore finely reticulate and the areolae so shallow as to give the impression, at first sight, of pits rather than reticulations. The conidia are quite similar to those of *A. tropica,* but the oöspore-characters indicate a closer relationship to *A. platensis* or *A. Swertiae.* According to Zalewski the reticulate spores have a less perfectly developed epispore which reaches its highest development in *A. Tragopogonis.* This arrangement of species is confirmed by the work of Stevens.

The material upon which the present paper is based is contained in the herbaria of the New York Botanical Garden and of Columbia University and in the private collections of Dr. L. M. Underwood, Dr. J. C. Arthur and the author. The literature of the genus has been carefully looked over by means of Dr. Farlow's Bibliographical Index and other aids. No localities are cited from which material has not been examined, but all published

* Bot. Cent. 15: 215–224. 1883.

† Bot. Gaz. 32: 77–98, 157–169, 238–261. *pl. 1–4 + text figs.* 1901.

reports have been taken into account in determining the distribution of species; and mention is made of all reported hosts upon which no specimens have been seen. The determinations of all hosts have been verified, with the resulting omission of a few of those previously published. These discrepancies are noted in the proper places by the insertion after the specimen of the previously published host name. All specimens containing oöspores are marked by an asterisk (*). Inasmuch as the hosts, or species closely related to the hosts, of all the extralimital species of the genus occur in North America, these species have been included in the key, and brief mention made of them in their place in the sequence of species. In conclusion I wish to express my appreciation of the courtesies which have been shown me in this work by the loan of specimens, by critical suggestions and by the determination of hosts.

ALBUGO (Pers.) S. F. Gray, Nat. Arr. Brit. Pl. 1: 540. 1821

Uredo § *Albugo* Pers. Syn. Meth. Fung. 223. 1801.
Cystopus Lév. Ann. Sci. Nat. III. 8: 371. 1847.

Conidiophores simple, cylindric or clavate, crowded into subepidermal sori without peridium or paraphyses; conidia cylindric or globular, borne in chains, smooth, hyaline or with light-yellow contents; oöspores globular, produced in various parts of the host, often separate from the conidia and forming more or less conspicuous masses; spores liberated by the rupture of the epidermis of the host; germination always by zoöspores.

Type species, *A. Cruciferarum* S. F. Gray = *Uredo candida* Pers.

Key to the species

Oöspore tuberculate; conidia globose or more or less cylindric, not as long as broad, if discoid the membrane of equal thickness throughout.
  Oöspore with prominent tubercles; conidia similar, or the terminal smaller.
    Oöspore with a few very large tubercles; conidial membrane of equal thickness throughout.
      Conidia globular, hyaline.
        Conidia and oöspores large; hosts Papaverales, mainly Brassicaceae. 1. *A. candida.*
        Conidia and oöspores small; hosts Boraginaceae. 2. *A. sibirica.*
      Conidia discoid, yellow. 3. *A. tropica.*

Oöspore with numerous small tubercles; conidial membrane with an equatorial thickening. 4. *A. Ipomoeae-panduranae.*
Oöspore finely echinulate; conidia dissimilar, the terminal larger. 5. *A. Lepigoni.*
Oöspore reticulate (unknown in nos. 8 and 9); conidia cylindric or elliptic, usually longer than broad, if discoid the membrane with an equatorial thickening.
Oöspore with the areolae unoccupied; conidial membrane with an equatorial thickening.
Oöspore coarsely reticulate; conidia elongate.
Oöspore with the reticulations tuberculate at their angles; conidia cylindric, or with more or less rounded corners, hyaline, the terminal larger.
Conidial membrane always with an equatorial thickening.
Conidia more or less rounded; hosts Gentianaceae. 6. *A. Swertiae.*
Conidia cylindric; hosts Compositae. 7. *A. Tragopogonis.*
Conidial membrane of the terminal conidium only with an equatorial thickening. 8. *A. quadrata.*
Oöspore without tubercles; conidia obovoid or elliptic.
Conidia obovoid, the terminal larger. 9. *A. Tillaeae.*
Conidia elliptic, the terminal smaller.
Conidia uniformly hyaline. 10. *A. Bliti.*
Conidia light-yellow, the terminal with a dark equatorial band. 11. *A. platensis.*
Oöspore finely and shallowly reticulate, appearing pitted; conidia discoid, yellow. 12. *A. occidentalis.*
Oöspore with a tubercle in each areola; conidia cylindric, the membrane of uniform thickness. 13. *A. Portulacae.*

1. ALBUGO CANDIDA (Pers.) Kuntze, Rev. Gen. Pl. 2: 658. 1891

Aecidium candidum Pers. in Gmelin, Syst. Nat. 2^2: 1473. 1791.
Uredo candida Pers. Syn. Meth. Fung. 223. 1801.
Uredo Cheiranthi Pers. Syn. Meth. Fung. 224. 1801.
Cystopus candidus Lév.; Berk. Jour. Hort. Soc. London 3: 271. 1848.

Sori on all parts of the host except the roots, white or rarely light-yellow, prominent and rather deep-seated in the tissues of the host, very variable in size and shape, often confluent and frequently producing marked distortion of the host; conidiophores hyaline, clavate, about 35–40 × 15–17 μ; conidia similar, globular, hyaline, with uniform thin walls, 15–18 μ; oöspores usually confined to the stems and fruits of the host, rarely in the leaves, chocolate-colored, about 40–55 μ; epispore thick, verrucose, or with low blunt ridges which are often confluent and irregularly branched.

This is the most widely distributed and by far the commonest species of the genus. Occurring as it does upon such a large number of hosts, a wide variation in characters is to be expected, yet an examination of numerous specimens, both American and foreign, has shown a remarkable stability of essential characters. The fungus as it grows upon *Bursa*, from which it was originally described, does not differ materially, either in habit or measurements, from that upon other species of *Brassicaceae*. In Europe the same fungus attacks various species of *Capparidaceae* and exhibits the same characters. An *Albugo* which occurs in Europe upon *Reseda* has also been referred to this species, from which it differs materially in habit, producing a much thinner and more superficial sorus than those produced upon the other two families of hosts. In the absence of oöspores and of perceptible difference in the conidia this disposition of the material had best be retained. The point of greatest variation in the species in America is that of oöspore-formation. The oöspores have not been observed on the majority of hosts and their location varies greatly in cases where they are known. Oöspores have been examined from the following hosts: *Brassica nigra* (stems), *Bursa Bursa-pastoris* (capsules), *Camelina microcarpa* (leaves), *Raphanus sativus* (capsules), *Roripa Armoracia* (leaves) and *Sophia pinnata* (leaves). Swingle * also reports oöspores from *Dentaria diphylla* (leaves), *Bursa Bursa-pastoris* (stems) and *Lepidium campestre* (stems). The morphology of this species has been studied by Wager † and Stevens. ‡

ON BRASSICACEAE:

Arabis furcata S. Wats., Montana, *Rydberg & Bessey 4230*; Washington, *Suksdorf 266*.

Arabis lyrata L., New York, *Underwood*.

Arabis virginica (L.) Trel., Alabama, *Underwood*; Mississippi, *Tracy*.

Barbarea Barbarea (L.) MacM., California, *Heller 5108* (Fungi Columb. *1710*).

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* Jour. Myc. 7: 110, 111. 1892.

† Ann. Bot. 10: 297–342. *pl. 15, 16*. 1896.

‡ Bot. Gaz. 32: 91, 98, 254. *pl. 2*. 1901.

Brassica arvensis (L.) B. S. P., South Dakota, *Chaney*.

Brassica campestris L., Massachussetts, *Humphrey* (Econ. Fungi *401*).

Brassica integrifolia (West.) O. E. Schultz, St. Croix, *Ricksecker 336*.

Brassica nigra (L.) Koch, Alabama, *Carver;* Illinois, *Burrill;* Indiana, *Olive;* Iowa, *Arthur;* Nebraska, *Williams;* New Jersey,* *Halsted* (Econ. Fungi *256*); South Dakota, *Griffiths* (W. Am. Fungi *46*).

Brassica sp., Wisconsin, *Pammel*.

Bursa Bursa-pastoris (L.) Britton, California, *Copeland;* Illinois, *Earle, Seymour;* Indiana, *Underwood 3734* (Ind. Fl. *98a*), * *Wilson;* Iowa, *Macbride;* Kansas, *Baker* (Fungi Columb. *2108*); Massachusetts, *Farlow* (N. Am. Fungi *204a*); Michigan, *Beal* (Econ. Fungi *257b*); Missouri, *Galloway, Galloway & Tracy, Trelease;* New Jersey, *Halsted* (Econ. Fungi *257a*), *Stevens;* New York, *Arthur, Britton, Underwood, Underwood & Cook* (Illust. Fungi *91*); Ohio, *Kellerman* (Ohio Fungi *122*); Ontario, *Dearness* (Fungi Columb. *133*); Wisconsin, *Pammel*.

Camelina microcarpa Andrz., Ohio, **Tyler* (Ohio Fungi *63*, on "*C. sativa* (L.) Crantz"); Virginia, *Murrill*.

Cardamine bulbosa (Schreb.) B. S. P., Indiana, *Olive*.

Cheiranthus asper Nutt., Oregon, *Suksdorf 220*.

Cheiranthus pacificum Sheldon, Oregon, *Sheldon*.

Dentaria diphylla Michx., New York, *Shear* (N. Y. Fungi *199*), *Underwood*.

Dentaria laciniata Muhl., South Carolina, *Rolfs 1687*.

Hesperis matronalis L., Ontario, *Dearness*.

Iodanthus pinnatifidus (Michx.) Steud., Indiana, *Arthur*.

Lepidium densiflorum Schrad., Nevada, *Baker 1087*.

Lepidium virginicum L., Florida, *Hume 34;* Illinois, *Earle;* Indiana, *Arthur, Underwood;* Kansas, *Bartholomew* (Fungi Columb. *2110*); Nebraska, *Williams;* New York, *Underwood;* Mississippi, *Tracy;* South Carolina, *Ravenel* (Fungi Car. 4: *93*), *Rolfs 1661;* Texas, *Ravenel 291a;* Bahama Is., *Hitchcock* (on "*Cakile maritima* Scop.?"); Bermuda, *Brown & Britton*.

Neslia paniculata Desv., Quebec, *Eggleston 2978.*

Raphanus sativus L., Illinois, *Breyfogle;* Indiana, *Underwood;* Iowa, *Arthur;* Kansas, **Bartholomew* (Fungi Columb. *1805*); New York, *Arthur,* **Underwood.*

Roripa Armoracia (L.) A. S. Hitchcock, Indiana, *Stewart,* * *Wilson;* Kansas, *Bartholomew* (Fungi Columb. *1806*), *Kellerman;* Massachussetts, *Seymour* (Econ. Fungi *454b*); Missouri, *Demetrio* (N. Am. Fungi *2420*); New Jersey, *Stevens;* New York, *Arthur, Holzworth, Underwood;* Ohio, *Kelsey* (Econ. Fungi *454a*); South Dakota, *Williams.*

Roripa hispida (Desv.) Britton, Illinois, *Arthur.*

Roripa obtusa (Nutt.) Britton, Kansas, *Bartholomew* (Fungi Columb. *2109*).

Roripa palustris (DC.) Bessey, Oregon, *Cusick 2600.*

Roripa sessiliflora (Nutt.) A. S. Hitchcock, Illinois, *Patterson;* Iowa, *Ehinger;* Kansas, *Bartholomew* (Fungi Columb. *2001*); Kentucky, *Price;* Tennessee, *Ruth 747.*

Roripa Walteri (Ell.) Greene, Florida, *Underwood;* Texas, *Bush 25, Lighthipe.*

Schoenocrambe linifolium (Nutt.) Greene, British Columbia, *? Macoun.*

Sisymbrium officinale (L). Scop., Indiana, *Arthur, Olive, Underwood, Wilson;* Massachusetts, *Farlow* (N. Am. Fungi *204b*); Missouri, *Bartholomew* (Fungi Columb. *2111*); New Jersey, *Halsted* (Ec. Fungi *259a*); New York, *Underwood 270a;* Nova Scotia, *Robinson 463a;* Ontario, *Dearness* (Econ. Fungi *259b*); Pennsylvania, *Britton;* Washington, *Parker, Piper;* Wisconsin, *Pammel.*

Sophia Hartwegiana (Tourn.) Greene, Montana, *Anderson, Kelsey.*

Sophia incisa (Engelm.) Greene, Colorado, *Baker, Earle & Tracy 1084;* Montana, *Kelsey.*

Sophia millefolia Rydb., Indiana, *Underwood.*

Sophia pinnata (Walt.) Britton, Arizona, * *Griffiths* (W. Am. Fungi *335*); Indiana, *Underwood* (Ind. Fl. *98b*); Durango, *Palmer.*

Thlaspi glaucum A. Nelson, Wyoming, *Nelson 4177.*

Thlaspi Nuttallii Rydb., Montana, *Blankinship.*

Brassicaceae sp., Montana, *Anderson.*

The following additional hosts are reported within our limits : *Arabis glabra* (L.) Bernh., *Brassica Napus* L., *B. oleracea* L., *Cakile edentula* (Bigel.) Hook., *Cheiranthus* sp. cult., *Coronopus* sp., *Draba caroliniana* Walt., *Lepidium campestre* (L.) R. Br., *L. sativum* L., *Roripa Nasturtium* (L.) A. S. Hitchcock, and *Sinapis alba* L.

TYPE LOCALITY : Europe, on *Thlaspi Bursa-pastoris* L. = *Bursa Bursa-pastoris* (L.) Britton.

DISTRIBUTION : Southern Canada to Mexico, Bermuda, and the West Indies. Also in South America, Europe, Asia, Africa, Australia, and New Zealand.

2. **Albugo sibirica** (Zalew.)

Cystopus sibiricus Zalew. Bot. Cent. **15** : 222. 1883.

No material of this species has been examined. It is known only from the original description, where it is recorded from some species of *Boraginaceae* from Siberia erroneously referred by Baron von Thümen to *Echinospermum Lappula.* It is said to differ from *A. candida* in its smaller measurements and in the structure of the epispore of the oöspore.

3. **Albugo tropica** (Lagerh.) Lagerh. ined.

Cystopus tropicus Lagerh. ; Pat. & Lagerh. Bull. Soc. Myc. France **8** : 123. 1892.

This species was described from Ecuador on some unidentified species of *Piperaceae.* Material in the herbarium of the New York Botanical Garden from the type locality, and presumably a part of the original collection, is on *Peperomia pellucida* H.B.K., a species which is also widely distributed in the West Indies and Central America.

4. ALBUGO IPOMOEAE-PANDURANAE (Schwein.) Swing. Jour. Myc. **7** : 112. 1891

Aecidium Ipomoeae-panduranae Schwein. Schr. Natur. Ges. Leipzig **1** : 69. 1822.

Caeoma convolvulatum Link, in Willd. Sp. Pl. **6**^{2} : 49. 1825.

Uredo Convolvulae Spreng. Syst. Veg. ed. 16. **4** : 572. 1827.

Aecidium Ipomeae Schwein.; Berk. Grevillea **3**: 60. 1874. (Hyponym.)

Cystopus Convolvulacearum Otth; Zalew. Bot. Cent. **15**: 223. 1883.

Cystopus Convolvulacearum Speg. Ann. Soc. Ci. Argent. **17**: 128. 1884.

Cystopus Ipomoeae-panduranae Stev. & Swing. Trans. Kan. Acad. Sci. **11**: 67. 1889.

Sori amphigenous or caulicolous, white or light-yellow, prominent, superficial, 0.5–20 mm., rounded, often confluent and frequently producing marked distortions of the host; conidiophores hyaline, clavate, unequally curved at base, about 15 × 30 μ; conidia short-cylindric, similar or the terminal more rounded, hyaline; the membrane with an equatorial thickening, usually very pronounced, 14–20 × 12–18 μ; oösporic sori separate from the conidial, caulicolous, rarely on the petioles, 1–2 × 5–6 cm. or even more, causing marked distortion of the host; oöspores light yellowish-brown, 25–55 μ; epispore papillate or with irregular, more or less curved ridges.

The position in the genus of this species has varied quite a little in the various elaborations which have appeared in recent years. Berlese and De-Toni * included it in *Cystopus Tragopogonis* from which it was separated by Saccardo.† According to Zalewski (*l. c.*) and Fischer ‡ it is placed next to *A. candida*, in the first instance on account of the structure of the epispore of the oöspore, and in the second as the result of inaccurate observations as to the thickness of the conidial membrane. In his *Monografia delle Peronosporacee*, Berlese attempts to accommodate the species to this varied treatment and so places *C. Ipomoeae-panduranae* next to *C. candida* on account of its conidial membrane having no equatorial thickening, and includes *C. Convolvulacearum* Speg. among those species which have an equatorially thickened conidial membrane, and at the same time cites various species of *Convolvulaceae* as hosts of *C. Tragopogonis*. An examination of co-type material of Spegazzini's species leaves no doubt concerning its identity with the North American species. Three packets of the material distributed by Ellis and Everhart in their North

* Saccardo, Syll. Fung. 7: 234. 1888.

† Syll. Fung. 9: 340. 1891.

‡ Rabenh. Krypt. Fl. ed. 2. 4[1]: 419. 1892.

American Fungi *1809* were examined. Berlese had previously* cited this as authentic material of the thin-walled species, but it proved to be the most pronouncedly thick-walled specimen at hand. In a conidium of 12 μ diameter the thickening frequently reaches 5 μ making the connecting strand of protoplasm but 2 μ.

The results of the morphological investigations of Stevens,† coupled with markings and general development of the epispore of the oöspore, lead to the conclusion that Zalewski was correct in his placing of the species. That the relationship of this species should long be in doubt is not surprising, as the oöspores which are borne in large galls on the stems of the host escaped notice until recently, while the conidia on the majority of hosts bear a superficial resemblance to those *A. Tragopogonis*. In all the material examined the conidia are short-cylindric, appearing in certain planes almost cubical, except in the case of those on *Ipomoea Batatas*, the sweet potato, which are very much more rounded than typically. It is not impossible that a distinct species occurs in this host.

ON CONVOLVULACEAE:

Calonyction aculeatum (L.) House, Florida, *Britton 419;* Oaxaca, *Holway 3735*.

Convolvulus incanus Vahl, Texas, *Heller 1910.*

Ipomoea Batatas (L.) Lam., Alabama, *Earle 2265;* Delaware, *Chester;* Louisiana, *Langlois* (N. Am. Fungi *1809*); Mississippi, *Earle* (Econ. Fungi *47*); New Jersey, *Arthur, Ellis* (N. Am. Fungi *205*), *Stevens;* South Carolina, *Ravenel* (Myc. Univ. *815*), *Rolfs 1685;* Porto Rico, *Underwood & Griggs 8.*

Ipomoea carolina Pursh, Louisiana, *Langlois 598;* South Carolina, *Rolfs.*

Ipomoea lacunosa L., ? Kansas, *Swingle;* North Carolina, *coll. ign.*

Ipomoea leptophylla Torr., Kansas, * *Bartholomew* (Fungi Columb. *2003*).

Ipomoea mexicana A. Gray, New Mexico, *Mulford 920;* Mexico (city), *Pringle 6607.*

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* Icon. Fung. Phyc. 7. 1898.

† Bot. Gaz. 38: 300–302. *f. 1, 2.* 1904.

Ipomoea pandurata L., Alabama, *Carver;* Delaware, *Commons;* Florida, *Hume 79, Nash 1889, Tracy 7155;* Georgia, *Underwood;* Illinois, *Hart;* Indiana, *Arthur, Olive;* Missouri, *Kellerman, Galloway, Tracy & Galloway;* New Jersey, * *Halsted 164* (Econ. Fungi *377*, also conidia as *336*), *Stevens;* Ontario, * *Dearness;* Virginia, *Paul* (Fungi Columb. *2004*).

Ipomoea Pes-caprae L., Bahamas, *Hitchcock;* Porto Rico, *Heller 1396*.

Ipomoea simulans Hanbury, Morelos, *Pringle 6565*.

Ipomoea triloba L., Arizona, *LeRoy, Pringle.*

Pharbitis hederacea (L.) Choisy, District of Columbia, *Williams;* Georgia, *Underwood;* Illinois, *Seymour;* Indiana, *Olive, Underwood;* Kansas, *Bartholomew* (Fungi Columb. *2002*); Kentucky, *Kellerman;* Louisiana, *Langlois 589;* Missouri, *Galloway, Pammel;* Nebraska, *Williams;* New Jersey, *Halsted* (Econ. Fungi *334b, 334c*) *Stevens;* South Carolina, *Ravenel* (Fungi Am. *501*), *Rolfs 1686;* Virginia, *Seymour* (Econ. Fungi *334a*).

Pharbitis purpurea (L.) Voigt, Georgia, *Underwood;* Mississippi, *Tracy.*

Thyella tamnifolia (L.) Raf., Cuba, *Britton & Shafer 679*.

The following additional hosts are reported within our limits: *Convolvulus sepium* L., *Ipomoea incarnata* Vahl, *I. Jalapa* Michx., and *Quamoclit Quamoclit* (L.) Britton.

TYPE LOCALITY: North Carolina, on *Ipomoea "pandurana"* L.

DISTRIBUTION: Ontario to California, Central America and the West Indies. Also in South America, Europe, Asia and Africa.

5. ALBUGO LEPIGONI (de Bary) Kuntze, Rev. Gen. Pl. 2: 658. 1891

Erysibe sphaerica β Caryophyllacearum Wallr. Fl. Crypt. Germ. 2: 193. 1833.

Cystopus Lepigoni de Bary, in Rabenh. Fungi Europ. *483*. 1863.

Cystopus argentinus Speg. Bol. Acad. Ci. Cordoba 11: 28. 1887.

Caulicolous or epiphyllous; sori rounded or elongate, 1–3 mm., yellowish; conidiophores clavate; conidia with the membrane of uniform thickness throughout, of two kinds, the terminal larger, hyaline or light-yellow, globular, 25–30 μ, the membrane about 5 μ

thick, the lower smaller, hyaline, globose or ovoid, 18–25 × 18–23 μ, membrane about 1–2 μ thick; oöspores produced in the leaves and stems of the host, 50–65 μ, light-brown, finely and densely papillate or echinulate, the tubercles showing a tendency to be confluent and form short ridges.

Infesting as it does only the maritime *Caryophyllaceae*, this species is of necessity restricted in its habitat, yet appears to be as widely distributed as its chief host, *Tissa marina*, from which it was originally described. Material has been examined from various European countries and from Algiers. Hennings * also reports it from South America. What is presumably the same species is described as *Cystopus argentinus* by Spegazzini, who fails to give really distinguishing characters by which it can be separated from the present species. The morphology of the species has been studied by Ruhland.†

ON CARYOPHYLLACEAE:

Tissa leucantha (Robs.) Greene, California, *Parish 4462*.

Tissa marina (L.) Britton, California, *Parish*; New York, *Britton*.

TYPE LOCALITY: Germany, on *Arenaria marina* L. = *Tissa marina* (L.) Britton.

DISTRIBUTION: New York and California. Also in South America, Europe and Africa.

6. **Albugo Swertiae** (Berl. & Kom.)

Cystopus Convolvulacearum Speg. var. *Swertiae* Berl. & Kom.; Berl. Riv. Pat. Veg. **9**: 26. 1900.

The only known locality for this species is the Amur region in eastern Siberia where it was collected on *Swertia connata* Schrenk by Komarof. An examination of this material shows the present species to be very closely related to *A. Tragopogonis*, yet quite distinct. Species of *Swertia* and the closely related genus *Frasera* have a wide distribution in North America.

7. ALBUGO TRAGOPOGONIS (DC.) S. F. Gray, Nat. Arr. Brit. Pl. **1**: 540. 1821

Uredo candida β Tragopogi Pers. Syn. Meth. Fung. 233. 1801.
Uredo Tragopogi DC. Fl. France **2**: 237. 1805.

* Hedwigia 35: 210. 1896.
† Hedwigia 41: 179. 1902.

Cystopus spinulosus de Bary, in Rabenh. Fungi Europ. *479*. 1862.
Cystopus cubicus de Bary, Ann. Sci. Nat. IV. **20**: 132. 1863.
Cystopus pulverulentus B. & C. Jour. Linn. Soc. Bot. **10**: 357. 1869.
Cystopus brasiliensis Speg. Bol. Acad. Ci. Cordoba **11**: 481. 1889.
Albugo spinulosa Kuntze, Rev. Gen. Pl. **2**: 658. 1891.
Cystopus Tragopogonis spinulosus Davis, Trans. Wis. Acad. **11**: 165. 1897. (Hyponym.)
Cystopus Mikaniae Speg. Ann. Mus. Nac. Buenos Aires III. **1**: 67. 1902.

Sori hypophyllous or caulicolous, prominent, deep-seated, white or yellowish, pulverulent, rounded or elongate, 1–3 × 1–8 mm.; conidiophores hyaline, clavate, about 12–15 × 40–50 μ; conidia light-yellow or hyaline, short-cylindric, the terminal larger and less angular than the lower, membrane with an equatorial thickening, 12–15 × 18–22 μ; oöspores produced in the stems and leaves of the host, dark-brown or almost black at maturity, very opaque, 44–68 μ; epispore reticulate, areolae 2 μ, wing bearing papillate tubercles at its angles.

The oöspores, which are produced in the leaves or rarely in the stems of the host, have been examined from a number of American and European specimens on hosts representing *Ambrosiaceae, Cichoriaceae* and various tribes of *Carduaceae*. The wing of the reticulation is lowest in specimens from the first families mentioned, while those on *Carduus* are scarcely more pronounced. The oöspores from various species of *Senecio* have the widest wing, while those from *Matricaria* are intermediate between those last mentioned. Oöspores produced on *Parthenium* have broader and lower reticulations than do the majority of specimens examined. It is however apparent that the American as well as the European material on the tribes *Cynareae, Senecioneae, Anthemideae* and *Heliantheae* belong to the same species. The only other North American hosts of this family for an *Albugo*, so far as is known, are of the tribe *Inuleae*. As no American material on these hosts contained oöspores, they were studied from European specimens and found to be identical with those produced on other members of *Carduaceae*. It appears from this that the American material from hosts of this tribe should be referred to the present species.

While there are minor differences in the conidia and in the relative size of the areolae of the oöspores, there do not appear to be sufficient grounds for the separation of the material examined into additional species. Especially is this true in regard to de Bary's *Cystopus spinulosus*, which is supposed to have pronounced spines on the oöspore. Dr. A. Fischer has examined the type specimen of this species and declares the character unreliable.* This is borne out by the more recent investigations of Dr. Magnus.† Since then Berlese has figured the spinulose oöspores,‡ using the material distributed by von Thümen (Myc. Univ. *1423*) on *Inula salicina* from Parma. The figures of the entire oöspores have a spinulose appearance due to the projection of the reticulations beyond the margin of the spore. The figure of an enlarged portion of the epispore looks very unlike anything found by me in the packet of this material, or, for that matter, in any other, as no such epispore has been observed by me in any specimen of the genus.

South American material from hosts of the tribes *Astereae* and *Eupatorieae* was examined. Oöspores similar to those produced on species of other tribes of this family were found on *Ageratum conyzoides* from Ecuador. From the same host Ule, in 1884, collected material in Brazil which has been referred to *Albugo brasiliensis* (Speg.) P. Hennings § and which was issued in Rabenhorst-Winter-Pazschke Fungi Europaei *3873* as *Cystopus Tragopogonis.* From a comparison of these two South American specimens it appears that Spegazzini's species is merely a synonym of *A. Tragopogonis.* Two other South American species, *Cystopus Mikaniae* Speg. and *Albugo Solivae* Schröt., have been described, but no material of either is at hand for examination. Inasmuch as the original descriptions of these species are scarcely distinctive and the hosts are closely related to species known to be hosts of *A. Tragopogonis*, it is very probable that they are also synonyms of that species. In addition to the above, another species, *Cystopus pulverulentus* B. & C., was described from an unidentified species of *Compositae* from Cuba. According to Dr. Farlow ‖ the type "cannot be traced in Herb. Curtis by the number cited in the original

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* Rabenh. Krypt. Fl. ed. 2. 1^4: 422. 1892.

† Ber. Deutsch. Bot. Ges. 11 : 327–330. *pl. 15.* 1893.

‡ Icon. Fung. Phyc. *pl. 5.* 1898.

§ Hedwigia 35 : 212. 1896.

‖ Bibl. Index N. Am. Fungi 1 : 177. 1901.

description." As the latter is too vague to allow of a more definite determination than would the mere citation of the host, this species had probably best be placed with the present one. The morphology of this species has been studied by Stevens.*

ON AMBROSIACEAE:

Ambrosia artemisiaefolia L., Alabama, **Carver 180;* Illinois, **Hart;* Kansas, **Swingle 1667;* Massachusetts, **Farlow* (N. Am. Fungi *205b*), **Seymour;* Missouri, **Demetrio* (N. Am. Fungi *2421*); New Jersey, **Halsted* (Econ. Fungi *291a*), *Stevens;* New York, *Underwood;* South Dakota, *Chaney, Williams* (Econ. Fungi *291b*); Wisconsin, *Pammel.*

Ambrosia psilostachya DC., Iowa, **Macbride;* South Dakota, *Rydberg 798;* Utah, *Macbride.*

Ambrosia trifida L., Kansas, *Swingle.*

Gaertneria acanthocarpa (Hook.) Britton, Utah, **Garrett* (Fungi Columb. *2205*).

Iva ambrosiaefolia A. Gray, Arizona, **Griffiths* (W. Am. Fungi *336*, on "*Franseria tenuifolia* Gray"); New Mexico, *Tracy 810.*

Iva ciliata Willd., Illinois, **Hart;* Missouri, **Hart.*

ON CARDUACEAE:

Artemisia biennis Willd., Montana, *Anderson & Kelsey.*

Carduus arvensis (L.) Robins., New York, *Arthur, Brown,* **Halsted* (Econ. Fungi *302*), *Stevens, Underwood;* Ontario, *Dearness.*

Carduus lanceolatus L., Newfoundland, *? Waghorne.*

Carduus muticus (Michx.) Pers., Minnesota, *Holway 241;* Ontario, *Dearness.*

Carduus spinosissimus Walt., Louisiana, **Langlois 335.*

Matricaria matricarioides (Less.) Porter, California, **Abrams 2487;* Oregon, **Lloyd.*

Parthenium integrifolium L., Iowa, **Arthur.*

Parthenium repens Eggert, Kansas, *Hitchcock 1086.*

? Senecio cymbalaroides Nutt., Montana, *Kelsey.*

Senecio Hartianus Heller, Colorado, *Rydberg & Vreeland 5499.*

* Bot. Gaz. 32: 85, 97, 259. *pl. 3; pl. 4, f. 43, 53.* 1901.

Senecio oblanceolatus Rydb., Colorado, *Demetrio* (N. Am. Fungi *2208*, on "*S. aureus.*" The host is mixed but chiefly as cited here).

Senecio peninsularis Vasey & Rose, Baja California, **Palmer 659*.

Senecio serra Hook., Montana, **Kelsey;* Washington, **Piper.*

ON CICHORIACEAE:

Tragopogon porrifolius L., Massachusetts, *Farlow* (N. Am. Fungi *205b*); New Jersey, *Halsted* (Econ. Fungi *445*); New Mexico, **Mulford 1285a;* New York, *Arthur*, *Underwood.*

The following additional hosts are reported within our limits: *Antennaria plantaginifolia* (L.) Richards., *Artemisia canadensis* Michx., *Gaertneria discolor* (Nutt.) Kuntze, *Senecio aureus* L., *S. lugens* Richards., and *S. serra integriusculus* A. Gray.

TYPE LOCALITY: Europe, on *Tragopogon porrifolius* L.

DISTRIBUTION: Newfoundland to Washington, Baja California and Alabama. Also in South America, Europe, Asia, Africa and Australia.

8. ALBUGO QUADRATA (Kalchb. & Cooke) Kuntze, Rev. Gen. Pl. 2: 658. 1891

This species is known only from Cape Colony, where it was collected on *Herpestis verticillaris* Nees by McOwen. The conidia are most nearly like those of *A. Tragopogonis*, but in the absence of oöspores it is impossible satisfactorily to refer the species to a place in the genus.

9. **Albugo Tillaeae** (Lagerh.)

Cystopus Tillaeae Lagerh.; Pat. & Lagerh. Bull. Soc. Myc. France 8: 167. 1891.

No material of this species has been examined; but the description indicates a close relationship with *A. Bliti.* It is known only from Quito, Ecuador, the type locality, where it occurs on *Tillaea rubescens* H.B.K. Species of this genus occur sparingly in tropical America.

10. ALBUGO BLITI (Biv.) Kuntze, Rev. Gen. Pl. 2: 658. 1891

Uredo Bliti Biv. Stirp. Rar. Sicilia **3**: 11. 1815.
Caeoma Amaranthi Schwein. Trans. Am. Phil. Soc. II. **4**: 292. 1832.
Cystopus Bliti de Bary, Ann. Sci. Nat. IV. **20**: 131. 1863.
Cystopus Amaranthi Berk. Grevillea **3**: 58. 1874.
Cystopus Amaranthacearum Zalew. Bot. Cent. **15**: 223. 1883.
Cystopus Cyathulae Winter; Roum. Rev. Myc. **11**: 66. 1889.

Sori amphigenous, white or very light-yellow, prominent, subsuperficial, rounded, sometimes confluent, 1–10 mm.; conidiophores hyaline, cylindric, about $15 \times 60\,\mu$; conidia hyaline, elliptic, the terminal smaller, globular; the membrane with an equatorial thickening, $8–15 \times 15–20\,\mu$; oöspores produced in the leaves of the host, dark-brown, $50–60\,\mu$, averaging $55\,\mu$; epispore coarsely reticulate, areolae $6–8\,\mu$.

According to Zalewski (*l. c.*) there are two species of *Albugo* on the genus *Amaranthus*, the first, *Cystopus Bliti*, being confined to *Amaranthus Blitum*, while the second, *C. Amaranthacearum*, infests the other species of the genus. The points of distinction are confined to the oöspore and are of questionable value, although their reliability could not be disproved on account of a lack of authentic European material. The oöspores of *C. Bliti* are said to be formed only on the stem of the host, to vary from light- to dark-brown in color and to have irregular reticulations. Those of *C. Amaranthacearum* are borne in the leaves of the host, are of a uniform dark-brown and are regularly reticulate. The only specimen at hand on undoubted *Amaranthus Blitum* contains a few detached leaves with conidia only. That the place of oöspore-production cannot be regarded as of taxonomic value is evident, as this varies with the host in *A. candida* and in the same host in *A. Portulacae*. The color of the oöspore depends entirely upon maturity and may show remarkable variation just as do those of the present species in all specimens examined. The pattern of the reticulations cannot be taken as a taxonomic character unless accompanied by other marked distinctions, as the pattern is practically the same, or at most a modification of the same basic pattern, in *A. Bliti*, *A. platensis*, and *A. Portulacae*. In all of these species it is by no means uncommon to find that a number of contiguous areolae are only imperfectly separated from each other by simple or even branched reticulations which end blindly before reaching the opposite side of the areola, thus producing a more or less complex labyrinth of ridges in place of the regular pentagonal or hexagonal reticulations which are typical of this group of species. The morphology of this species has been studied by Stevens.*

ON AMARANTHACEAE:

Acnida tamariscina tuberculata (Moq.) Uline & Bray, Iowa, **Arthur.*

Amaranthus Bigelovii Uline & Bray, Texas, *Heller 1867.*

Amaranthus blitoides S. Wats., California, *Underwood;* Montana, *Reynolds;* Washington, **Suksdorf 182.*

Amaranthus emarginatus Salzm., Guadeloupe, *Duss 4067.*

Amaranthus graecizans L., Montana, **Anderson.*

Amaranthus hybridus L., Alabama, *Earle 2264;* Florida, *Hitchcock 293;* Illinois, *Hart,* **Waite;* Indiana, *Underwood* (Ind. Fl. *99*), *Wilson;* Iowa, **Hitchcock;* Kansas, *Norton 425;* Missouri, *Bush 316,* **Tracy & Galloway;* Nebraska, *Williams;* New Jersey, **Halsted* (Econ. Fungi *352*), **Stevens;* New York, *Peck* (Roum. Fungi Sel. *4551*), *Shear* (N. Y. Fungi *198*), *Underwood;* Wisconsin, **Davis, Pammel.*

Amaranthus Palmeri S. Wats., New Mexico, *Metcalfe 719;* Chihuahua, **Pringle 1112;* Jalisco, *Palmer.*

Amaranthus retroflexus L., Alabama, *Earle;* Illinois, *Burrill, Earle;* Indiana, **Bolley, Olive;* Iowa, **Arthur;* Massachussetts, **Farlow* (N. Am. Fungi *206*), *Seymour* (Econ. Fungi *254b*); New Jersey, **Stevens;* New York, *Halsted* (Econ. Fungi *354a*), *Jelliffe, Peck* (Myc. Univ. *619*), *Underwood 396;* Ontario, *Dearness* (Fungi Columb. *46*); South Dakota, **Griffiths* (W. Am. Fungi *33*); Wisconsin, *Pammel.*

Amaranthus spinosus L., Illinois, **Earle;* Indiana, *Rose;* Louisiana, *Ball 662;* Texas, **Long* (Fungi Columb.

* Bot. Gaz. **28**: 149, 233. *pl. 11–15.* 1900.

1709), *Stanfield;* Virginia, *Heller 1023;* Mexico, *Berlandier;* Porto Rico, *Millspaugh.*

Amaranthus tristis L., Grenada, *Broadway;* St. Croix, *Ricksecker 109.*

Amaranthus viridis L., Florida, * *Hitchcock 298, Nash 2179.*

Cladothrix lanuginosa (Moq.) Nutt., Kansas, *Hitchcock 431;* New Mexico, *Wooton;* Mexico, *Berlandier.*

Cyathula lappulacea Moq., New York, *Peck* (Roum. Fungi Sel. *4863*).

Also reported from within our limits on the following additional hosts: *Acnida cannabina* L., *A. tamariscina* (Nutt.) Willd., *Amaranthus crispus* (Lesp. & Thev.) Braun, and *A. hybridus paniculatus* (L.) Uline & Bray.

TYPE LOCALITY: Sicily, on *Amaranthus Blitum* L.

DISTRIBUTION: Vermont to Washington, Mexico, Florida and the West Indies. Also in South America, Europe, Asia and Africa.

11. ALBUGO PLATENSIS (Speg.) Swing. Jour. Myc. 7: 113. 1892

Cystopus platensis Speg. Rev. Argent. Hist. Nat. 1: 32. 1891.

Hypophyllous, sori at first pallid, later surrounded by a purplish line, irregular in outline, 1–5 mm., scattered or gregarious, prominent; conidiophores cylindric, about 40–45 × 15 μ; conidia elliptic, 20–22 × 18–20 μ, very light-yellow, the membrane with an equatorial thickening which is darker-colored in the smaller terminal conidium; oöspores borne in the leaves of the host, very opaque, very dark-brown, globular, 55–85 μ, averaging 60 μ, finely reticulate, areolae about 4 μ.

This species is very closely related to *A. Bliti*, from which it is, however, quite distinct. The conidia of *A. Bliti* are hyaline and white in mass while those of *A. platensis* are slightly colored, appearing light-yellow in mass while the apical conidium has a darkened equatorial band. The oöspores, which are produced in the leaves of the host in both species, are very similar and at first sight indistinguishable. Those of *A. platensis* are very dark-brown, so opaque that until treated with HCl they appear as black grains, and are finely reticulate, while those of *A. Bliti* are lighter in color, less opaque, slightly smaller in size and more coarsely reticulate, the areolae being from one third to one half larger.

ON ALLIONIACEAE:

Boerhaavia anisophylla A. Gray, New Mexico, *Wooton 462.*

? *Boerhaavia diffusa* L., McComb's Expedition, *Newberry.*

Boerhaavia erecta L., Florida, *Swingle 4139;* Sonora, *Palmer;* Jamaica, *Harris 6853;* St. Croix, *Ricksecker 401.*

Boerhaavia hirsuta Willd., Texas, **Long* (Fungi Columb. *1605*, on "*B. decumbens*"); Yucatan, *Gaumer 309;* Cuba, *Britton & Shafer 1;* Guadeloupe, *Duss 2174;* Porto Rico, *Goll 536.*

Boerhaavia paniculata Rich., Culebra, *Britton & Wheeler 2.*

Boerhaavia spicata Choisy, Arizona, *Griffiths 2071;* New Mexican, *Wooton.*

Boerhaavia Xanti S. Wats., Sonora, *Palmer.*

Wedelia incarnata (L.) Kuntze, Arizona, *Rusby;* New Mexico, *Skehan 102, Wooton;* Texas, *Seler 1901;* Utah, *Goodding 809;* San Luis Potosi, *Schaffner 562.*

Reported from within our limits on the following additional hosts: *Boerhaavia Sonorae* Rose and *B. viscosa* Lag. & Rodr.

TYPE LOCALITY: Buenos Aires, Argentina, on *Boerhaavia hirsuta* Willd.

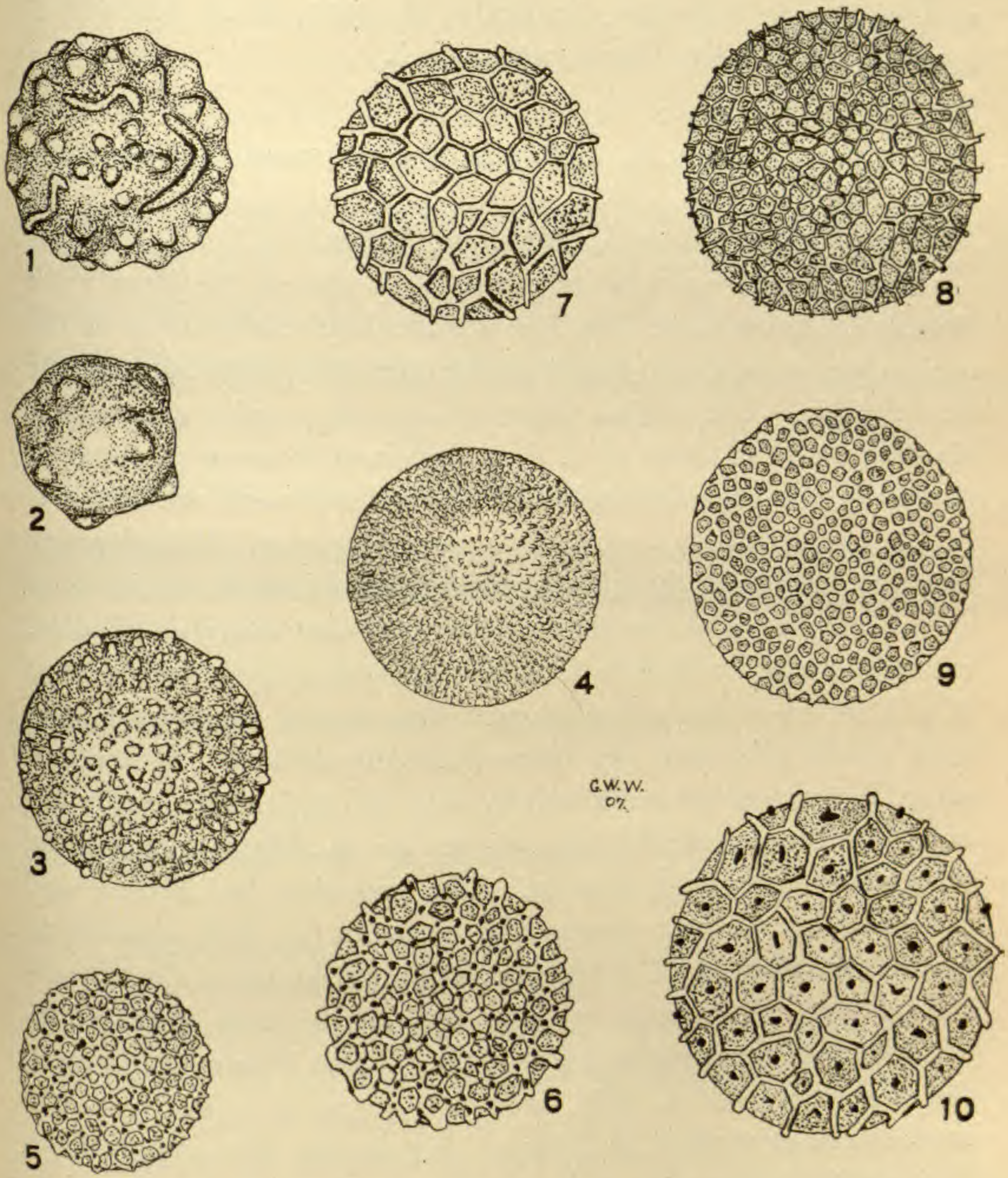
DISTRIBUTION: Utah to peninsular Florida, southern Mexico and the West Indies. Also in South America, Asia and Africa.

12. **Albugo occidentalis** sp. nov.

Soris hypophyllis, subrotundis vel irregularibus, rarius confluentibus, superficialibus, prominentibus, subflavidis, 1–3 mm. crassis; conidiophoris cylindraceis, circa $12 \times 40\,\mu$; conidiis flavidis, breviter cylindraceis, $14–20 \times 8–16\,\mu$, membrana hyalina, ad medium annulo cincta; oosporis in hospitis foliis, globosis, luteo-brunneis, regulariter tenuiterque reticulatis, $50–60\,\mu$ diametro, areolis pentagonis vel hexagonis, circa $2\,\mu$ crassis.

Sori hypophyllous, rounded or irregular in outline, sometimes confluent, superficial, prominent, yellowish, 1–3 mm.; conidiophores cylindric, about $12 \times 40\,\mu$; conidia discoid, the membrane hyaline with an equatorial thickening, contents yellow, $14–20 \times 8–16\,\mu$; oöspores borne in the leaves of the host with the conidia, globular, $50–60\,\mu$, yellowish-brown, very closely and shallowly reticulate, areolae about $2\,\mu$.

Type in herbarium of the New York Botanical Garden, *L. M. Underwood & A. D. Selby 108*, from the hills about Box Cañon,



Oöspores of *Albugo*. (All × 500.)

1. *A. candida*, from *Raphanus sativus*, in Fungi Columbiani *1805*.
2. *A. tropica*, from *Peperomia pellucida*, Ecuador, ex Herb. Lagerheim.
3. *A. Ipomoeae-panduranae*, from *Ipomoea pandurata*, in Economic Fungi *337*.
4. *A. Lepigoni*, from *Lepigonum medium*, in Fungi Europaei *483*.
5. *A. Swertiae*, from *Swertia connata*, in Fungi Rossiae Exsiccati *301*.
6. *A. Tragopogonis*, from *Tragopogon porrifolius*, Mulford *1285a*.
7. *A. Bliti*, from *Amaranthus hybridus*, in Economic Fungi *352*.
8. *A. platensis*, from *Boerhaavia decumbens*, in Fungi Columbiani *1605*.
9. *A. occidentalis*, from *Blitum capitatum*, type specimen, Underwood & Selby *108*.
10. *A. Portulacae*, from *Portulaca oleracea*, in West American Fungi *31*.

west of Ouray, Colorado, September 8, 1901, at an altitude of 2,300–2,500 m. On *Blitum capitatum* L.

ON CHENOPODIACEAE:

Blitum capitatum L., Colorado, * *Underwood & Selby 108.* (Type.)

Chenopodium rubrum L., Montana, *Kelsey.*

This material was referred in the herbarium of the New York Botanical Garden to *A. Bliti*, but a superficial examination of the conidia was sufficient to throw doubt upon the correctness of the identification. The conidia differ in their yellow color and in their discoid form from those of *A. Bliti*, and from those of *A. platensis* in the brighter color and uniformly hyaline membrane, while in outline they approach most nearly to those of *A. tropica.* The oöspores, however, are markedly different from those of these species or of any other member of the genus. They are very closely reticulate, with the areolae so shallow as at first sight to give the appearance of pitting rather than reticulations. This is our rarest and most local species, yet none are more markedly distinct. It is represented in the material examined by only two collections, while but one American mycologist has referred to an *Albugo* which could belong to the present species. The inclusion by Berlese and DeToni * of *Atriplex* among the hosts of *A. Bliti* appears to be the first mention of a species of this genus on a Chenopodiaceous host. No locality is given nor can the host be traced by any bibliographical assistance at hand. Later Pammel † reported the occurrence of *A. Bliti* upon the sugar beet in Iowa and mentions its occurence on *Blitum.* He figures the conidia from *Beta* and the oöspores from *Amaranthus*, as they were not found on the former host. Later the same author ‡ cites references to the occurrence of *A. Bliti* on *Chenopodium* in Europe, but no light has been gained from them.

DISTRIBUTION: Montana and Colorado. Probably also in Iowa and Europe.

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* Sacc. Syll. Fung. 7: 236. 1888.

† Bull. Iowa Agr. Expr. Sta. 15: 236. *pl. 6.* 1891.

‡ Jour. Myc. 7: 102. 1892.

13. ALBUGO PORTULACAE (DC.) Kuntze, Rev. Gen. Pl. 2: 658. 1891

Uredo Portulacae DC. Fl. France 5: 88. 1815.

Cystopus Portulacae de Bary, Ann. Sci. Nat. IV. 20: 131. 1863.

Sori white or yellowish, on all parts of the host except the roots, rounded or irregular in outline, up to 5 mm.; conidiophores clavate, about 9×25 μ, hyaline; conidia dissimilar, the terminal larger, cylindrical and papillate, the basal smaller, subglobular, about $12–15 \times 15–22$ μ, walls hyaline, contents light-yellow; oöspores borne in the stems and leaves, globular, dark-brown, about 70 μ; epispore regularly reticulated, with short ridges or papillate tubercles in the areas.

This species is restricted throughout its range to a single host, upon which it does not appear to be very common, although the distribution of both host and fungus is probably coextensive. It is easily distinguished from related species by the uniform thickness of the conidial membrane and by the tubercles in the areolae of the oöspore. The morphology of this species has been studied by Stevens.*

ON PORTULACACEAE:

Portulaca oleracea L., Connecticut, *Underwood;* Georgia, * *Underwood;* Illinois, *Blount, Burrill,* * *Earle, Waite;* Indiana, *Bolley, Olive,* * *Underwood;* Iowa, * *Arthur;* Missouri, *Galloway;* New Jersey, *Ellis* (N. Am. Fungi *1808*), *Halsted* (Econ. Fungi *264a*); New York, *Underwood;* New Mexico, * *Cockerell;* Ohio, *Tyler* (Ohio Fungi *83*); Ontario, *Dearness* (Fungi Columb. *45*, Econ. Fungi *264b*); South Carolina, *Ravenel* (Fungi Am. *500*); South Dakota, * *Chaney,* * *Griffiths* (W. Am. Fungi *31*).

TYPE LOCALITY: France, on *Portulaca oleracea* L.

DISTRIBUTION: Vermont to South Dakota, New Mexico and Georgia. Also in South America, Europe, Asia and Africa.

SPECIES EXCLUDENDAE

While several names have been proposed under this genus which for one reason or another cannot be retained, it appears scarcely necessary to mention any of these which have not gained admission to Saccardo's *Sylloge Fungorum.*

* Bot. Gaz. 32: 79, 97, 254. *pl. 1; pl. 4, f. 44–46, 48–50.* 1901.

Cystopus Euphorbiae Cooke & Massee, Grevillea **20**: 106. 1892.

The roughened conidia bespeak a closer relationship with the Uredinales than with the present genus.

Cystopus Salsolae and *C. Schlechteri* P. Sydow, Hedwigia Beibl. 38: 142. 1889.

Authentic material of both these species has been examined. In both instances the host is covered with white spots which closely simulate the sori of *Albugo* and answer to the description in the diagnoses of these species. A microscopic examination of these spots failed to show anything except crystals of some chemical. These answer fairly well to the measurements given, but show no membrane or other parts as described, for the spores. Nothing more similar to conidia, however, was observed. The spores described as oöspores are present in fair abundance in the material of both species. They are borne apparently singly, at the apex of isolated conidiophores, and are the conidia of some species of Hyphomycetes and rather closely related to *Coniosporium* or *Torula*.

NEW YORK BOTANICAL GARDEN.

Some Lactarii from Windham County, Vermont

Gertrude Simmons Burlingham

Vermont is undoubtedly one of the richest of the New England states in the number and variety of its fleshy fungi; yet with the exception of the lists of Charles C. Frost,* and a paper by Professor Burt,† nothing has been published to indicate any extended study of the higher *Basidiomycetes* which occur in the state. In connection with a special study of the genus *Lactarius*, it was my fortune to spend last summer collecting in that portion of Windham county, Vermont, immediately north of the region explored by Frost. Six miles west of Newfane village, at an elevation of about 500 meters, we "pitched camp" in a small farmhouse delightfully situated in the midst of the fragrance and the sunshine and the bird voices of the mowing,‡ while closely encircling it on three sides was the forest with the more subtle odors, the cool shade, and the songs of the veery and the hermit thrush. Although the most extensive field work was done in the town of Newfane, several excursions were made into the neighboring townships reaching west to Stratton Mountain, and east to Putney Mountain, including a range of elevation from 180 to 615 meters.

The topography of the region is characterized by a succession of hill-like mountains with intervening valleys traversed by some small stream whose waters finally reach the larger valley of the West River. The elevations are mostly covered with timber, and lower lands which were tilled two generations ago are, in some cases, being reclaimed by the forests. Except along the Connecticut and the lower valley of the West River, chestnut groves are lacking. There are a few scattering oaks, but no rich oak woods. The white pines, too, are scarce in this part of Vermont,

* Tuckerman and Frost. Catalogue of plants within thirty miles of Amherst College. 1875.

† Key to the genera of the *Basidiomycetes* of Vermont. 1899.

‡ "Mowing" is used in New England for any land from which hay is cut, while the term "meadow" is restricted to level and usually moist grass lands.

but the young trees grow rapidly where given an opportunity. Forests of balsam fir, spruce, and hemlock are numerous. The deciduous woods are made up principally of maples, beeches, yellow and paper birch, and aspens. Along small streams, alders abound. The soil is a loam or a sandy loam, with a topsoil of vegetable mold in the less steep and rocky woods.

From the middle of July to the middle of September the weather was unusually dry. Consequently there was a scarcity of the *Lactarii* except in naturally moist woods, and in wooded ravines. The swamps were not as a rule good collecting grounds, owing to the fact that they were so often supplied by cold springs. Nevertheless the region, with its varying elevations, diverse forest conditions, and shaded ravines, proved a most fruitful collecting field. During July and August, after a light rain or even a heavy dew, *Boleti* and *Russulae* were very abundant in the more open places in the woods; by the middle of August the *Cortinarii* began to be plentiful; and from first to last many other genera were represented by a lesser number of species. But in the present paper I shall attempt to cover merely the summer's work upon the genus *Lactarius*.

The absence of *Lactarius piperatus* was notable, but the related form, *Lactarius deceptivus* Peck, was very common throughout the region. Two species were found which have not been reported before in the United States; namely, *Lactarius resimus* Fr.,* and *Lactarius circellatus* (Batt.) Fr. *Lactarius rimosellus* also should be mentioned as a species recently described by Dr. Peck (Rep. State Bot. N. Y. 1905: 37. 1906). *Lactarius oculatus*, which was described by Peck as a variety of *Lactarius subdulcis*, is here separated as a distinct species, since the Vermont specimens were so plainly viscid when moist.

Many thanks are due Dr. Charles H. Peck for the privilege of examining the type specimens in the herbarium of the New York

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* In the Rep. State Bot. N. Y. for 1872, Peck describes *Lactarius regalis*, which, in the Rep. State Bot. N. Y. for 1884 and 1885, he refers to *Lactarius resimus* as a variety. The type specimens show the plant in various stages including forms young enough to have tomentum on the margin. From the absence of this tomentum in the five type specimens, it would seem that they belong to a distinct species as first described; but further collections of this form must be made before its position can be positively determined.

State Museum, and for his assistance in determining doubtful forms; also to Prof. L. M. Underwood, under whose direction the study of the *Lactarii* is being pursued, and Dr. Marshall A. Howe, who placed at our disposal for the summer the house which we occupied, and otherwise rendered valuable assistance through his intimate knowledge of Newfane.

The following is the list of species taken, together with the description of new species.

Lactarius aspideoides sp. nov.

Pileus fleshy, rather firm, convex-umbilicate, then plane, becoming infundibuliform with age, 3–4.5 cm. broad, sulphur-yellow zoned with deeper yellow, zones narrow, sometimes obscure, very viscid when wet, gluten thick and persisting, margin involute and minutely tomentose at first; gills whitish then cream-colored spotted with yellow, close, sometimes forking next the stem, adnate but acute at the inner end, 4 mm. broad, staining lilac where wounded; stem sulphur-yellow, often spotted with deeper yellow, viscid when young or wet, equal or abruptly smaller at the base, glabrous, stuffed, becoming hollow, 2–3.5 cm. long, 6–10 mm. thick; spores white, globular to broadly elliptical, echinulate, 5–7 by 7–8 μ; flesh whitish, changing faintly lilac where exposed to the air; milk white, a change in color indicated only by the change in the color of the broken flesh; taste bitter.

In a grassy place in hillside sheep-pasture near small fir trees, 523 m. elevation, after heavy rain and warm weather, September 21–24; Newfane.

This species is related to *Lactarius aspideus* Fries, but is separated from it by the brighter-colored *zoned* pileus, the smaller size, and the bitter taste of the milk. I could not detect any change in the color of a drop of milk, but the gills and flesh change to lilac where wounded. The tomentum on the margin of the young pileus is chaffy in appearance.

Lactarius Bensleyae sp. nov.

Pileus firm, fleshy, nearly flat with margin inrolled, papillate, when older depressed in the center but the margin still recurved, surface covered with a dense minute short rather stiff pubescence, dry, blue-black when young and moist, then zoned with dark-gray, finally with brownish-gray, darker in the center, 2–15 mm. broad; gills whitish, some forking near the stem, close, slightly decurrent; stem somewhat buff, covered more or less with a gray pruinosity, glabrous, dry, nearly equal, becoming hollow, 1 cm. or less in length, 2–3 mm. thick; spores slightly cream-colored, mostly globular, some slightly elliptical, echinulate, 5–6.5 μ or rarely 6.5 by 8 μ; flesh of pileus gray, of stem buff; milk white, unchanging, acrid.

In black soil in a wet place at times overflowed, under yellow birch and young spruce woods, 500 m. elevation, July to September; Newfane, Agnes H. Bensley.

This species is gregarious and sometimes cespitose. As many as 35 were found growing in an area of less than one square foot. It can be distinguished from *Lactarius griseus* Peck, by its minute size, its dark-colored and frequently zoned pileus, and by the short and dense hirsute-pubescent covering of the pileus.

Lactarius isabellinus sp. nov.

Pileus fleshy, not very thick, convex, then broadly convex, at length infundibuliform, umbonate, dry, glabrous, but a little roughened and wrinkled in the center especially when mature, azonate, red-fulvous in the center, buff toward the margin, all fading to buff when mature, 3–4.5 cm. broad; margin glabrous, even or faintly striate when old, and sometimes areolate-wrinkled; gills pale-yellowish, becoming reddish .where bruised, crowded, thin, forking near the stem or midway to the margin, slightly decurrent, 3 mm. broad, or twice as broad as the thickness of the flesh; stem the same color as the pileus, equal or slightly tapering upwards, tomentose at the base, stuffed, becoming hollow, 4 cm. long, 6 mm. thick; spores white, slightly echinulate, 6–7.5 by 7–8.5 μ; flesh white, staining yellowish from the milk; milk white, at length (after five minutes) becoming sulphur-yellow, astringent, then acrid, abundant.

In leaf mold, moist open place in mixed woods, 460 m. elevation, warm dry weather, September; Newfane.

The milk changes color slowly, and sometimes a drop will not seem to change, but the milk always dries yellow on the flesh. The species was found but once; then, however, several specimens in various stages of development.

Lactarius minusculus sp. nov.

Pileus fleshy, thin, broadly convex, with a small umbo, becoming plane then somewhat depressed in the center, glabrous, viscid in wet weather, sometimes shining with viscidity, azonate, fulvous in the center, shading to cream-fulvous, then to cream on the margin, 1.1–3 cm. broad, margin minutely crenate, pruinose at first, in mature specimens slightly wavy and sometimes substriate; gills close, thin, adnate, seldom forking, broad for the thickness of the pileus; stem slightly paler than the pileus, equal, stuffed, a little tomentose at the base when growing in moss, about 2.5 cm. long, 4 mm. thick; spores white, subglobose, slightly echinulate, 6–8 μ; flesh isabelline-white; milk white, unchanging, acrid.

In moss or on decayed wood, under yellow birches, in cool, moist woods, 500 m. elevation, July; Newfane.

This species resembles *Lactarius subdulcis* somewhat, but differs in its smaller size, the viscidity of the pileus, the crenate margin, in being expallent, and in the acrid milk. The plants were found in the same general locality several times in July, always after a rain. Frequently the gills appear pruinose.

Lactarius nitidus sp. nov.

Pileus fleshy, rather thin, convex then depressed in the center, margin arching for some time, umbonate, glabrous, smooth, shining-viscid when wet, mahogany-red, more golden-red toward the margin, umbo persistently dark, otherwise fading when dry, 3 cm. broad; gills yellowish becoming pruinose, close, sometimes forking, slightly decurrent; stem mahogany-red, equal, smooth, glabrous, stuffed becoming hollow, 4.5–5 cm. long, 5–8 mm. thick, sometimes ventricose when growing in wet places; spores white, echinulate, 5–6 by 6–8 μ; flesh faintly buff, turning a little reddish where cut; milk white, unchanging, mild.

In a grassy sheep-pasture in the shade of hemlocks, and in woods, 500 m. elevation, warm weather, September; Newfane.

Lactarius oculatus (Peck) sp. nov.

Lactarius subdulcis oculatus Peck, Rep. State Bot. N. Y. **1902**: 37. 1903.

Pileus fleshy, thin, convex then depressed in the center, margin arched then nearly plane, umbonate, viscid in dew or wet weather, glabrous, smooth, rich-fulvous in the center shading to buff-fulvous toward the margin, except the umbo fading to pinkish, 1.5–2.5 cm. broad, margin pruinose at first, slightly crenate; gills whitish then yellowish, at length pruinose, crowded, a few forking near the stem; stem buff at the top, sublatericeous below the middle, equal, stuffed, tomentose at the base, slightly sticky in wet weather, up to 6 cm. long, 5 mm. thick; spores white, broadly elliptical to subglobose, echinulate, 6–7.5 by 8–9.5 μ; flesh buff-whitish; milk white, unchanging, mild.

In moss under pine and hemlock, 500 meters elevation, July to September; Newfane.

"Pileus moist, subhygrophanous, vinaceous buff with a small central spot or umbo persistently reddish-brown or chestnut color. Otherwise like the species. Under spruce and balsam fir trees. September." Peck, Rep. State Bot. N. Y. **1902**: 37. *pl. 83, f. 20–24.* 1903.

Dr. Peck gave the name *oculatus* to the form on account of the eye-like appearance of the umbo in the mature or dry specimen. This spot is not noticeable in the moist condition. The viscidity of the pileus in wet weather, and the expallent color serve to separate it from *Lactarius subdulcis*.

In addition to the above, the following species were collected:

LACTARIUS AFFINIS Peck.

In moist fir or mixed woods with evergreens predominating, August to September, 500 m. elevation; Newfane.

LACTARIUS ALPINUS Peck.

Mossy moist place on border of fir woods, September, 500 m. elevation; Newfane.

LACTARIUS CAMPHORATUS (Bull.) Fr.

Common, July to September; Wardsboro; Stratton; Newfane; Putney. *Edible.*

LACTARIUS CINEREUS Peck.

Common in mixed woods, especially among beech leaves, most abundant in July and August; Newfane.

LACTARIUS CIRCELLATUS (Batt.) Fr.

In cool mixed woods, spruce and fir and hemlock predominating, August to September, 500 m. elevation; Newfane.

LACTARIUS DECEPTIVUS Peck.

Common especially under hemlocks, July to September; Newfane. *Edible.*

LACTARIUS DELICIOSUS (L.) Fr.

Common in moist places in fir, spruce, or hemlock woods, July to September; Newfane. *Edible.*

LACTARIUS FLEXUOSUS Fr.

Found twice under maples in leaves, rather dry, 500 m. elevation, September; Newfane.

LACTARIUS FULIGINOSUS Fr.

Found in mixed woods several times but not common, 500 m. elevation, August; Newfane.

LACTARIUS GERARDII Peck.

At foot of Stratton Mountain, under maple, balsam fir, and spruce, July, 615 m. elevation. *Edible.*

LACTARIUS GRISEUS Peck.

Common in wet woods on ground and on decaying wood, July to September, 180 to 615 m. elevation; Stratton; Newfane; Putney.

LACTARIUS HYSGINUS Fr.

In grassy wood road and in both leaf and needle soil, under fir and hemlocks, moist woods, August to September, 500 m. elevation; Newfane.

LACTARIUS LIGNIOTUS Fr.

Not common, a few scattering specimens, August to September, 500 m. elevation; Newfane.

LACTARIUS PALUDINELLUS Peck.

In moist places in woods, found once; Newfane.

LACTARIUS PARVUS Peck.

Found once on decayed wood in moist mixed woods, 500 m. elevation, September; Newfane.

LACTARIUS PYROGALUS (Bull.) Fr.

Grassy open place in woods, 500 m. elevation, July; Newfane.

LACTARIUS RESIMUS Fr.

Rare, found only one specimen, under spruce on edge of steep woods, 500 m. elevation, September; Newfane.

LACTARIUS RIMOSELLUS Peck.

Found several times under beech among ferns, near wood road, July to August, 500 m. elevation; Newfane. *Edible.*

LACTARIUS SUBDULCIS (Bull.) Fr.

Common in woods and on border of woods, especially in moist places, 180–615 m. elevation, June to September; Stratton; Newfane; Putney.

LACTARIUS SUBPURPUREUS Peck.

In grassy sheep pastures with scattered firs, after heavy rains. 530 m. elevation; September; Newfane.

LACTARIUS THEIOGALUS (Bull.) Fr.

Common in spruce and hemlock woods, in both dry and wet; weather, 180–500 m. ft. elevation, July to September; Newfane.

LACTARIUS TORMINOSUS (Schaeff.) Fr.

Common in moist woods, sometimes nearly white, 500 m. elevation, August to September; Newfane.

LACTARIUS TURPIS Fr.

Found three times in moist places; twice in fir woods, once in maple woods near a pine tree, 500 m. elevation, August to September; Newfane.

LACTARIUS UVIDUS Fr.

Common in *Sphagnum* in fir woods and under firs and alders in a wet ravine, 460 m. elevation, August, September; Newfane. Several of the specimens were attacked by a fungus which affected the hymenium only and did not prevent the flow of milk. This has been deposited with Dr. Peck for identification and description.

LACTARIUS VELLEREUS Fr.

Mixed woods and under beech, 180 to 615 m. elevation, August; Newfane.

LACTARIUS VOLEMUS Fr.

Found once in woods-road under maples and beeches, 500 m. elevation; and once in a moist ravine near Newfane village, August. *Edible.*

The accompanying synopsis is offered as an aid in identifying the above-named species. In order to make the synopsis as complete as possible, I have included the additional species which are given in Frost's list, most of which were probably collected in the vicinity of Brattleboro. These added species are indicated by an asterisk. In his list the names of eleven new species occur which have never been described; these are of course omitted.

Synopsis of species

MILK BRIGHT-COLORED FROM THE FIRST, wounds often turning greenish .... Section **I.**
MILK AT FIRST WHITE THEN CHANGING COLOR .... Section **II.**
MILK WHITE AND UNCHANGING .... Section **III.**

I

Milk orange; pileus some shade of orange zoned with darker, fading; gills deep-orange with yellowish reflections .... *L. deliciosus.*
Milk saffron-yellow; pileus grayish-yellow, somewhat zonate; gills grayish-yellow; under pines.. *L. Chelidonium.**
Milk dark-red; pileus pale reddish-purple approaching Indian lake, fading, faintly zonate; gills dark-red, fading........................... *L. subpurpureus.*
Milk indigo-blue; entire plant indigo-blue; pileus with grayish lustre, zonate; gills becoming yellowish .... *L. Indigo.**

II

Milk becoming sulphur-yellow.. A.
Milk becoming salmon; at least wounds changing; pileus dry; spores yellow.. AA.
Milk becoming lilac; at least wounds changing; pileus viscid........ AAA.

A

1. Pileus viscid .... 2.
   Pileus dry, fulvous in center, buff toward margin, all buff when mature; stem same color; gills paler; milk changes slowly... *L. isabellinus.*
2. Margin at first involute, tomentose; pileus whitish, azonate, large, umbilicate .... *L. resimus.*
   Margin glabrous or merely downy when young; pileus yellowish, salmon zoned with bister or fawn more or less distinct; stem same color or paler; gills whitish to yellow, becoming reddish where bruised; milk bitter then acrid................................ *L. theiogalus.*

AA

Pileus sooty or the color of coffee and milk, surface smooth, pruinose in appearance, 2.5–6.5 cm. broad; gills subclose........................ *L. fuliginosus.*
Pileus more velvety-pruinose, center often wrinkled, umbonate, rich dark umber to sepia, 2.5–10 cm. broad .... *L. ligniotus.*

AAA

Pileus and stem sulphur-yellow; pileus zoned with deeper yellow; stem equal or abruptly smaller at the base, viscid, sometimes spotted; plants small; milk bitter.. *L. aspideoides.*
Pileus pale brownish-gray or drab, with lilac tint, center sometimes dark-brown to yellow-brown, sometimes faintly zonate, 5–8 cm. broad; wet places in woods.. *L. uvidus.*

III

1. Milk acrid.. 2.
   Milk mild.. 3.
2. Pileus viscid .... 4.
   Pileus dry.. 11.
3. Pileus viscid when wet but soon dry, glabrous........................... 18.
   Pileus dry .... 21.
4. Margin at first involute, tomentose..................................... 5.
   Margin naked .... 6.
5. Pileus pale-ochraceous tinged with flesh, sometimes nearly white, usually zonate, with beard-like tomentum persisting on margin, 7–10 cm. broad; gills white or yellowish .... *L. torminosus.*

Pileus woolly-tomentose all over, fibrillose on margin, dingy-flesh-colored or reddish-buff, azonate, very viscid in wet weather, 4–10 cm. broad; milk scanty, *sometimes becoming pale-yellow*. .... *L. cilicioides.**

Pileus olivaceous-umber, yellowish toward margin, agglutinated-villose, or at length glabrous, blackish in drying, 7–15 cm. broad; stem uneven or spotted; gills white, then yellowish, then gray, nearly black where bruised.......... *L. turpis.*

6. Pileus some shade of yellow .... 7.
   Pileus some shade of red or fulvous .... 9.
   Pileus gray.......... 10.
   Pileus livid or plum-colored, becoming yellowish, large and firm; stem stout, same color as pileus or paler, not spotted.......... *L. trivialis.*
7. Pileus zonate.......... 8.
   Pileus azonate, ochraceous, up to 10 cm. broad; spores white; gills tinted yellow.......... *L. affinis.*
8. Pileus 6–11 cm. broad; stem often scrobiculate-spotted; spores yellow.......... *L. insulsus.**
   Pileus 5–8 cm. broad; stem never spotted.......... *L. zonarius.**
9. Pileus dull-garnet in center, paler toward margin, gluten persisting, 5–8 cm. broad, thin margin inflexed; stem often spotted, paler than pileus; gills white to yellowish.......... *L. hysginus.*
   Pileus fulvous in center, buff-fulvous toward margin, margin finely crenate; gills white; plants small.......... *L. minusculus.*
10. Pileus cinereus, usually azonate, disk darker, 2–5 cm. broad, thin, fragile; gills close, white; stem often tomentose at base, paler than pileus, up to 8 cm. long.......... *L. cinereus.*
    Pileus dark-gray with lilac tints, zones and disk reddish-brown, fading to pale-gray, 6–8 cm. broad; gills close .... *L. circellatus.*
11. Pileus glabrous .... 12.
    Margin with a roll of cottony tomentum, or pileus velvety-tomentose.......... 16.
    Pileus minutely hirsute-pubescent, or squamulose-tomentose.......... 17.
    Pileus minutely squamulose, ochraceous to fulvous, 2.5–4 cm. broad; gills yellowish to ochraceous.......... *L. alpinus.*
12. Pileus some shade of red.......... 13.
    Pileus whitish.......... 14.
    Pileus some shade of gray.......... 15.
13. Pileus reddish-brown or lilac-brown, small, slender; gills close, white or yellowish, dingy-greenish where wounded; on decaying wood.......... *L. parvus.*
    Pileus bay-red, shining, sometimes floccose-pubescent when young, 5–11 cm. broad; gills ochraceous or reddish; milk very acrid.. *L. rufus.**
14. Pileus umbilicate to infundibuliform, 6–18 cm. broad; stem solid, short, or 2–8 cm. tall; gills very close, dichotomous, arcuate, decurrent .... *L. piperatus.**
    Pileus thinner than preceding, 5–10 cm. broad; stem 5–10 cm. high; gills adnate, horizontal, white to yellowish.......... *L. pargamenus.**
15. Pileus livid-gray, zoned, moist but not viscid, 5–7.5 cm. broad; stem stuffed then hollow; gills thin, distant, subochraceous.. *L. pyrogalus.*

Pileus lead-gray or violet-gray, zoned or zoneless, smooth shining, then rivulose-scaly and unpolished, margin flexuose, 5–15 cm. broad; stem solid; gills thick, distant, light-yellowish .... *L. flexuosus.*

16. Pileus convex-umbilicate to infundibuliform, up to 15 cm. broad, surface with the texture of chamois, margin cottony-tomentose .... *L. deceptivus.*

Pileus convex to umbilicate, covered with a nap-like tomentum, 5–12 cm. broad; stem stout .... *L. vellereus.*

17. Pileus hirsute-pubescent, blue-black when young, then zoned with gray, finally yellowish-brown near margin, 5–15 mm. broad; stem short, glabrous; spores cream .... *L. Bensleyae.*

Pileus squamulose-tomentose, thin, gray, then brownish-gray azonate; stem tomentose at base, 2.5–6.5 cm. long .... *L. griseus.*

18. Pileus some shade of red .... 19.

Pileus some other color .... 20.

19. Pileus and stem mahogany, shining when moist, umbilicate, expanding, but margin arched, about 4 cm. broad .... *L. nitidus.*

Pileus fulvous, darker in the center, except umbo fading to pinkish, small, fragile .... *L. oculatus.*

20. Pileus pale alutaceous, azonate, convex-umbilicate, 6–15 cm. broad, margin involute for some time; stem 2.5–6 cm. high; gills close, pallid .... *L. pallidus.**

Pileus brown, fading, often umbonate, up to 3 cm. broad, margin striatulate; in marshy places .... *L. paludinellus.*

21. Pileus glabrous .... 22.

Pileus pruinose velvety .... 23.

Pileus rimulose-areolate so as to appear minutely squamulose, brick-red when moist, fading when dry, and surface cracking into minute scale-like areas; gills yellowish, then colored like pileus; milk subwatery; odor and size like *L. camphoratus* .... *L. rimosellus.*

22. Pileus golden-fulvous or brownish-orange, smooth, convex then plane, or slightly depressed, 5–13 cm. broad, surface sometimes cracking; gills white to yellowish, turning brown where injured; odor strong in drying; stout .... *L. volemus.*

Pileus dark red-brown; stem same color; gills yellow to brick-red; odor sweet; plants small .... *L. camphoratus.*

Pileus pale-fulvous; gills pallid; milk mild then bitterish; odor none; plants small .... *L. subdulcis.*

23. Pileus fuliginous-brown, umbonate, center wrinkled, 4–10 cm. broad; stem same color; gills distant; spores white, globose, echinulate .... *L. Gerardii.*

Pileus yellowish-tawny or brownish-orange, 5–10 cm. broad; gills distant, white or cream; spores broadly elliptical, nearly smooth; stem solid, glabrous or pruinose, 2.5 cm. or more high .... *L. distans.**

NEW YORK BOTANICAL GARDEN.

New species of fungi

Charles Horton Peck

Lepiota xylophila

Pileus thin, campanulate or convex, umbonate, minutely squamulose, white or whitish and even on the margin when fresh, becoming brownish with age or in drying, with the umbo darker and the margin widely and distinctly plicate-striate ; lamellae rather narrow, free, denticulate on the edge, minutely pulverulent, whitish, faintly tinged with yellow or greenish-yellow ; stem slender, equal or nearly so, hollow, pale-yellowish or greenish-yellow ; spores elliptic, uniguttulate, 8–12 μ long, 6–7 μ broad.

Pileus 2–4 cm. broad ; stem 2–4 cm. long, 2–4 mm. thick.

On wood of red fir, Douglas fir and redwood. Hawaii. Collected by N. A. Cobb ; communicated by H. von Schrenk.

The species is closely related to *Lepiota cepaestipes* Sow., from which it may be separated by its different colors, its peculiar habitat, the even margin of the fresh pileus, and its stem which is not enlarged at or near the base.

Clitocybe nobilis

Pileus fleshy, convex, sometimes becoming slightly centrally depressed, dry, glabrous, firm, creamy-white becoming buff or brownish with age or in drying, often broadly umbonate and darker in the center, flesh white, taste and odor agreeable ; lamellae thin, close, decurrent, whitish ; stem solid, stuffed, or hollow with a small cavity, tapering upward, somewhat bulbous, glabrous, firm, white or whitish becoming pallid or brownish and striate with age or in drying ; spores elliptic, 7–8 μ long, 4–5 μ broad.

Pileus 7–12 cm. broad ; stem 5–10 cm. long, 6–8 mm. thick.

Solitary or gregarious, in clearings, growing in black vegetable mold or from buried wood or bark. Deer lake, Ontario. August. C. Guillet.

A fine large species of a soft or spongy texture when fresh, but it shrinks much in drying and becomes firm or hard. It apparently belongs to the section *Disciformes*.

Collybia hirticeps

Pileus thin, submembranous, convex, umbilicate, dry, densely clothed with long tufted or matted appressed mummy-brown hairs, which are often somewhat radiately arranged in the fresh plant, giving a sulcate-striate appearance to the margin of the pileus, margin in the young plant and in the mature dried plant strongly incurved; lamellae moderately close, rounded behind, slightly adnexed or free, persistently white; stem long, tough, equal, stuffed with fibrils, tomentose, colored like or a little paler than the pileus; spores globose or subglobose, 4–5 μ long, 4 μ broad.

Pileus 1.5–2.5 cm. broad; stem 5–7 cm. long, 2–3 mm. thick.

Cespitose; decaying wood or branches in woods. Pigeon lake, Ontario. August, 1905. C. Guillet. — Pennsylvania. D. R. Sumstine. Closely allied to *Collybia zonata* Peck, from which it is at once distinguished by its brown color, the entire absence of zones and the longer coarser hair of the pileus.

Omphalia serotina

Pileus submembranous, convex, sometimes slightly depressed in the center or subumbilicate, widely striate on the margin when fresh and moist, slightly striate when dry, grayish-brown, grayish-white or subcinereous; lamellae rather broad, subdistant, adnate or slightly decurrent, white; stem slender, hollow, glabrous, slightly villose-tomentose at the base, pallid; spores narrowly elliptic, 8–10 μ long, 4–5 μ broad.

Pileus 1–2 cm. broad; stem 1.5–2.5 cm. long, 1 mm. thick.

Among fallen leaves in woods. Near Boston, Massachusetts. December. Mrs. E. B. Blackford. A small species somewhat ambiguous in character. When a specimen is placed in water it revives as in specimens of *Marasmius*, but its texture is not tough as in that genus. Neither is the pileus as distinctly umbilicate as is usual in species of *Omphalia*. It appears to be closely related to *Omphalia grisea* Fr., from which its smaller size and purer white lamellae will separate it.

Entoloma murinum

Pileus thin, fragile, conic, convex or nearly plane, umbonate, dry, silky in appearance, glabrous to the touch, grayish-brown or mouse-colored, the thin margin often wavy and split, striate in the dried plant; lamellae thin, close, sinuate, adnate, white becoming pale-pink; stem slender, brittle, equal or slightly tapering upward, straight or flexuous, hollow, white or whitish becoming darker with age; spores angular, uniguttulate, 10–12 μ long, 6–8 μ broad, often with an oblique apiculus at one end.

Pileus 2–3 cm. broad; stem 2–3.5 cm. long, 1.5–2 mm. thick.

Among long grass and sphagnum. Falmouth, Massachusetts. September. S. Davis.

This species is closely related to *Entoloma Peckianum* Burt, from which it is distinguished by its smaller size, more fragile texture, and paler color. The umbo also is darker than the rest of the pileus and the margin in the dried specimens is finely striate.

Entoloma deminutivum

Pileus thin, fragile, convex becoming nearly plane, umbonate, hygrophanous, chestnut-brown or blackish and striatulate on the margin when young or moist, becoming paler and shining when the moisture has escaped, the small umbo darker than the rest of the pileus, odor farinaceous; lamellae thin, narrow, subclose, slightly adnexed, subventricose, white becoming pink; stem fragile, equal or slightly tapering upward, glabrous, shining, white or whitish; spores angular, uniguttulate, 10–12 μ long, 6–8 μ broad.

Pileus 1.3–3 cm. broad; stem 1.3–3 cm. long, 2 mm. thick.

Low damp black soil under trees. Stow, Massachusetts. October. S. Davis.

A small species distinguished from the preceding by its odor, color and hygrophanous character, and from *Entoloma sericeum* (Bull.) Fr., to which it is related, by its umbonate and darker-colored pileus, its white stem and its larger spores.

Eccilia unicolor

Pileus thin, submembranous, conic or very convex, becoming expanded, umbilicate, glabrous, silky, shining, hygrophanous, yellowish-brown and striatulate on the margin when moist, becoming paler or brownish-orange in drying; lamellae unequal, thin, narrow, close, arcuate, decurrent, sometimes serrate on the edge, colored like the pileus; stem externally cartilaginous, straight or flexuous, glabrous, shining, stuffed, pruinose at the top, colored like or a little paler than the pileus, with a whitish mycelioid tomentum at the base; spores angular, uniguttulate, 8–12 μ long, 6–8 μ broad.

Pileus 1–2.5 cm. broad; stem 3–6 cm. long, 1–3 mm. thick.

Gravelly soil in waste places. Falmouth, Massachusetts.

July. S. Davis. The umbilicus is darker at the bottom. The marginal striations persist in the dried specimens.

Eccilia Subacus

Pileus thin, submembranous, conic, convex or expanded, broadly depressed, umbilicate or truncate, smooth and shining when fresh, densely pruinose when dry, white ; lamellae thin, distant, adnate or slightly decurrent, white becoming pinkish ; stem slender, fragile, equal or slightly tapering upward, glabrous, stuffed or hollow, white ; spores angular, uniguttulate, 10–12 μ long, 6–8 μ broad.

Pileus 0.6–2.5 cm. broad ; stem 2–5 cm. long, 1–2 mm. thick.

Gregarious, growing among grass and bushes. Stow, Massachusetts. September. S. Davis.

This species is very closely related to *Eccilia Acus* Smith, but it differs from that species in the even margin of the pileus, in the adnate or but slightly decurrent lamellae, and in the absence of an umbilicus or in having only and rarely a shallow one. The upper part of the stem is sometimes sprinkled with white granules.

Flammula betulina

Pileus fleshy, convex becoming nearly plane, floccose or fibrillose, roughish, viscid when young, subviscid when old, sometimes slightly appendiculate on the margin, buff-colored, flesh white ; lamellae thin, broad, close, ventricose, adnate or decurrent with a tooth, whitish becoming cinnamon-brown ; stem fleshy, fragile, equal, fibrous, stuffed, striate at the top, whitish ; spores elliptic, 6–8 μ long, 4–5 μ broad.

Pileus 5–12 cm. broad ; stem 5–7 cm. long, 6–9 mm. thick.

Decaying wood of white birch. Stow, Massachusetts. October. S. Davis.

In the young plant there is a slight webby veil which sometimes adheres in fragments to the margin of the pileus, but usually it is fugacious. The floccose squamules on the pileus are sometimes concentrically arranged.

Inocybe decipientoides

Pileus rather thin, subconic becoming nearly plane, umbonate, fibrillose, squamulose in the center, grayish or grayish-brown, the umbo brown, flesh white ; lamellae adnexed, ventricose, subdistant, whitish becoming brownish-ferruginous, white on the edge ; stem fragile, equal or nearly so, hollow, shining, fibrillose, striate and whitish at the top, brownish below; spores subelliptic, obscurely angular or slightly irregular, 10 μ long, 6 μ broad.

Pileus 2–3 cm. broad; stem about 2.5 cm. long, 2–3 mm. thick.

Grassy places. Boston, Massachusetts. June. S. Davis. The species is closely related to *Inocybe decipiens* Bres., but it differs in the color of the pileus, in the hollow stem and in the smaller spores.

Naucoria sororia

Pileus fleshy, fragile, convex, broadly umbonate, glabrous, lacunose, subviscid, tawny, often with a slightly darker zone near the margin when moist, even, wavy, or slightly lobed on the margin, flesh firm, watery, white, taste and odor farinaceous; lamellae narrow, close, adnate, whitish becoming darker with age and in drying; stem equal or slightly bulbous, flexuous, fragile, striate at the top, stuffed, pale-tawny, white within; spores elliptic, 10–12 μ long, 6–8 μ broad.

Pileus 5–10 cm. broad; stem 4–12 cm. long, 4–8 mm. thick.

Solitary or gregarious; in open grassy places. Falmouth, Massachusetts. July. S. Davis. This species is related to *Naucoria semiorbicularis* (Bull.) Fr., from which it may be distinguished by its lacunose pileus, its farinaceous odor and taste, and its fragile character, and by its stem being striate at the top.

Psathyrella betulina

Pileus thin, submembranous, fragile, conic or convex, sometimes broadly umbonate, glabrous, atomate, hygrophanous, fuscous or dark-brown when moist, paler when dry; lamellae broad, adnate, subdistant, cinereous becoming black, white on the margin; stem fragile, equal, hollow, glabrous, shining, white; spores black, elliptic, 8–10 μ long, 5–6 μ broad.

Pileus 1.2–2.5 cm. broad; stem 2.5–5 cm. long, 1–2 mm. thick.

Decaying branches of white birch. Stow, Massachusetts. September. S. Davis.

Hydnum sulcatipes

Pileus fleshy but thin, convex or nearly plane, glabrous; aculei slender, subulate, sometimes compressed at the base and occasionally confluent, especially near the margin of the pileus, whitish, about 2 mm. long; stem slender, equal, sulcate, the ridges sometimes branched; spores subglobose or broadly elliptic, 7–8 μ long, nearly or quite as broad.

Pileus 2–3 cm. broad; stem 2–3 cm. long, 3–4 mm. thick.

Ground in woods. Blue Mounds, Wisconsin. August. J. J. Neuman.

This species is remarkable for the peculiar character of the stem. This resembles the stems of some species of *Helvella* and by reason of it I have ventured to give an imperfect description of the species. No notes concerning the colors of the fresh plant were furnished by the discoverer.

Clavaria amethystinoides

Clubs 2–4 cm. tall, with few rather short suberect branches, very pale-lilac, becoming drab-gray in drying, the branches often compressed and rugose, more or less pruinose when dry, the tips commonly acute; spores globose, 8 μ in diameter.

Among sphagnum. Stow, Massachusetts. September. S. Davis.

This species is evidently related to *C. amethystina* Bull. and *C. Schäfferi* Sacc. From the former it is separated by its different mode of branching and its globose spores; from the latter, to which it seems more closely allied, by its simple, not cestipose mode of growth, by the acute or mucronate tips of the branches, and by the pruinose character of the branches, which also are often rugose and irregular.

Peckiella hymenioides

Subiculum thin, downy-tomentose, white, overrunning the hymenium of the host plant; perithecia subglobose, partly concealed by the subiculum, pale-amber becoming blackish-brown; asci slender, cylindric, 8-spored, 60–80 μ long, 5–6 μ broad; spores simple, subfusiform, pointed or acute at each end, 12–15 μ long, 4–5 μ broad.

On the hymenium of *Lactarius uvidus* Fr. Newfane, Vermont. August. Miss G. S. Burlingham. This species is very similar in external appearance to *Peckiella hymenii* Peck, but its asci are much shorter, its spores smaller, and its subiculum thinner. The milk of the host plant was still present at the time when the specimens were collected.

Leotia punctipes

Receptacle subglobose, undulate, gyrose, very lustrous, dark-green, 4–8 mm. broad in the dried specimens; stem slender, 1.8

3 cm. long, 1-3 mm. thick, hollow, dotted with minute dark-green points, green but paler than the receptacle; asci cylindric or subclavate; spores oblong, straight or slightly curved, 15–20 μ long, 5–6 μ broad; paraphyses filiform.

Among sphagnum. Stow, Massachusetts. September. S. Davis.

This species is similar to *Leotia chlorocephala* Schw., from which it differs in its gyrose or undulate receptacle, its punctate stem and its habitat. The stem is not pulverulent and the spores rarely show any vacuoles.

Dothiorella aberrans

Perithecia cespitose, few or many in a cluster, rarely single, globose or subglobose, erumpent, black; spores numerous, broadly elliptic or subglobose, hyaline becoming slightly colored with age, 5–8 μ long, 4–5 μ broad.

Dead branches of papaw, *Asimina triloba* (L.) Dunal. Oberlin, Ohio. May. F. O. Grover.

This species differs from *Sphaeropsis Asiminae* E. & E. in its clustered perithecia and smaller spores; and from *Dothiorella Asiminae* in its black perithecia and its larger spores at length becoming slightly colored. In this character it makes an approach toward the genus *Haplosporella*, to which it might with almost equal propriety be referred.

Helicosporium Tiliae

Tufted or by confluence effused and forming olive-brown patches; hyphae erect, septate, often paler at the top, 5–8 μ thick; spores forming one coil, subhyaline, 5- or 6-nucleate, obscurely septate, 8 μ thick, the coil 20–22 μ broad.

Bark of basswood, *Tilia americana* L. Near Emma, Missouri. September. C. H. Demetrio.

Rhinotrichum Sumstinei

Widely diffused, thin, tawny-brown; hyphae creeping or ascending, sparingly branched, yellow when viewed by transmitted light, septate, the ultimate, and sometimes the penultimate article also denticulate, 8–12 μ broad; spores globose, colored like the hyphae, 12–16 μ in diameter.

Dead decorticated wood. Pennsylvania. D. R. Sumstine.

Armillaria ventricosa (Peck)

Lentinus ventricosus Peck, Bull. Torrey Club **23**: 414. 1896.

Pileus fleshy, convex or nearly plane above, glabrous, shining, white, the thin margin involute, flesh white or whitish; lamellae narrow, close, decurrent, sometimes dentate or denticulate on the edge, whitish; stem short, thick, ventricose, solid or sometimes hollow through erosion by insects, abruptly narrowed at the base, annulate, white or whitish; spores 10–12 μ long, 5–6 μ broad.

Pileus 8–15 cm. broad; stem 5–10 cm. long, 1.5–2.5 cm. in the widest part.

Ground. Alabama. December. L. M. Underwood.— District of Columbia. November. T. A. Williams.

Fresh specimens received from the last mentioned locality indicated that this mushroom belongs rather to the genus *Armillaria* than to *Lentinus.*

GEOLOGICAL HALL, ALBANY, NEW YORK.

INDEX TO AMERICAN BOTANICAL LITERATURE
(1906)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions their kindness will be appreciated.

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Ames, O. Descriptions of new species of *Acoridium* from the Philippines. Proc. Biol. Soc. Wash. **19**: 143–153. 25 S 1906.
Eighteen species are described as new.

Ammidown, L. E. *Blumenbachia insignis* a casual plant at Southbridge, Massachusetts. Rhodora **8**: 225, 226. 24 D 1906.

Arthur, J. C. The paired seeds of cocklebur. Plant World **9**: 227–232. *f. 39.* [N] 1906.

Bailey, J. W. Vancouver Island bryology, no. 1. Bryologist **9**: 95, 96. 1 N 1906.

Bailey, W. W. Our poisonous plants. Am. Bot. **11**: 57–63. N 1906.

Bailey, W. W. Something about names. Am. Bot. **11**: 81–83. D 1906.

Bartlett, H. H. *Juncus compressus* in the province of Quebec. Rhodora **8**: 233. 24 D 1906.

Bean, W. J. South American beeches. Kew Bull. Misc. Inf. **1906**: 379–381. D 1906.

Berger, A. Neue Aloineen und andere Sukkulenten. Notizbl. Königl. Bot. Gart. Berlin **4**: 246–250. 12 N 1906.
Includes a description of *Agave parrasana* sp. nov., from Mexico.

Bessey, C. E. Objects imbedded in trees. Am. Bot. **11**: 54, 55. N 1906.

Birger, S. Die Vegetation bei Port Stanley auf den Falklandsinseln. Bot. Jahrb. **39**: 275–305. *pl. 1, 2 + f. 1.* 8 Je 1906.

Bissell, C. H. A new station for *Asplenium pinnatifidum.* Rhodora **8**: 230. 24 D 1906.

Blumer, J. C. Wild fruits and shrubs of the Priest River valley. Plant World **9**: 240–246. [N] 1906.

Bradshaw, M. F. Common things. Am. Bot. **11**: 55–57. N 1906.

Brandegee, T. S. New species of Mexican plants collected by Dr. C. A. Purpus. Zoe **5**: 231–241. 15 S 1906.

Descriptions of 25 new species in 24 genera, including the new genera *Talinaria* and *Achaenipodium.*

Brandegee, T. S. Plants of California. Zoe **5**: 227–230. 15 S 1906.

Includes descriptions of new species in *Allium*, *Saliva*, *Tetracoccus*, and *Argithamnia.*

Britton, N. L. Recent explorations in Jamaica. Jour. N. Y. Bot. Gard. **7**: 245–250. *f. 43.* N 1906.

Brooks, C. Temperature and toxic action. Bot. Gaz. **42**: 359–375. *f. 1–12.* [30] N 1906.

Brown, N. E. *Xanthosoma cordatum.* Kew Bull. Misc. Inf. **1906**: 7. F 1906.

New species, native of British Guiana.

Burns, G. P. & Hedden, M. E. Conditions influencing regeneration of hypocotyl. Beih. Bot. Centralb. $\mathbf{19}^{1}$: 383–392. *f. 1–4.* 1906.

Chamberlain, C. J. The ovule and female gametophyte of *Dioon.* Bot. Gaz. **42**: 321–358. *pl. 13–15 + f. 1–9.* [30] N 1906.

Chase, A. Notes on genera of *Paniceae.* I. Proc. Biol. Soc. Wash. **19**: 183–192. 8 D 1906. [Illust.]

Includes *Leptoloma* gen. nov.

Clinton, G. P. *Tilletiaceae.* N. Am. Fl. **7**: 47–72. 4 O 1906.

Clinton, G. P. *Ustilaginaceae.* N. Am. Fl. **7**: 3–45. 4 O 1906.

Clinton, G. P. *Ustilaginales.* N. Am. Fl. **7**: 1. 4 O 1906.

Clute, W. N. Wind-distributed seeds. Am. Bot. **11**: 73–75. D 1906. [Illust.]

Clute, W. N. Winged seeds. Am. Bot. **11**: 49–53. N 1906. [Illust.]

Cook, M. T. The embryogeny of some Cuban *Nymphaeaceae.* Bot. Gaz. **42**: 376–392. *pl. 16–18.* [30] N 1906.

Coppedge, R. W. The effect of light on *Melilotus alba.* Trans. Kan. Acad. Sci. **20**[1]: 97–105. 1906.

DeVries, H. Species and varieties: their origin by mutation. Second edition. i–xviii. 1–847. *portrait.* Chicago, 1906.

Edwards, A. M. The examination of certain infusorial earths or clays for the United States Geological Survey. Nuova Notar. **17**: 102–107. Jl 1906.

Edwards, A. M. The magnesian limestone of New Jersey and the search for *Bacillaria* in it. Nuova Notar. **17**: 174–180. O 1906.

Fedde, F. *Eschscholtziae* generis species novae. II. Repert. Nov. Sp. **3**: 27, 28. 31 Jl 1906; — III. Repert. Nov. Sp. **3**: 75, 76. 20 S 1906; — IV. Repert. Nov. Sp. **3**: 105. 20 O 1906; — V. Repert. Nov. Sp. **3**: 183–185. 15 D 1906.

Includes descriptions of 6 new species.

Fernald, M. L. An alpine variety of *Solidago macrophylla.* Rhodora **8**: 227, 228. 24 D 1906.

Fernald, M. L. *Potamogeton spathaeformis* a probable hybrid in Mystic Pond. Rhodora **8**: 224. 26 N 1906.

Fernald, M. L. Twelve additions to the flora of Rhode Island. Rhodora **8**: 219–222. 26 N 1906.

Fernow, B. E. A survey in the tropics [in the high Sierra Maestra of Cuba]. Forestry Quart. **4**: 239–258. D 1906.

Fernow, B. E. List of trees on the Sierra Maestra [Cuba]. Forestry Quart. **4**: 259–269. D 1906.

Fink, B. Further notes on cladonias. VIII. *Cladonia botrytes, Cladonia caespiticia,* and *Cladonia delicata.* Bryologist **9**: 89–91. *pl. 8.* 1 N 1906.

Fink, B. Lichens: their economic rôle. Plant World **9**: 258–265. [D] 1906.

Gager, C. S. Outline study of seeds and seedlings. Plant World **9**: 208–218. [O] 1906.

Gager, C. S. Symbiosis in *Gunnera manicata.* Jour. N. Y. Bot. Gard. **7**: 214–217. *f. 31.* S 1906.

Glatfelter, N. M. Preliminary list of higher fungi collected in the vicinity of St. Louis, Mo., from 1898 to 1905. Trans. Acad. Sci. St. Louis **16**: 33–94. 14 Je 1906.

Greene, E. L. A study of *Rhus glabra.* Proc. Wash. Acad. Sci. **8**: 167–196. 18 D 1906.

Includes descriptions of 24 new species.

Hagen, I. A study of *Tetraplodon australis*. Bryologist **9**: 92–94. 1 N 1906.

Hambleton, J. C. Key to the families of Ohio lichens. Ohio Nat. **7**: 14–16. 12 N 1906.

Harms, H. Eine neue Art der Gattung *Macrolobium* Schreb. (*M. stenosiphon*) aus Columbia. Repert. Nov. Sp. **3**: 51–53. 25 Au 1906.

Harper, R. M. The vegetation of Bald Knob, Elmore County, Alabama. Plant World **9**: 265–269. [D] 1906.

Haynes, C. C. Ten lophozias. Bryologist **9**: 99, 100. *pl. 9*. 1 N 1906.

Heimerl, A. Beiträge zur Kenntnis amerikanischer Nyctaginaceen. Oesterr. Bot. Zeits. **56**: 249–255. Jl 1906; 406–414. O 1906; 424–429. N 1906.

Includes new species in *Mirabilis*, *Boerhaavia* (2), *Bougainvillea*, *Neea* (2), and *Pisonia* (2).

Heller, A. A. Botanical exploration in California, season of 1905 (continued). Muhlenbergia **2**: 105–164. 20 F 1906; 165–176. 1 N 1906.

Includes descriptions of 9 new species in 7 genera, and *Malacolepis* gen. nov.

Heller, A. A. Botanical exploration in California, season of 1906. Muhlenbergia **2**: 177–256. 31 D 1906.

Includes descriptions of 20 new species in 14 genera.

Hemsley, W. B. A new fruit from Uruguay. Kew Bull. Misc. Inf. **1906**: 365, 366. D 1906.

Pouteria suavis sp. nov.

Henshaw, J. W. Mountain wild flowers of America. i–xxi. 1–384. *frontisp.* + *pl. 1–99*. Boston, 1906.

Hillier, J. M. Colorado rubber. Kew Bull. Misc. Inf. **1906**: 218, 219. Au 1906.

Hitchcock, A. S. Notes on grasses. Rhodora **8**: 205–212. 26 N 1906.

Includes new species in *Panicum* (4) and *Glyceria*.

Lorenz, A. Notes on the mosses of Waterville, New Hampshire. Bryologist **9**: 96, 97. 1 N 1906.

McCleery, E. M. Pubescence and other external peculiarities of Ohio plants. Ohio Nat. **7**: 16, 17. 12 N 1906.

MacDougal, D. T. The delta of the Rio Colorado. Bull. Am. Geog. Soc. **38**: 1–16. *map* + *f. 1–6*. Ja 1906.

Macoun, J. The cryptogamic flora of Ottawa. Ottawa Nat. **20**: 177–186. 3 D 1906.

Continued from Ottawa Nat. **12**: 100 (1898); not, of course, from **21**: 100, as stated.

Macoun, J. M. Contributions to Canadian botany. XVII. Ottawa Nat. **20**: 135–143. 15 O 1906; — XVIII. Ottawa Nat. **20**: 162–171. 6 N 1906.

Malme, G. O. A. *Xyrides* austro-americanae novae. Repert. Nov. Sp. **3**: 111–113. 20 O 1906.

Descriptions of 3 new species.

Massee, G. Fungi exotici: V. Kew Bull. Misc. Inf. **1906**: 255–258. O 1906.

Includes new species, in *Calonectria* and *Stilbospora*, from Trinidad.

Massee, G. Revision of the genus *Hemileia* Berk. Kew Bull. Misc. Inf. **1906**: 35–42. *pl.* Mr 1906.

Four species are recognized, including *H. americana* sp. nov., from Costa Rica.

Masters, M. T. *Aristolochia* (*Gymnolobus*) *consimilis.* Kew Bull. Misc. Inf. **1906**: 7. F 1906.

New species, native of British Guiana.

Masters, M. T. *Aristolochia* (*Gymnolobus*) *daemoninoxia.* Kew Bull. Misc. Inf. **1906**: 6, 7. F 1906.

New species, native of British Guiana.

Meeker, G. A little experiment in flower-making. Trans. Kan. Acad. Sci. **20**[1]: 188, 189. 1906.

Merrill, E. D. An enumeration of Philippine *Gramineae* with keys to genera and species. Philipp. Jour. Sci. Suppl. **1**: 307–392. 31 D 1906.

Includes descriptions of 5 new species in as many genera.

Mez, C. Additamenta monographica 1906. Repert. Nov. Sp. **3**: 4–15. 31 Jl 1906; 33–45. 25 Au 1906; 66–71. 20 S 1906; 97–104. 20 O 1906.

Including new American species in *Pitcairnia* (6), *Puya* (12), *Hechtia*, *Deuterocohnia*, *Dyckia*, *Tillandsia* (17), *Guzmania*, *Aniba*, *Persea* (5), *Ocotea* (7), *Ardisia*, *Conomorpha* (2), *Cybianthus*, *Rapanea* (2), and *Clavija*.

Murrill, W. A. Further remarks on a serious chestnut disease. Jour. N. Y. Bot. Gard. **7**: 203–211. *f. 25–30.* S 1906.

Murrill, W. A. A summer in Europe; some foreign botanists and botanical institutions. Jour. N. Y. Bot. Gard. **7**: 221–237. *f. 32–42.* O 1906.

Nelson, A. & Kennedy, P. B. New plants from the Great Basin. Proc. Biol. Soc. Wash. **19**: 155–157. 12 N 1906.

New species in *Sophia*, *Sphaerostigma*, *Godetia*, *Oreocarya*, and *Cryptanthe* (3).

Overton, J. B. The morphology of the ascocarp and spore-formation in the many-spored asci of *Thecotheus Pelletieri.* Bot. Gaz. **42**: 450–492. *pl. 29, 30.* 22 D 1906.

Paris, E. G. Muscinées de la Guiane française (2e article). Rev. Bryol. **33**: 55–58. [Jl] 1906.
Includes new species in *Syrrhopodon*, *Meteorium*, and *Ectropothecium*.

Paris, E. G. Muscinées des Andes de la Nouvelle Grenade. Rev. Bryol. **33**: 102–105. [N] 1906.
Includes new species in *Lepidopilum* and *Rigodium*.

Parsons, H. G. Children's gardens and their value to teachers of botany and nature study. Plant World **9**: 237–239. *f. 38.* [N] 1906.

Pease, A. S. & Moore, A. H. Peculiarities of *Botrychium lanceolatum* in America. Rhodora **8**: 229. 24 D 1906.

Pilger, R. Ein neues *Antiphytum* (*A. Bornmülleri*) aus dem südlichen Brasilien. Repert. Nov. Sp. **3**: 24, 25. 31 Jl 1906.

Preston, H. W. Two editions of Torrey & Gray's Flora of North America. Rhodora **8**: 232, 233. 24 D 1906.

Ramaley, F. The Tokyo botanical garden. Plant World **9**: 251–258. *f. 40–43.* [D] 1906.

Reagan, A. B. Notes on the flora of the Rosebud Indian reservation South Dakota. Trans. Kan. Acad. Sci **20**^{1}: 190–196. 1906.
Includes *Prunus Rosebudii* sp. nov.

Renauld, F. Causerie sur les *Harpidia*. Rev. Bryol. **33**: 89–100. [N] 1906.

Robinson, W. J. The filmy ferns (*Hymenophyllaceae*). Plant World **9**: 219–221. *f. 33–37.* [O] 1906.

Rolfe, R. A. New orchids. — Decade 26. Kew Bull. Misc. Inf. **1906**: 30–34. F 1906; — Decade 27. Kew Bull. Misc. Inf. **1906**: 84–88. Ap 1906; — Decade 28. Kew Bull. Misc. Inf. **1906**: 112–117. Je 1906; — Decade 29. Kew Bull. Misc. Inf. **1906**: 375–379. D 1906.
Includes 12 new American species in 11 genera.

Rusby, H. H. Observations in economic botany made at Oscoda, Michigan. Jour. N. Y. Bot. Gard. **7**: 211–213. S 1906.

Saunders, C. F. Edible pine seeds. Am. Bot. **11**: 87, 88. D 1906.

Saunders, C. F. Mountain misery [*Chamaebatia foliolosa*]. Am. Bot. **11**: 53, 54. N 1906.

Sayre, L. E. The botanical features of the new United States Pharmacopoeia. Trans. Kan. Acad. Sci. **20**^{1}: 185–187. 1906.

Schaffner, J. H. Nodding of the terminal heads of *Silphium laciniatum*. Ohio Nat. **7**: 39. 13 D 1906.

Schaffner, J. H. A successful mutant of *Verbena* without external isolation. Ohio Nat. **7**: 31–34. 13 D 1906.

Schaffner, M. The embryology of the shepherd's purse. Ohio Nat. **7**: 1–8. *f. 1–38.* 12 N 1906.

Schlechter, R. *Orchidaceae* novae et criticeae. Decas IV. Repert. Nov. Sp. **3**: 15–20. 31 Jl 1906; — Decas V. Repert. Nov. Sp. **3**: 45–51. 25 Au 1906; — Decas VI. Repert. Nov. Sp. **3**: 77–82. 20 S 1906; — Decas VII. Repert. Nov. Sp. **3**: 106–111. 20 O 1906.

Includes 25 new American species in 12 genera; of the genera one, *Pittierella*, is new.

Schneider, C. K. Species varietatesque *Pomacearum* novae. IV. Repert. Nov. Sp. **3**: 177–183. 15 D 1906.

Includes a description of *Amelanchier Jonesiana* sp. nov., from Arizona.

Setchell, W. A. A revision of the genus *Constantinea.* Nuova Notar. **17**: 162–173. O 1906.

Three species are recognized, including *C. subulifera* sp. nov.

Setchell, W. A. The Sierran puffball [*Lycoperdon sculptum*]. Sierra Club Bull. **6**: 39–42. *pl. 13.* Ja 1906.

Shreve, F. The Hope botanical gardens. Plant World **9**: 201–207. *f. 29–32.* [O] 1906.

Sodiro, L. Contribuciones al conocimiento de la flora Ecuatoriana. Monografia III. Tacsonias Ecuatorianas. i, ii. 1–31. *pl. 1–4.* Quito, 1906.

This is a revised edition of a paper published in 1903.

Sprague, T. A. & Hutchinson, R. R. *Gurania Eggersii.* Kew Bull. Misc. Inf. **1906**: 200, 201. Au 1906.

New species, native of Ecuador.

Sprague, T. A. & Hutchinson, R. R. *Gurania phanerosiphon.* Kew Bull. Misc. Inf. **1906**: 201. Au 1906.

New species, native of Ecuador.

Stapf, O. *Cervantesia glabrata.* Kew Bull. Misc. Inf. **1906**: 76. Ap 1906.

New species, native of Ecuador.

Tayler, M. E. The germination of the morning glory. Plant World **9**: 246, 247. [N] 1906.

Taylor, N. Botanical notes on the vegetation of the high Maestra [Cuba]. Forestry Quart. **4**: 270–273. D 1906.

Taylor, N. Collecting in the mountains west of Santiago, Cuba. Jour. N. Y. Bot. Gard. **7**: 256–260. N 1906.

Thellung, A. Die Gattung *Lepidium* (L.) R. Br. Eine monographische Studie. Neue Denks. Allg. Schweiz. Ges. **41**: 1–340. *f. 1–12.* 1906.

Tullsen, H. The probable origin of key-fruits. Plant World **9**: 233–236. [N] 1906.

Underwood, L. M. A report on the condition of the tropical laboratory. Jour. N. Y. Bot. Gard. **7**: 250–255. N 1906.

Wangerin, W. Die Umgrenzung und Gliederung der Familie der *Cornaceae.* Bot. Jahrb. Beibl. 86: 1–88. *f. 1–10.* 14 Au 1906.

Wiegand, K. M. & Foxworthy, F. W. A key to the genera of woody plants in winter, including those with hardy representatives found growing wild or in cultivation within New York State. Second edition. 1–33. Ithaca, N. Y., 1906.

Wright, C. H. *Achatocarpus pubescens.* Kew Bull. Misc. Inf. **1906**: 6. F 1906.

New species, native of Ecuador.

Wright, C. H. *Astragalus brevidentatus.* Kew Bull. Misc. Inf. **1906**: 200. Au 1906.

New species, native of the Galapagos Islands.

Wright, C. H. *Bidens simplicifolia.* Kew Bull. Misc. Inf. **1906**: 5. F 1906.

New species, native of Ecuador.

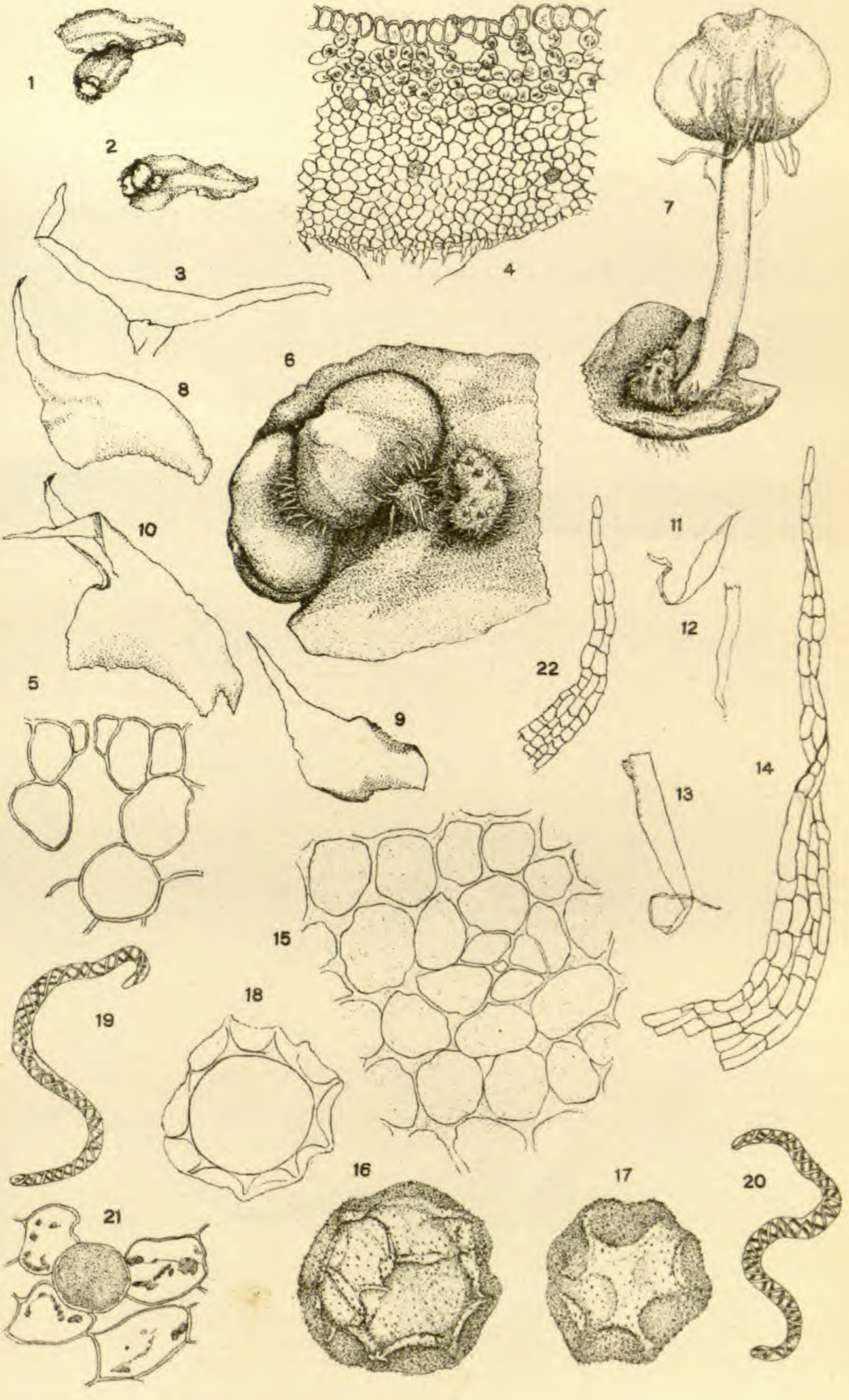
Wright, C. H. *Euterpe Jenmanii.* Kew Bull. Misc. Inf. **1906**: 203. Au 1906.

New species, native of British Guiana.

Wright, C. H. *Euterpe ventricosa.* Kew Bull. Misc. Inf. **1906**: 203. Au 1906.

New species, native of British Guiana.

Yamanouchi, S. The life-history of *Polysiphonia violacea.* Bot. Gaz. **42**: 401–449. *pl. 19–28.* 22 D 1906.



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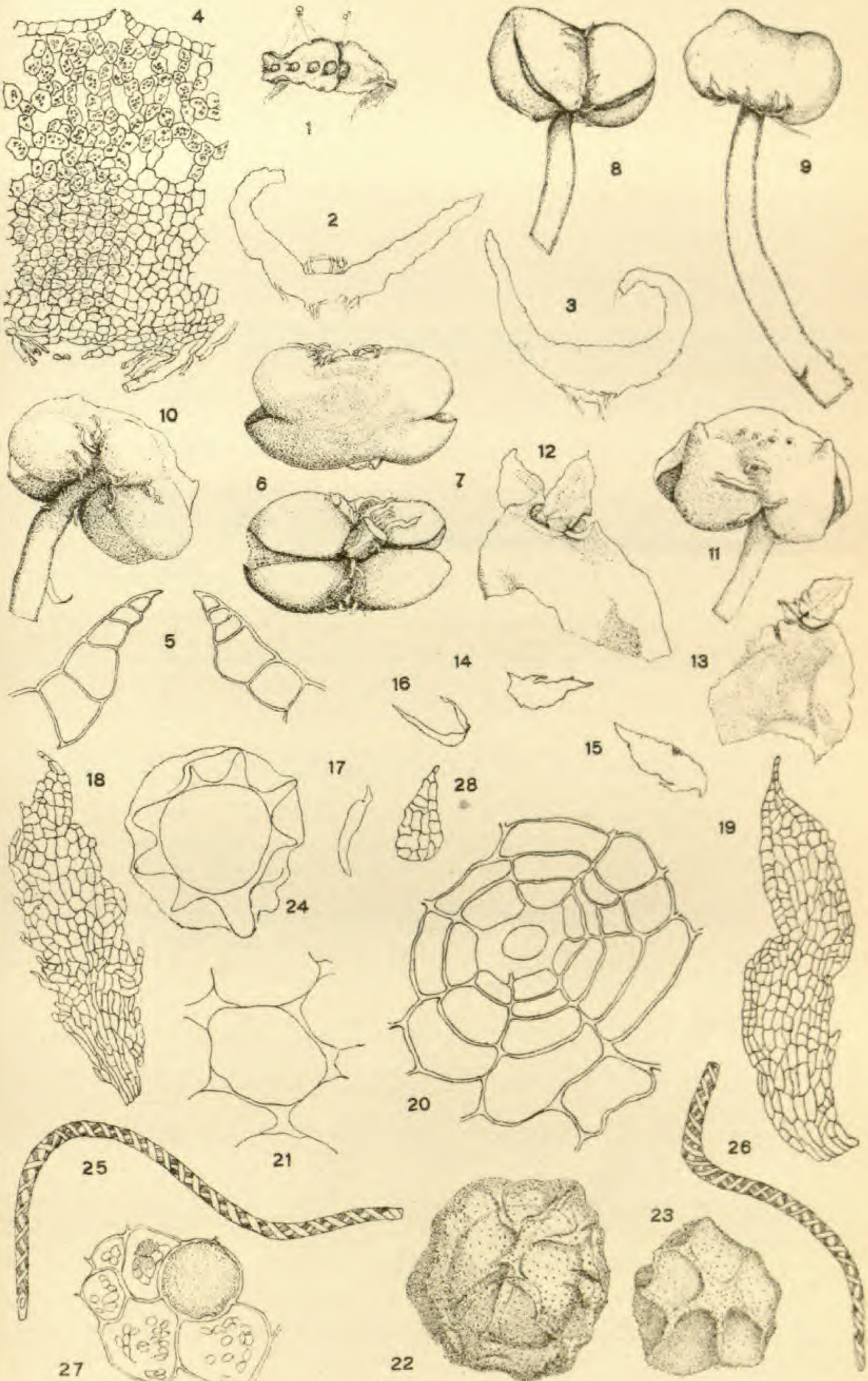

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Martindale, Isaac Comly. Marine algae of the New Jersey coast and adjacent waters of Staten Island. Pages 87–111. 24 Au 1889.

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Spruce, Richard. *Hepaticae* Bolivianae, in Andibus Boliviae orientalis, annis 1885–6, a cl. H. H. Rusby lectae. Pages 113–140. 20 Ja 1890.

Vol. 1, No. 4; price, 75 cents:

Sturtevant, Edward Lewis. On seedless fruits. Pages 141–187. 30 My 1890.

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Halsted, Byron David. Reserve food-materials in buds and surrounding parts. Pages 1–26, *plates 1, 2.* 10 S 1890.

Vol. 2, No. 2; price, 75 cents:

Vail, Anna Murray & Hollick, Charles Arthur. Contributions to the botany of Virginia. Pages 27–56, *plates 3, 4.* 23 D 1890.

Vol. 2, No. 3; not furnished separately:

Holm, Herman Theodor. Contributions to the knowledge of the germination of some North American plants. Pages 57–108, *plates 5–19.* 15 Ap 1891.

Vol. 2, No. 4; price, 75 cents:

Wheelock, William Efner. The genus *Polygala* in North America. Pages 109–152. 30 D 1891.

Vol. 3, No 1; not furnished separately:

Small, John Kunkel & Heller, Amos Arthur. Flora of western North Carolina and contiguous territory. Pages 1–39. 20 F 1892.

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Morong, Thomas. The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74.* 15 Mr 1893.

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Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. [Part 1.] Pages 1–67. 28 Ap 1893.

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CONTENTS

Costa Rican orchids—I. (Plates 7 and 8.) GEORGE VALENTINE NASH 113
An occurrence of glands in the embryo of Zea Mays. CHARLES STUART GAGER 125
American fossil mosses, with description of a new species from Florissant, Colorado. (Plate 9.) ELIZABETH GERTRUDE BRITTON and ARTHUR HOLLICK 139
Studies in the North American Convolvulaceae—III. Calycobolus, Bonamia, and Stylisma . . . . HOMER DOLIVER HOUSE 143
Notes on Carex—II. . . . . KENNETH KENT MACKENZIE 151
Two new willows from the Canadian Rocky Mountains. WILLARD WINFIELD ROWLEE 157
INDEX TO AMERICAN BOTANICAL LITERATURE 161

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Costa Rican orchids — I

GEORGE VALENTINE NASH

(WITH PLATES 7 AND 8)

In the months of April and May, 1906, Mr. William R. Maxon, of the U. S. National Museum, during a furlough from that institution, made, in the interests of the New York Botanical Garden, an exploration of portions of Costa Rica. Much attention was given to the collection of living plants, especially in the families *Cactaceae*, *Orchidaceae*, and *Bromeliaceae*, which furnished many specimens of great interest. The material was carefully collected and excellently packed, so that little harm came to it during the long journey, and it arrived in fine condition.

The orchids were especially well represented. Of many of these no herbarium material was secured, as at the time of collection they were not in flower. A number of these have now come into flower and others will undoubtedly do so, and it is the object of this and succeeding articles to report upon them.

Mr. Maxon gave, in the form of a report to the Director-in-chief of the Garden, an account of his explorations and many of the places visited by him, in the *Journal of the New York Botanical Garden* for August, 1906. As this may be inaccessible to many, the locations of some of the places referred to, which do not appear in the atlases ordinarily at hand, are given here, extracted in the main from Mr. Maxon's published account.

The country was entered at Port Limon, the eastern terminus of the Northern Railway of Costa Rica, which runs in a general westerly direction through the low lands of Siquirres, and then

[The BULLETIN for February 1907 (34 : 57–112, *pl. 5, 6*) was issued 9 Ap 1907.]

south and west along the gorge of the Rio Reventazon, traversing the region of Juan Viñas and Santiago. It then proceeds through Cartago to San José, the capital of the country, beyond which place Mr. Maxon did not proceed by rail. With this place as his base, excursions were made into the neighboring country, including the valley of the Rio Tirivi and the estate of La Palma, a few miles northeast of the city. While here a visit was made to Santo Domingo de San Mateo, at an elevation of about 300 meters, a little to the westward of San José, and the only locality visited west of that city. Mr. Maxon reports it as an exceedingly dry region at the time of his visit, but without a characteristic desert vegetation. A number of orchids were secured here, some of them of exceeding interest.

At Cartago, which has an elevation of about 1450 meters, considerable collecting was done, especially of living plants of orchids and bromeliads. Collections were also made at Santiago, a few miles to the eastward of Cartago. At Turrialba, on the border of the *tierra caliente*, some time was spent, and from that place a trip was made to the low humid forest on the border of the Rio Reventazon, at an altitude of about 600 meters. While at Cartago an excursion was also made to Coliblanco, an estate lying at the base of the volcano of Turrialba. One of the principal excurions while at Cartago was to the Finca Navarro, at an altitude of 1,350 meters. Navarro lies about seven miles to the southeast in a mountain valley a little lower than Cartago, at the junction of the Agua Caliente and the Rio Naranjo. Many of the orchids were secured at this point.

Judging from Mr. Maxon's collections and from recent publications, the orchid flora of Costa Rica must be exceedingly rich. It is to be hoped that explorations so well begun may be continued, for such continuation is certain to yield valuable results. Following are some of the orchids secured by Mr. Maxon, which may be safely reported upon at present.

CORYMBIS FLAVA (Sw.) Hemsley, Biol. Cent. Am. Bot. 3: 297. 1884

Serapias flava Sw. Prod. 119. 1788.
Neottia flava Sw. Fl. Ind. Occ. 3: 1417. 1806.

On moist forested slope, Finca Navarro, *no. 644*. Hemsley, *l. c.*, reports this from Mirador, southern Mexico, and from Chiriqui, Panama. Its detection in Costa Rica, therefore, was to be expected. Mr. Maxon in his field notes describes the flowers as yellow. This species was originally described from Jamaica.

PLEUROTHALLIS POLYLIRIA Endres & Reichenb. f. Gard. Chron. **32**: 1483. 1871

On tree bordering the Agua Caliente, Finca Navarro, *no. 702A*. This pretty species, one of the larger members of the genus, is a free bloomer, sending up usually several racemes from the same leaf. The flowers hang in a somewhat secund manner, giving the inflorescence an appearance resembling that of the lily-of-the-valley.

Originally described from fresh living material sent by W. W. Saunders to Reichenbach, who does not state from what country the plant was derived. A herbarium specimen, collected in Costa Rica by M. Endres, is, however, referred to as being the same, so that the indications are that that country is the native home of this interesting plant.

PLEUROTHALLIS MINAX Reichenb. f. Bonplandia **2**: 24. 1854

? Pleurothallis plumosa Lindl. Bot. Reg. **28**: Misc. 72. 1842.

On a tree bordering the Agua Caliente, Finca Navarro, *no. 707*. I have taken up with some hesitation Reichenbach's name for this plant, instead of that given by Lindley, who originally described the flowers as "green, with a little purple dotting on the inside," and gave the home of his plant as Trinidad. Later (*Folia Orch. Pleurothallis* 27. 1859) he makes this statement: "Flowers green in gardens, orange coloured wild," and refers to his species a specimen collected by Fendler in Venezuela, *no. 2152*, and also material secured by Wagener at Caracas. He further remarks thus: "The dissection of a flower of his *P. minax* given me by Prof. Rchb. and Fendler's specimens show that plant not to be distinct from *P. plumosa*." A specimen secured by Wagener at Caracas, at an elevation of 5000 feet, and presumably the one to which Lindley refers above, was the basis of *P. minax*. The plant which Mr. Maxon secured came into flower in the early part of November of last year, the flowers being of a dull orange, thus closely approaching the "dottergelb" applied by Reichenbach in describing the color of the flowers of his species, and incidentally showing that the Costa Rican plants, at all events, do not produce green flowers in cultivation. So it does not seem possible to reconcile this with the green flowers originally accredited to *P. plumosa*, nor does it seem likely that a plant from Trinidad should be identical with one from an elevation, in practically the same latitude, of 5000 feet. The short velvety pubescence of the peduncle, axis of the raceme, bracts and flowers, and the color and details of the flowers, especially those of the lip, of *P. minax* so closely coincide with those in Mr. Maxon's plant that I cannot but place it there, rather than take up for it the name of *P. plumosa*, as done by Hemsley (Biol. Cent. Am. Bot. **3**: 201. 1883) for a specimen collected by Wendland, also in Costa Rica. Perhaps Lindley was wrong as to the color of his flowers, although he indicates that he was dealing with fresh material, or he may have been mistaken as to the country from which the material came — at all events, it seems better now to adopt for this Costa Rican plant a name which can be applied with some certainty, rather than a doubtful one. A comparison with Lindley's type may some time definitely settle the question.

ISOCHILUS LINEARIS (Jacq.) R. Br. in Ait. Hort. Kew. ed. 2. **5**: 209. 1813

Epidendrum lineare Jacq. Select. Stirp. Am. Hist. 221. *pl. 131. f. 1.* 1763.

Partially shaded rocky bank, Santiago, *no. 108*. Widely distributed in tropical America, but originally described from Martinique.

PONERA AMETHYSTINA Reichenb. f. in Saund. Ref. Bot. *pl. 93*. 1869

Santo Domingo de San Mateo. On tree-trunk by Rio Machuco, *no. 545*; and on tree trunk near Rio Grande, *no. 570*. This region is described by the collector as an exceedingly dry one but without a characteristic desert vegetation. An interesting find. The plant was originally figured and described from living material, secured by Mr. Skinner at Santa Fé de Veraguas, Panamà, which flowered in the collection of Mr. W. W. Saunders. Its detection in the above locality extends its range considerably to the north and west of its place of discovery. The flowers in our specimens have the sepals and petals more acute and the terminal lobe of the lip somewhat narrower than indicated in the plate referred to above, but they agree essentially in all the other particulars. The hollow at the base of the column, represented in the drawing and rather questionably referred to by Reichenbach, is quite manifest in the flowers of the Costa Rican plant. The lip, however, has no such hollow at the base, but, on the contrary, is noticeably thickened at that point.

EPIDENDRUM COCHLEATUM L. Sp. Pl. ed. 2. 1351. 1763

On trees in humid forest, Santiago, *no. 101*. On tree-trunk in forest, Turrialba, *no. 179*. Quite widely distributed in tropical America, ranging from southern Mexico to Venezuela, and common in the West Indies; also frequent in southern Florida.

The type locality is the Bahamas. Linnaeus appears to have had two things in his species. He gives three citations, as follows: Sloane, Jam. 250. *pl. 121. f. 2*; Catesby, Car. 2: 88. *pl. 88*; and Plum. Pl. Am. Icon. *pl. 185. f. 2*. In his description he says: "nectario cordato." This effectually disposes of the first citation above, as that figure has a broadly obcordate or almost orbicular lip. The plant is figured, moreover, with very short round pseudobulbs, and has the sepals and petals represented as much broader and of a different shape than those in the plant commonly accepted as this species. The flowers are also described by Sloane as "reddish purple." One could hardly mistake this figure for what is commonly known as *E. cochleatum*. The other two figures cited represent what has been widely known as this species, that of Catesby being in color and allowing of no doubt. The lip is also decidedly cordate, as called for by Linnaeus, thus permitting us to retain the common conception of this species. Catesby's plant was from the Bahamas, and Plumier gives no origin for his, but cites Catesby's plate; the type locality is thus pretty clearly as indicated above.

EPIDENDRUM OCHRACEUM Lindl. Bot. Reg. **24**: Misc. 14. *pl. 26.* 1838

On trees in humid forest, Santiago, *no. 104.* First received by Lindley from the garden of Sir Charles Lemon, who received the living material from George U. Skinner, who had collected it in Guatemala. It is widely distributed in Central America.

EPIDENDRUM PALEACEUM (Lindl.) Reichenb. f. Beitr. Orch. Cent. Am. 80. 1866

Dinema paleaceum Lindl. Bot. Reg. **26**: Misc. 51. 1840.
Epidendrum auritum Lindl. Bot. Reg. **29**: Misc. 4. 1843.

On branches of fallen tree-tops, Turrialba, *no. 164.* Rather extensively distributed from Guiana to southern Mexico, and originally described from Guatemalan material. This is the second time this little species has been brought to us by collectors; Mr. Percy Wilson secured it in Honduras in 1903. It is interesting to note that Wendland also obtained specimens of this plant at Turrialba in 1857.

LAELIA RUBESCENS Lindl. Bot. Reg. **26**: Misc. 20. *pl. 41.* 1840

Under cultivation in the garden of Mr. P. Biolley, at San José, *no. 358.* Mr. Biolley secured the plant in January of the same year at Uricuaja, on the Pacific coast, at an altitude of about 200 m. When this species was first described its native country was unknown, but it was supposed to be Mexico, a supposition which was later verified. Owing to the variability of its flowers and pseudobulbs, two species described subsequently by Lindley, *L. acuminata* and *L. peduncularis*, are usually referred here. Under this broad conception it ranges from Mexico throughout Central America to Costa Rica.

EPIDENDRUM STAMFORDIANUM Batem. Orch. Mex. & Guat. *pl. 11.* 1838

On horizontal branch of a tree, Santo Domingo de San Mateo, *no. 600A.* This came mixed with a fine plant of *Schomburgkia* sp. (*no. 600*). Another specimen, *no. 355*, which was under cultivation at San José, was also secured from Mr. P. Biolley, in whose garden at that place it was. Mr. Biolley secured it at Uricuajo, at an altitude of about 200 m., on the Pacific coast, in January of the same year.

The species was originally found by George U. Skinner along the shores of Lake Izabal, near Izabal, Guatemala. He sent plants in 1837 to England, where they flowered the following year, furnishing the material from which the original description and illustration referred to above were drawn. The flowering of this plant caused considerable excitement among the orchidologists of that day, as it was the first member of the genus known in which the inflorescence was not borne at the apex of the leafy stem. In this species, as well as in several others, the inflorescence is borne upon a leafless stem arising from the base of the leafy pseudobulb.

Mr. Skinner remarks (Batem. Orch. Mex. & Guat. *l. c.*) that the plant is known in its native country as "quartorones," in allusion to the four colors of its blossoms. The flowers of the plants which have blossomed in the New York Botanical Garden have undergone remarkable changes in color as they faded, the white of the lip passing into yellow and buff, and various combinations of these, produced by stripes, spots and blendings.

Elleanthus caricoides sp. nov. (PLATE 7)

A densely tufted plant, smooth and glabrous with the exceptions noted below, with numerous gracefully drooping slender stems. Stems 4 dm. long or less, round, about 1.5 mm. in diameter at the base, sparsely spotted with purple : leaves 5–7 ; sheaths grooved, much shorter than the blades, spotted with purple, the lower 2 or sometimes 3 soon turning brown, bladeless or with but rudimentary blades; blades flat, about 7-nerved, erect, somewhat twisted and recurved above the base, linear-lanceolate to linear, shining, long-acuminate at the apex, narrowed toward the base, 1–2 dm. long, the lowermost sometimes a little shorter and the one immediately below the inflorescence often but 4–6 cm. long, 7–8 mm. wide : inflorescence 2–3 cm. long, on a peduncle less than 1.5 cm. long, the bracts, the lowermost one of which is usually empty, ovate-lanceolate, green, apparently spirally arranged, long-acuminate, 2–3 times as long as the flower, nearly erect and somewhat recurved above the middle ; flowers, including the ovary which is 2–3 mm. long and more or less appressed-pubescent with black-brown hairs, about 1 cm. long, gibbous on one side : lateral sepals 7–8 mm. long, about 3 mm. wide, oblong to oblong-oval, rather abruptly contracted above into a laterally compressed and keeled apex, more or less pubescent on the back with black-brown deciduous hairs, about 5-nerved; dorsal sepal 5–6 mm. long, and about 2 mm. wide, the compressed apex much less prominent: petals oblong-linear, somewhat dilated at the rounded and apiculate apex, 6–7 mm. long, 1.5–2 mm. wide: lip nearly campanulate, completely surrounding the column so that its margins meet, about 7–8 mm. long, when spread out 10–12 mm. wide at the truncate and sparingly ciliate apex and 5–6 mm. wide at the base, a 2-ridged crest just below the middle, the two appendages near the base of the lip oblong, papillate, 1.5–2 mm. long and about 1 mm. wide: column 7–8 mm. long, 4-toothed at the broadened apex.

On the lower horizontal branch of a tree bordering the Agua Caliente, in the humid region, upon the Finca Navarro, *no. 692*.

CATASETUM MACULATUM Kunth, Syn. Pl. Aequin. 1: 331. 1822

Cultivated at San José, *no. 352*. Another species which Mr. Maxon secured from Mr. Biolley, who secured it at San Mateo, on the Pacific coast. It flowered with us first on November 23 of last year. This material very closely agrees with the description of Kunth, also with the details of the figure published (H. B. K. Nov. Gen. & Sp. **7**: *pl. 630*). The parts are not so green as called for in that description, and this perhaps accounts for Mr. Maxon receiving the plant under the name of var. *luteopurpurata* Cogn., a name, however, of which I can find no record of publication. Mr. Percy Wilson, who visited Honduras in 1903 in the interests of the New York Botanical Garden, also obtained living material of the same species which has flowered at the Garden.

Catesetum maculatum was found first near Turbaco, Colombia, at an altitude of about 324 m. I cannot think, however, that the *C. maculatum* of Bateman (Orch. Mex. & Guat. *pl. 2*) is the same thing, for the setae of the column are described and figured as very short, quite different from the very long ones in the true *C. maculatum* Kunth. The *C. maculatum* of Lindley (Bot. Reg. **26**: *pl. 62*. 1840) seems to be different also; the color of the flowers is quite different and the petals are entire, while in the plants from Costa Rica and Honduras these parts are decidedly serrated, thus agreeing with the original description of Kunth.

CYCNOCHES ROSSIANUM Rolfe, Gard. Chron. 69: 456. 1891

On tree-trunk at border of forest, vicinity of Rio Reventazon, Turrialba, *no. 172*. A most interesting find. Rolfe drew his description from material secured from a plant which flowered in the collection of Signor H. J. Ross, Poggio Gherardo, Florence, Italy, in 1889. This plant was purchased for *C. Warscewiczii*, quite another species with pure green staminate flowers, represented by a living plant in the collections of the New York Botanical Garden. The native country of the original plant of *Cycnoches Rossianum* was not known, and it is interesting to have its home thus revealed. The plants which Mr. Maxon brought back with him have produced up to the present time only staminate flowers, which agree with the description given by Mr. Rolfe.

The staminate racemes are long and slender, in the Costa Rican plant measuring up to 6 dm. long with the flowers rather scattered. The sepals and petals are yellowish-green, heavily blotched with purple-brown, as described by Rolfe, who says further that the pistillate raceme he examined had but a single flower which was about twice the size of the staminate flowers and of a uniform green color with a slightly darker shade on the lip.

XYLOBIUM FOVEATUM (Lindl.) Stein, Orchideenb. 597. 1892

Navarro, *no. 674*. This was originally described from plants secured in Demerara. Cogniaux (Mart. Fl. Bras. 3^5: 470) gives its range as extending to Venezuela, Peru and Colombia. While the Costa Rican material differs somewhat from the South American plant, judging from descriptions, it seems best for the present to refer it to the same species.

Maxillaria Valenzuelana (A. Rich.)

Pleurothallis Valenzuelana A. Rich. in Sagra, Hist. Cuba **11**: 234 1850.

Dicrypta iridifolia Batem.; Loud. Hort. Brit. Sec. Add. Suppl. 630. 1839. Name only.

Maxillaria iridifolia Reichenb. f. Bonplandia **2**: 16. 1854.

On tree trunk, Cartago, *no. 53*. Cogniaux (Mart. Fl. Bras. 3^6: 78) gives the distribution of this plant as extending from Brazil to Colombia and Cuba. Its discovery in Costa Rica therefore extends the range to the continent of North America.

As indicated above in the synonymy, the first name applied to this plant is a nomen nudum ; the origin of the plant was attributed to Trinidad. The first adequately published name seems to have been *Pleurothallis Valenzuelana*, described from Vuelta de Abajo, western Cuba. Reichenbach, *l. c.*, states that his plant came from Cuhobas, Cuba, and indicates that it was collected by Pöppig. Pöppig employed his time as a botanical collector and physician, his botanical activities being principally confined to Matanzas and S. Elena, near Cahoba and the territory to the south and the southwest (Urban, Symb. Ant. 1 : 130). The type locality of this plant is, therefore, whether one adopt the name of Richard or that of Reichenbach, western Cuba.

Zygostates costaricensis sp. nov. (PLATE 8)

Plant grayish-green. Stem very short : leaves grayish-green ; lower ones widely spreading, the upper ones ascending to erect ; sheaths equitant, 1–2 cm. long, their margins hyaline ; blades articulated to the sheath, inequilaterally lanceolate or oblong-lanceolate, sometimes slightly falcate, acute, laterally compressed, 1.5–4 cm. long, 4–10 mm. wide : inflorescence axillary, racemose, the rachis densely hispid with spreading hairs of variable length, the spreading bracts, both those at the base of the rachis and those subtending flowers, broadly ovate to orbicular, acute, about 2 mm. long, partly clasping the rachis, ciliate on the margin with glandular hairs : flowers not crowded, on hispid pedicels which are shorter than the bracts : sepals free, orbicular, wing-keeled on the back, about 2 mm. in diameter, obtuse, the keel ciliate with a few teeth, the body of the sepals on the back sparingly hispid : petals orbicular, about 2 mm. long including the short claw, keeled and sparingly hispid on the back : lip papillose, incurved and arching over the flower, concave, 4–5 mm. long when straightened out, green at the base, slightly dilated above where it is about 1 mm. wide when spread out, acute at the apex : the 2 appendages about 1 mm. long, spreading like a ram's horns, white, papillose, flattened, somewhat dilated toward the obtuse apex : column very slender and weak, bent back, geniculate, the rostellum with a long crooked beak which is recurved into a semicircle about the middle : anther of the general shape of the rostellum and somewhat exceeding it in length, and with a recurved tip : pollinia 4, on a long slender stipe which is bent back upon itself toward the apex.

On tree-trunk in forest, Finca Navarro, *no. 680*. The most interesting plant revealed thus far in Mr. Maxon's collections.

The herbarium material of this plant brought back still had the old racemes attached, but all the flowers were missing, so it was impossible to place it satisfactorily. Fortunately Mr. Maxon succeeded in securing some good living plants. These throve and came into flower in October of last year. This supplied the needed material for a definite determination of the plant. It was interesting to find that it belonged to the genus *Zygostates*, known hitherto only from Brazil and Paraguay, and that it was also an undescribed species. Another genus is thus added to the orchid flora of North America.

Zygostates is closely related to *Ornithocephalus*, which ranges from northern South America and Trinidad through Panama and Central America, with one or two outlying species in Asia and Australia. It is distinguished from *Ornithocephalus* by the two appendages near the base of the column. The structure of the column and the unusual lip of this Costa Rican member of the genus differ considerably from the same organs in other species of the genus, but it seems best, at least for the present, to refer it here.

WARSCEWICZELLA WENDLANDII DISCOLOR Reichenb. f. in Warn. & Will. Orch. Alb. 3: *pl. 126.* 1884

On trees in humid forest, Santiago, *no. 105*; on tree-trunk, Cartago, *no. 55*. This interesting color-variation, in which the sepals and petals are pale-green instead of white, was first noted in a plant that flowered in the collection of Mr. A. H. Smee, in England. It is a very desirable plant, as it flowers freely, and for a long period. The contrast of the lavender of the lip with the pale-green petals and sepals is most effective. It also has the added value of a pleasant perfume.

NEW YORK BOTANICAL GARDEN.

Explanation of plates 7 and 8

PLATE 7. ELLEANTHUS CARICOIDES Nash

1. Apex of stem, natural size. 2. Flower, dorsal view, $\times$ 3. 3. Flower, lateral view, $\times$ 3. 4. Sepals, $\times$ 3. 5. Petals, $\times$ 3. 6. Lip, $\times$ 3. 7. Lip, spread out, $\times$ 3. 8. Column, anterior view, $\times$ 3. 9. Column, lateral view, $\times$ 3. 10. Pollinia, $\times$ 8.

PLATE 8. ZYGOSTATES COSTARICENSIS Nash

1. Plant, natural size. 2. Flower, lateral view, $\times$ 16. 3. Flower, from above, $\times$ 8. 4. Sepal, $\times$ 16. 5. Petal, $\times$ 16. 6. Appendages, column and anther, $\times$ 16. Anther, from below, $\times$ 16. 8. Anther, from above, $\times$ 16. 9. Pollinia, $\times$ 16.

An occurrence of glands in the embryo of Zea Mays

Charles Stuart Gager

The embryo of the grasses is an ancient battle-ground. Controversies over the homology of its various parts, and over their several functions, have been waged almost continually since the last half of the seventeenth century, when Malpighi[6] first described its anatomy. Its study formed part of the basis on which Schleiden[9] and Schacht[8] concluded that plant embryos originate in the end of the pollen-tube, while the embryo-sac serves only to protect and nourish them. By its study, in part, Mirbel and Spach,[7] and Brongniart[1] were led, on the other hand, to a diametrically opposite conclusion, namely, that the embryo originates in the embryo-sac, and that only after fecundation by the pollen.

The battle has waged fiercely over the indentification of the true cotyledon. The term scutellum (little shield), merely descriptive, harks back to Gaertner,[3] in 1788. His studies on the fruits and seeds of plants were considerably colored by his investigations of the eggs of animals, and he interpreted the shield-shaped organ in the grass embryo to be analogous to the vitellus, or nutritive part, of the animal egg. Hence he referred to it as "*vitellus scutelliformis*," or, briefly, *scutellum*. That he recognized it as really homologous with the cotyledon in other families is evidenced by the term "*scutellum cotyledoneum*" which he also employed.*

The literature shows some diversity in the significance with which the term scutellum is employed. Most authors use it, as Gaertner originally did, to apply to the entire organ, but at times its meaning has been narrowed† to the outer layer of cells, or epithelium of the shield. There seems to be little warrant and small gain in this latter restriction of it use, and the practice should be discouraged.

* "Singularem hanc Vitelli speciem, proprio *Scutelli cotyledonei* nomine distinguimus." Gaertner[3] (page cxlix).

† Brown and Herron. Jour. Chem. Soc. Lond. Trans. 35 : 623. 1879.

A discussion of the various interpretations that have been given since the time of Gaertner as to the homology of its parts, would not be germane to this paper.* Goebel,[4,5] in 1895 and 1900 on the basis of Bruns's[2] work and of his own study of *Streptochaeta*, interprets it as a true cotyledon, while "the epiblast, which lies over against it, but is not present in all grasses, is an arrested leaf," and the coleoptile, or sheath of the plumule, is the third leaf. The first green leaf is the fourth leaf of the plant. Thus the view most generally held at the present time closely agrees with that put forward by Malpighi in 1675.

Questions of function have been fully as puzzling as those of structure, if not more so, and this, too, notwithstanding the opportunities for solution by the method of experiment.

As early as 1845, Schleiden[53] regarded the scutellum of the oat as an organ of absorption, and was followed in this view by Schacht[52] and Sachs.[48,49] It was Sachs who first pointed out the fact that the embryo, in its earlier stages of development, lives as a parasite on the endosperm, and we owe to him the term "absorptive epithelium," as applied to the outer layer of cells of the scutellum.

Three principal regions are concerned in the nourishing of the germinating embryo. These are the scutellar epithelium, the aleurone layer, and the remaining cells of the endosperm.

Dutrochet had shown that starch, as such, could not pass through semi-permeable membranes, like the cell-walls of plants, by osmosis, and thus the conclusion was forced that the food stored in the endosperm must be transformed before it could become available to the awakened embryo.

The earliest idea to develop in this connection was that the effective agent in this transformation was gluten. Fabroni, in 1785, is said † to have isolated from grape-juice a gluten-like, adhesive matter, without which fermentation did not take place. Thenard,† experimenting with several fruits, confirmed Fabroni's experiment, and considered the glutinous matter, isolated by filtering fruit juices, as identical with yeast. Thus the attention of chemists and physiologists was naturally directed to gluten as indicated above.

* The different theories have been discussed by Van Tieghem.[10,11,12]

† Cited by Thomson[55] (1818), page 291.

In the same year (1785), Irvine[30] pointed out the fact that, in malting, not only did the malt become sweet, but the endosperm of crushed seeds, when mixed with the malt, also became converted into sugar.

Further advance seemed to await the discovery, by Colin and Claubry,[19] in 1814, that starch is colored blue by iodine.* This discovery became a great aid in endosperm studies.

In the following year Kirchhoff,[31, 32] on the basis of his experiments, concluded that the gluten accomplishes the formation of sugar in germinating seeds, and in farina that has been scalded with hot water. He also stated that the gluten attains through germination the property of transforming into sugar a much greater quantity of starch than is to be found in the seeds, and further clearly saw that the production of sugar in germinating seeds is a chemical process, and not a consequence of vegetation.

Experiments of a similar nature to those of Kirchhoff led Thomson,[55] in 1818, to the extreme view that the essential constituent of yeast is "a species of gluten," and "that it is some substance connected with the gluten that acts upon the starch, and converts it into sugar.

The studies of Proust[43] and of Saussure,[50] in 1819, and of Dombasle,[20] in 1820, on the conversion of starch to sugar by the action of gluten, contributed only slightly to the solution of the real question, but thirteen years later, in 1833, Biot and Persoz[13] announced the discovery of dextrine, which they had produced from starch by the influence of acids.† Vogel,[58] by similar means, had, in 1812, produced what was probably the same substance, but its name and the recognition of its true nature must be attributed to Biot and Persoz.

Previous to this, Braconnot,[15] in 1824, isolated a "special principle" which changed to sugar the starch from tubers of *Helianthus tuberosus*, and in the same year in which dextrine was discovered, Saussure[51] isolated from wheat endosperm a substance similar to Braconnot's "special principle," and which alone could

* Scholz (Jour. für Chem. und Phys. 12: 349. 1814. Footnote) attributes this discovery to Stromeyer, but gives no citation.

† Raspail,[46] who discovered the mark, or "hilum" on starch-grains, stated his belief in 1826, that "the carbonic-acid of the air is sufficient to effect the transformation of starch to sugar" (page 335).

convert into sugar four times its weight of starch. These studies, and that of Payen,[35] in 1824, paved the way for the discovery of diastase by Payen and Persoz[38] in 1833. This substance, its discoverers announced, could convert into dextrine 2,000 times its own weight of starch.

Later (1843, 1846) Payen[36, 37] demonstrated that starch must be altered "by water and diastase" before it can pass through cell-walls, and that only after being thus altered can it pass from tissue to tissue. The question now became, What is the source of the diastase by which, in germination, the endosperm is digested?

Raspail[45] had shown, in 1825, that, in germination, the endosperm gradually lost its starch, while the enlarging embryo became gradually enriched with starch-grains, and, in 1862, Sachs[48] observed that, in the germination of grass-embryos, the change of starch to sugar "begins on the side of the endosperm which lies next to the absorbing scutellum." He also demonstrated that the products of the solution of the endosperm are translocated to the germ, and homologized the scutellar epithelium "with the organ of the same name on the cotyledons of palms, and with the young epidermis of the *Ricinus* cotyledon . . . ."

From this time on, beginning with Bloziszewski,[14] in 1875, there have followed a number of researches on the germination of grass embryos deprived of endosperm, and on the ability of isolated embryos to utilize artificial endosperm. Among the earlier and more extensive of these investigations, are those of Brown and Morris,[16, 17] who demonstrated in 1888 the possibility of growing grass embryos on artificial endosperm, and, in 1890, showed that, at the beginning of germination, starch first reappears in the cells of the scutellum immediately under the epithelium. Its first appearance here, being coincident with the earliest stages of the depletion of the endosperm, was taken as evidence that it came from the latter.

The fundamental investigations as to whether or not the diastase could diffuse through cell-walls and, therefore, would not necessarily have to be secreted by the cells where it is to act, was not made until 1894, when Grüss,[23] with results contrary to those of Krabbe,[33] in 1890, demonstrated the possibility of such diffusion.

The work of Grüss indicated that the statement of Brown and Morris (1890), "that the disappearance of the cell-wall always precedes any visible attack upon the contained starch granules," is not true in all cases.

It would lead too far afield to review in detail the subsequent literature upon this topic. Experimental researches have led to at least five different views as to the place of origin of the digestive ferment during the germination of grasses. They may be briefly summarized as follows:

1. *The cells of the aleurone layer chiefly secrete the diastase*, which acts on the starch in the endosperm. This is the statement, in a more modern terminology, of the old view that starch is turned to sugar by gluten. It was tacitly assumed by Tschirch,[57] in 1889 (page 181, legend of *f. 63*).*

2. *The epithelium of the scutellum is the principal secreting layer.* This is the view of Brown and Morris,[16] in 1890,† of Grüss,[22] in 1893 (page 291), and, by implication, of Reed,[47] in 1904. According to Brown and Morris, a diastase that dissolves cell-walls is also secreted by these cells.

3. *The endosperm is the main source of the ferment*, according to Green[21] (1890), Krabbe[33] (1890), and Linz[34] (1896). "The diastase," says Krabbe, "is generally not translocated, but develops directly at the place of its activity." Secretion by the endosperm results "in consequence of some kind of stimulus on the part of the seedling." This last assertion was contradicted by Pfeffer[39] in 1893. Linz[34] definitely states (page 301), "that the epithelium of the scutellum of the seed of maize is not in a condition to secrete ferment, [and] that the epithelium is rather an apparatus which serves for the absorption of dissolved nutriment." Further on (page 318) he says, "The aleurone layer is not the source of the diastase which appears in the endosperm during germination."

4. *The scutellum and the endosperm secrete diastase*, but not so

* The notion that pure gluten can change starch to sugar is now, of course, demonstrably erroneous, but whether or not the cells of the gluten- or aleurone-layer in the grass-fruit can secrete a diastatic ferment is a different question.

† Brown and Escombe[18] (page 14) demonstrate the hydrolytic capacity of aleurone-cells of barley, the capacity of this layer for endosperm-depletion, and that such capacity on the part of the endosperm-cells is very probable.

the aleurone layer. This view is stated by Pfeffer,[40] in 1900, (page 599), who calls the diastase secreted by the scutellum "accessory diastase," and says its secretion may always be regulated by the needs of the plant. This conclusion is based in part upon the experimental demonstration that isolated bits of endosperm placed in contact with water become spontaneously depleted. In these experiments, the disappearance of the starch proceeds centripetally from the surface of the endosperm in contact with the water.

5. *All storage tissues are capable of auto-depletion,* according to Puriewitsch.[44] This conclusion was based upon studies of the endosperm and cotyledons of various seeds, and the contents of roots, bulbs, rhizomes, tubers, and other stems. In 1896 Grüss[25] states that "It is well known that the endosperm cells themselves secrete a ferment during germination" (pages 408, 422). This, together with his paper of 1895, indicates that his position then should be classed here, but in 1897 (page 664) he says: "Seedlings from which one has taken the endosperm may, without the aid of bacteria, nourish themselves upon starch paste, which thereby becomes changed to sugar." This, however, does not necessarily imply a change from his preceding position.

In addition to the above views, may be mentioned that of Wigand,[59] who in 1888, attributed a diastatic function to the aleurone layer, but only through the mediation of bacteria developing in it; and Hansteen's,[29] founded upon extensive though insufficiently guarded experiments, that it is not necessary for diastase to proceed from the scutellum during germination.

In 1890, Haberlandt[26] stated (page 48) that "The aleurone layer of the grass-endosperm, and presumably also of seeds of other plants, is henceforth to be classed with the digestive glands of insectivorous plants," and in 1904 he states (page 477) that "its histological structure, in connection with the experimental fact that the isolated gluten layer richly secretes diastase, forms the ground for my notion concerning the function of that layer." It is interesting to note that, in this last mentioned work, the pendulum has swung back to the original idea, advanced by Kirchhoff ninety years previously, that in germinating seeds the gluten is a source of the agent that changes starch to sugar. It hardly seems probable that Haberlandt's view will finally stand.

The work of Brown and Morris indicates that the endosperm of the grass fruit is dead, but the only inference warranted by the papers of Green, Krabbe, Hansteen, Pfeffer, and Linz is, as Linz definitely states (page 312), that it is alive.

The most obvious conclusion to be drawn from this review of the literature is that there is still need for further careful experimental investigation of the subject, in which every precaution shall be used to exclude bacterial contamination, and other sources of error. Such work has been done with the date seed by Pond,[42] whose experiments seem to leave little doubt that the date-endosperm, at least, is incapable of self-digestion.*

The facts of teratology have frequently thrown light upon normal structure, helping to establish the homology of an organ whose interpretation would otherwise remain in doubt. From the fact that structure is an expression of function, anatomical variations in the direction of a structure whose rôle is well understood, may quite justifiably be taken, in connection, of course, with other facts, as evidence of the probable function of the part that varies. It was with considerable interest, therefore, in the light of our present knowledge of the homology and physiology of the parts of the fruit of the *Gramineae*, that the writer, in an examination of cross-sections of the corn grain, observed a variation in the scutellar epithelium, the significance of which can scarcely be questioned.

This tissue, one cell thick, and variously called the "absorptive epithelium" and the "glandular epithelium," is, as is well known, clearly defined anatomically from the adjacent tissue on either side. The shape of its cells, narrow and oblong in section, their palisade arrangement, and the appearance of the protoplasm, granular and relatively dense in the resting seed, more vacuolated as germination begins, and with a well defined, vigorous nucleus, clearly distinguish it. Normally it forms an unbroken layer over the convex surface of the scutellum.

In the sections examined, this layer was found invaginated in places, in such a way as to form small pockets or sacs in the tissue of the scutellum. On one side there were two such structures, and on the other side one, with a slight suggestion of an unfinished

* A conclusion contrary to that reached by the same author[41] in 1904, when there was failure to observe certain necessary precautions of method.

fourth. The diagram (FIGURE 1), shows the location of these structures in the scutellum, while they are shown in detail in the photomicrographs, FIGURES 2 and 3. Two of them, as may be seen in the diagram, are of practically uniform diameter throughout, while the other and larger one is enlarged at the end.

Describing the scutellum of the corn in 1902, Torrey[56] says: "At the region of the tip this secretory epithelial layer dips down at frequent intervals into the scutellum. The convolutions so produced secure a larger surface of secretion where there is greatest need for the enzyme; for the endosperm is thickest at this point and in front of the embryo." Whether the structures seen by Torrey were the same as those described above is not entirely clear from his description, but his figure (*f. 1*) indicates that they were at least very similar. If so, their location is not restricted "to the region of the tip" of the scutellum, as is clearly shown in

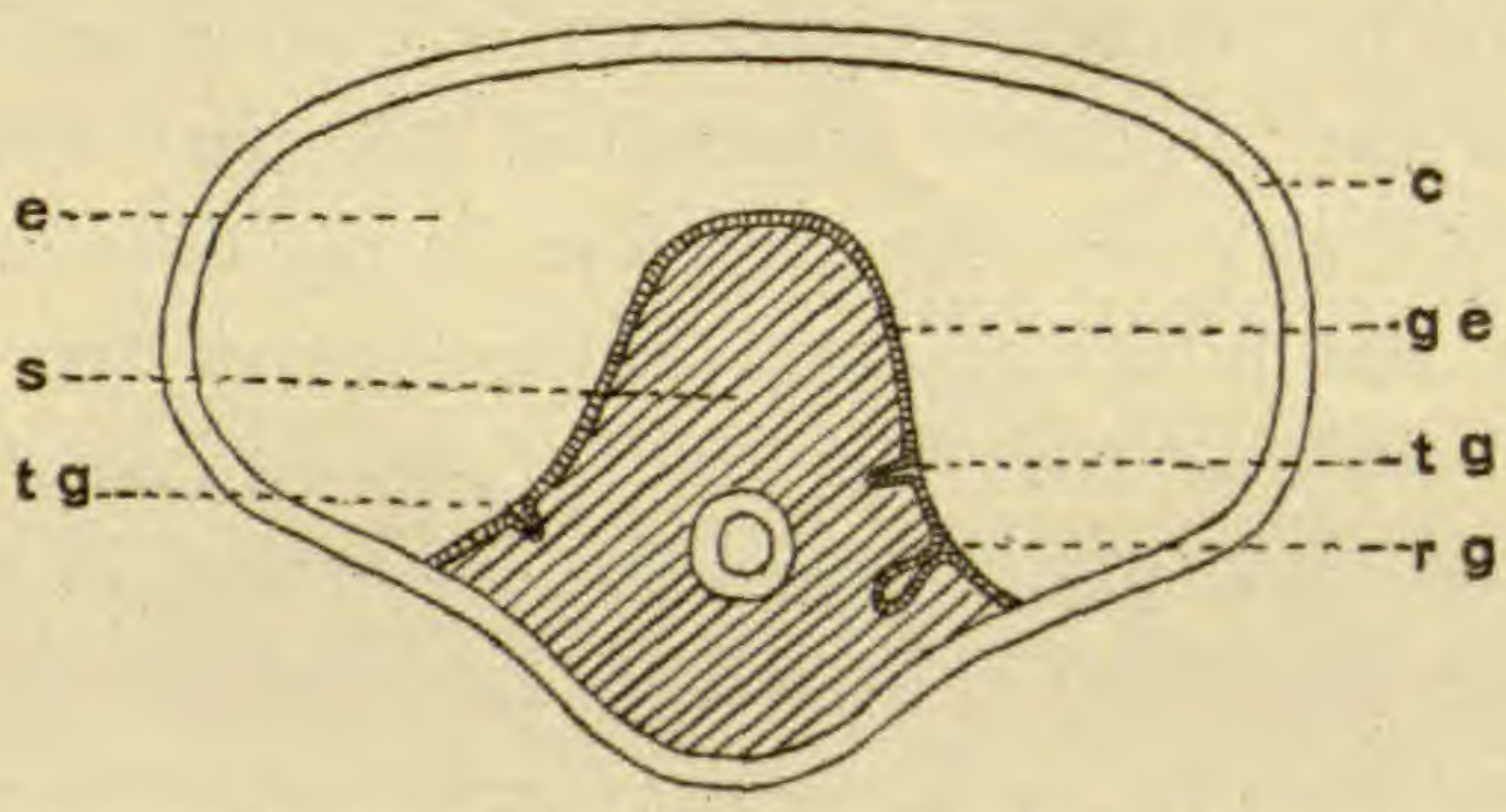

FIG. 1. Diagram of cross-section of grain of *Zea Mays*. *c*, combined coats of fruit and seed; *e*, endosperm region; *s*, scutellum; *ge*, glardular epithelium; *tg*, tubular glands; *rg*, gland slightly racemose.

FIGURE 1 herewith. Thus their distribution does not seem to be correlated with the thickness of the endosperm.

What is their significance? The variety of the corn is the "Hickory King," of J. M. Thorburn & Co., and the grains are of uniformly large area, though relatively flat and thin. Because of these facts it may be suggested, not unreasonably, that this invagination of the epithelium is merely an expression of vigorous, rapid growth, without corresponding opportunity for expansion. An analogy is found in the uneven, crinkled surface of foliage-leaves in many plants, due to the fact that one epithelium has grown more rapidly than the other. The wrinkling is a "mechanical necessity." This suggestion, I think, may be dismissed at once as having too little warrant in the facts, and as being less probable than another.

If the scutellar epithelium is primarily an organ for the absorption of nutriment, as Sachs held, the variation described would be even more surprising, for we should reasonably expect an evagination, or haustorial-like projection of the tissue into the endosperm, rather than an invagination, especially if the conception of the intimate relation between structure and function is valid.

If, however, we have to deal here with an epithelium whose chief function is secretion, then the variation described is one that might

FIGURE 2

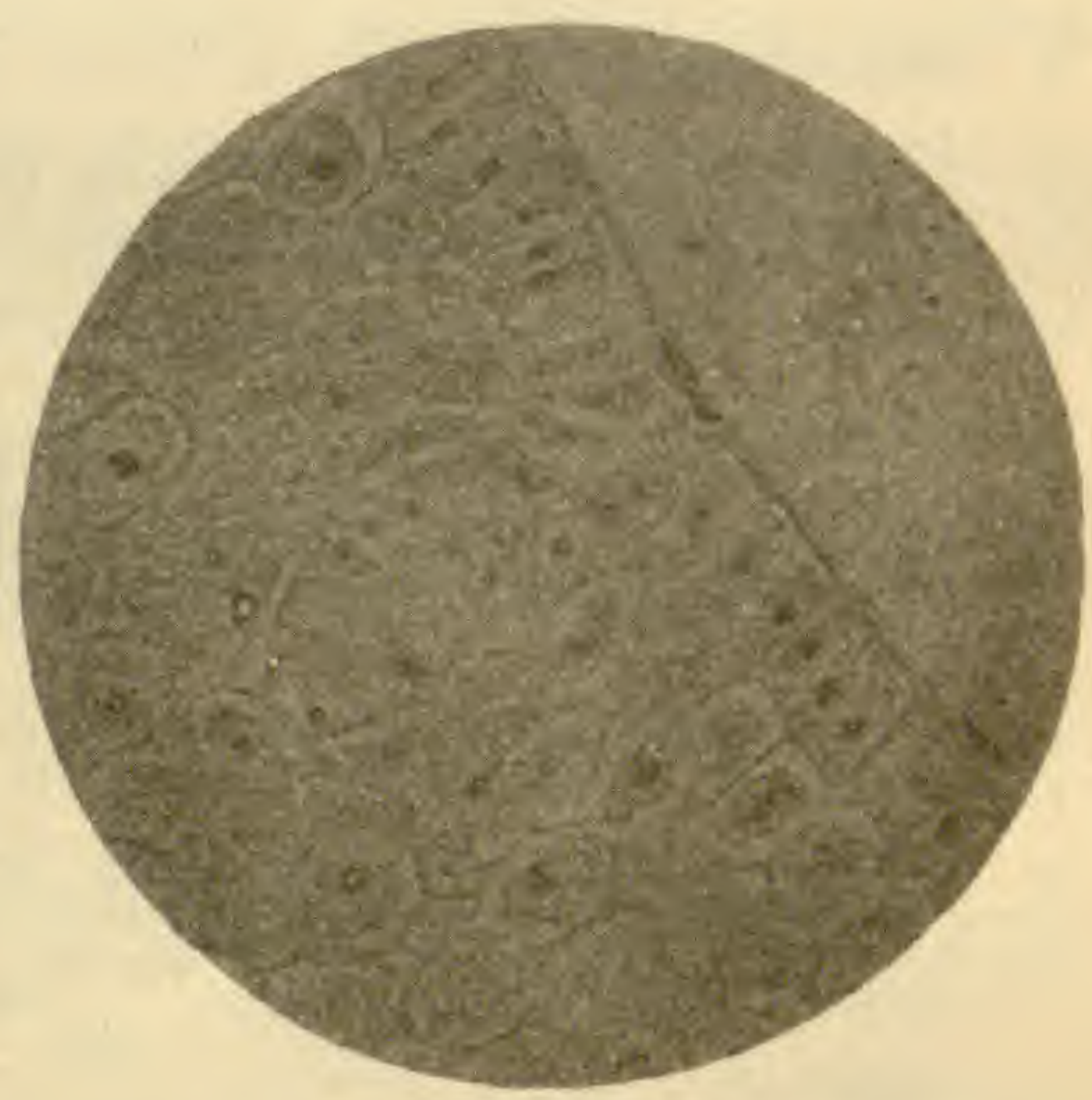

FIGURE 3

FIG. 2. Photomicrograph of cross-section of grain of maize. Tissue of scutellum at left, tissue of endosperm at right. Showing two glands in the scutellum.

FIG. 3. Photomicrograph of the upper gland of FIGURE 2, more highly magnified

have been predicted, and when once seen, the greater surprise would be that it was not of more frequent occurence. The first impression, that the anomalous structures are glands, is only strengthened by more careful observation and more thoughtful consideration. Any anatomist would at once classify the smaller invaginations as tubular glands, the simplest secreting structure next to the glandular epithelium, while the larger sac more nearly resembles a simple racemose gland.

Evidence of secretory activity was not sufficient in any part of the sections to throw light on the function of these structures. Their function may be inferred only from their anatomy, in the light of other well-known physiological observations.

Obviously no inference may be drawn from this anomaly as to the normal or the possible functions of the endosperm cells, nor of the cells of the aleurone layer, nor may any definite conclusion be drawn, on this basis alone, as to the proper function of the tissue involved. The weight of the evidence, however, is in line with all the facts of anatomy and experimental physiology which indicate that the scutellar epithelium of the grass embryo is an organ of secretion, a true glandular epithelium.

NEW YORK BOTANICAL GARDEN.

BIBLIOGRAPHY

ANATOMY

1. **Brongniart, A.** Mémoire sur la génération et le développement de l'embryon dans les végétaux phanérogames. Ann. Sci. Nat. **12**: 14, 145, 225. 1827.
2. **Bruns, E.** Der Grasembryo. Flora **76**: 1. 1892.
3. **Gaertner, J.** De fructibus et seminibus plantarum. Vol. I. 1788.
4. **Goebel, K.** Ein Beitrag zur Morphologie der Gräser. Flora **81**: 17. 1895.
5. —— Organography of plants. Tr. by I. B. Balfour. Oxford, 1905.
6. **Malpighi, M.** Anatome plantarum. London, 1675. (Also "Die Anatomie der Pflanzen." Bearbeitet von M. Möbius. Leipzig, 1901.)
7. **Mirbel, C. F. & Spach, E.** Notes pour servir à l'histoire de l'embryogénie végétale. Ann. Sci. Nat. II. **11**: 200. 1839.
8. **Schacht, H.** Entwickelungs-geschichte des Pflanzen-embryon. Amsterdam, 1850.
9. **Schleiden, M. J.** Mémoire sur la formation de l'ovule et l'origine de l'embryon dans les phanérogames. Ann. Sci. Nat. II. **11**: 129. 1839.
10. **Van Tieghem, P.** Observations anatomique sur le cotyledon des Graminées. Ann. Sci. Nat. V. **15**: 236. 1872.
11. —— Sur les phanérogames sous graines, formant la division Inseminées. Bull. Soc. Bot. France **44**: 99. 1897.
12. —— Morphologie de l'embryon et de la plantule chez les Graminées et les Cyperacées. Ann. Sci. Nat. VIII. **3**: 259. 1897.

PHYSIOLOGY

13. **Biot, J. B. & Persoz, J.** Mémoire sur les modifications que la fécule et la gomme subissent sous l'influence des acides. Ann. Chim. & Phys. **52**: 72. 1833.

14. **Bloziszewski, T.** Landwirtsch. Jahrb. **5**: 145. 1876. Also Jahresb. Agric. Chem. **6**: 232. 1875. (Cited by Brown and Morris; original not seen.)

15. **Braconnot, H.** Analyse des tubercles de l'*Helianthus tuberosus*, et observations sur la Dahline. Ann. Chim. & Phys. **25**: 358. 1824.

16. **Brown, H. T. & Morris, G. H.** Researches on the germination of some of the *Gramineae*. Jour. Chem. Soc. Trans. **57**: 458. 1890. (For abstract, see Nature **42**: 45. 1890.)

17. —— Burton-on-Trent Nat. Hist. Soc. Trans. **1**: 110. 1888. (Paper not accessible.)

18. **Brown, H. T. & Escombe, F.** On the depletion of the endosperm of *Hordeum vulgare* during germination. Proc. Roy. Soc. London **63**: 3. 1898.

19. **Colin, — & Claubry, H. G. de.** Mémoire sur les combinaisons de l'iode avec les substances végétales et animales. Ann. Chim. **90**: 87. 1814.

20. **Dombasle, M. de.** Lettre à M. Gay-Lussac, sur la conversion de la fécule en alcool par la fermentation. Ann. Chim. & Phys. **13**: 284. 1820.

21. **Green, J. R.** On the changes in the endosperm of *Ricinus communis* during germination. Ann. Bot. **4**: 383. 1890.

22. **Grüss, J.** Ueber den Eintritt von Diastase in das Endosperm. Ber. Deutsch. Bot. Gesell. **11**: 286. 1893.

23. —— Ueber das Verhalten des diastatischen Enzyms in der Keimpflanze. Jahrb. Wiss. Bot. **26**: 379. 1894.

24. —— Die Diastase im Pflanzenkörper. Ber. Deutsch. Bot. Gesell. **13**: 2. 1895.

25. —— Beiträge zur Physiologie der Keimung. Landwirtsch. Jahrb. **25**: 385. 1896.

26. **Haberlandt, G.** Die Kleberschicht des Grasendosperms als Diastase ausscheidendes Drüsengewebe. Ber. Deutsch. Bot. Gesell. **8**: 40. 1890.

27. —— Physiologische Pflanzenanatomie. Ed. 2. Leipzig, 1896. Also ed. 3. Leipzig, 1904.

28. —— Ueber die Secretion des Schildchens. Jahrb. Wiss. Bot. **30**: 645. 1897.

29. **Hansteen, B.** Ueber die Ursachen der Entleerung der Reservestoffe aus Samen. Flora **79**: 419. 1894.

30. **Irvine, W.** Essays, chiefly on chemical subjects. London, 1805. Essay vii, On Fermentation. (Read 1785.)

31. **Kirchhoff, G. S.** Ueber die Zuckerbildung beim Malzen des Getreides. Jour. für Chem. & Phys. **14**: 389. 1815.

32. —— Dans les graines céréales converties en malt, et dans la farine infusée dans l'eau bouillante. (Traduit de l'allemand.) Jour. de Pharm. & Sci. Access. **2**: 250. 1816.

33. **Krabbe, G.** Untersuchungen über das Diastaseferment unter specieller Berüchsichtigung seiner Wirkung auf Stärkekorner innerhalb der Pflanze. Jahrb. Wiss. Bot. **21**: 520. 1890.

34. **Linz, H.** Beiträge zur Physiologie der Keimung der Mais. Jahrb. Wiss. Bot. **29**: 267. 1896.

35. **Payen, A.** Observations sur l'analyse des tubercules de l'*Helianthus tuberosus*. Ann. Chim. & Phys. **26**: 98. 1824.

36. —— Mémoire sur l'amidon, la dextrine et la diastase, considérés sous les points de vue anatomique, chemique et physiologique. Mém. Acad. Sci. Inst. France, Sav. Etrang. **8**: 209. 1843.

37. —— Mémoire sur le développement des végétaux. *l. c.* **9**: 1. 1846.

38. **Payen, A. & Persoz, J.** Mémoire sur la diastase, etc. Ann. Chim. & Phys. **53**: 73. 1833.

39. **Pfeffer, W.** Ueber die Ursachen der Entleerung der Reservestoffe aus Samen. Ber. K. Sächs. Akad. Wiss. Leipzig, **45**: 421. 1893.

40. —— Physiology of plants. (Tr. by Ewart). Vol. I. Oxford, 1900.

41. **Pond, R. H.** The endosperm enzyme of *Phoenix dactylifera*. Preliminary report. Science II. **20**: 181. 1904.

42. —— The capacity of the date endosperm for self-digestion. Ann. Bot. **20**: 61. 1906.

43. **Proust, J. L.** Sur le principe qui assaisonne les fromages. Ann. Chim. & Phys. **10**: 29. 1819.

44. **Puriewitsch, K.** Ueber die selbstthätige Entleerung der Reservestoffbehälter. Ber. Deut. Bot. Gesell. **14**: 207. 1896. — Jahrb. Wiss. Bot. **31**: 1. 1897.

45. **Raspail, F. V.** Développement de la fécule dans les organes de la fructification des céréales, etc. Ann. Sci. Nat. **6**: 224, 384. 1825.

46. —— Additions au Mémoire sur l'analyse microscopique de la fécule. Ann. Sci. Nat. **7**: 325. 1826.

47. **Reed, H. S.** A study of the enzyme secreting cells in the seedlings of *Zea Mais* and *Phoenix dactylifera*. Ann. Bot. **18**: 267. 1904.

48. **Sachs, J.** Zur Keimungsgeschichte der Gräser. Bot. Zeit. **20**: 145. 1862.

49. —— Pflanzenphysiologie. Vol. I. Leipzig, 1892.

50. **Saussure, T. de.** Observations sur la décomposition de l'amidon à la température atmosphérique, par l'action de l'air et de l'eau. Ann. Chim. & Phys. **11**: 279. 1819.

51. —— De la formation du sucre dans la germination du froment. Mém. Soc. Phys. Hist. Nat. Genève **6**: 237. 1833.

52. **Schacht, H.** Lehrbuch **2**: 462. 1859. — Le Microscope, page 213. 1861.

53. **Schleiden, M. J.** Grundzüge der wissenschaftlichen Botanik. **2**: 185. Leipzig. 1845.

54. **Tangl, E.** Studien über das Endosperm einiger Gramineen. Sitzungsber. Akad. Wiss. Wien. 1885. (Cited by Haberlandt, 1890.)

55. **Thomson, T.** A system of chemistry. Vol. 4. Philadelphia, 1818.

56. **Torrey, J. C.** Cytological changes accompanying the secretion of diastase. Bull. Torrey Club **29**: 421. 1902.

57. **Tschirch, A.** Angewandte Pflanzenanatomie. Wien und Leipzig. 1889.

58. **Vogel, H. A.** Untersuchungen über den flüssigen Zucker aus Stärkmehl und über Umwandlung süsser Materien in gährungsfähigen Zucker. Jour. für Chem. & Phys. **5**: 80. 1812.

59. **Wigand, A.** Das Protoplasma als Fermentorganismus. Botanische Hefte **3**: 131. 1888.

American fossil mosses, with description of a new species from Florissant, Colorado

Elizabeth Gertrude Britton and Arthur Hollick

(with plate 9)

During the summer of 1906 Professor Theo. D. A. Cockerell and his wife spent several weeks at Florissant, Colorado, collecting fossil plants. Among those collected was found a beautifully preserved fruiting tuft of a moss, which was kindly transmitted to us for examination and description. The specimen was obtained from the well-known Tertiary shales of that locality, from which quantities of fossil insect and plant remains have been secured by many different collectors from time to time; but among the thousands of specimens thus brought to light only three have been heretofore described as mosses, viz.

Hypnum Haydenii Lesq. Ann. Rept. U. S. Geol. and Geog. Surv. Terr. **1874**: 309. 1876; Bull. U. S. Geol. and Geog. Surv. **1**: 583. "1875" [1876]; Rept. U. S. Geol. Surv. Terr. **7** (Tert. Fl.): 44. *pl. 5. f. 14, 14a, 14b.* 1878. (Plate 9, figures 1, 1a.)

Fontinalis pristina Lesq. Rept. U. S. Geol. Surv. Terr. **8** (Cret. and Tert. Fl.): 135. *pl. 21. f. 9.* 1883. (Plate 9, figures 2, 2a.)

Hypnum Brownii Kirchner, Trans. Acad. Sci. St. Louis **8**: 178. *pl. 12. f. 4, 4a.* 1898. (Plate 9, figures 3, 3a.)

None of these, however, is a fruiting specimen, and the generic determinations were based entirely on the leaf-characters, which, even if well defined, would not in themselves be characters from which generic or even family relationships could be satisfactorily determined. In this connection it may be suggested that the species first mentioned is more indicative of a *Lycopodium* or a conifer than of a moss, and the author voices his uncertainty in acknowledging that "the apparently thick leaves seem abnormal for a species of moss," and that "the mode of division . . . separates it from the Lycopods." *

In regard to the second species cited it may be merely remarked that the correctness of its reference to the genus *Fontinalis* is questionable, so far as may be judged by the figures, while in regard to the one last mentioned the author, in his description, says: "The leaves in most cases are indistinct and only the more solid stems are discernible." It is apparently a moss, but satisfactory evidence of its relationship with the genus *Hypnum* is not apparent in the figures.

The only other American fossil-plant remains described as mosses, with the exception of several existing species from deposits of Pleistocene and more recent age, are *Hypnum columbianum* Penhallow, in Dawson, Trans. Roy. Soc. Canada 8^4: 77. *fig. 3.* 1890 (PLATE 9, FIGURE 4), from lower Tertiary beds at Quesnel, B. C., which is more likely a conifer, apparently related to *Widdringtonia helvetica* Heer, Fl. Tert. Helv. **1**: 48. *pl. 16, f. 2–18*, or to *Glyptostrobus Ungeri* Heer, as depicted by several authors; and *Rhynchostegium Knowltoni* E. G. Britt., described and figured in Bull. Torrey Club **26**: 79, 80. 1899 (PLATE 9, FIGURE 5), from the upper Eocene or Miocene sandstone at Cle Elum, Kittitas County, Washington. These specimens, as in the case of those previously mentioned, are also sterile, so that in our specimen from Florissant we have the first fossil moss with fruit thus far recorded from America.

Glyphomitrium Cockerelleae sp. nov.

(PLATE 9, FIGURES 6, 6a)

Plants pulvinate, forming a dark-brown tuft 1 cm. high and 2.5 cm. wide, with lignitic remains appearing like a mass of dark-brown radicles. Stems erect and crowded, evidently branching: leaves

* Through the kindness of Dr. J. N. Rose, Associate Curator of the Division of Plants, U. S. National Museum, the type specimen of *Hypnum Haydenii* was transmitted to us for examination, from which our figures were made. We are satisfied that it is not a moss, and Dr. L. M. Underwood, of Columbia University, has expressed his opinion that it can not be a *Lycopodium*. The closest comparisons which we have been able to make are with certain conifers, especially with forms of *Juniperus communis* L., in which the young growing branchlets often present a striking similarity in general appearance to this specimen.

2–3 mm. long, linear-lanceolate, straight or curved, apparently with a thick vein and slender sharp apex : sporophytes terminal : seta erect and straight, 1–1.5 cm. long: calyptra mitrate and plicate, 2–2.5 mm. long, with well-marked ridges forming darker grooves in the light-colored stone.

The capsules were not yet developed when this specimen was buried and nothing but the calyptra remains to indicate the nature of the sporophyte, but from general aspect and characters it seems to belong nearest to the *Grimmiaceae* with a resemblance to the *Ptychomitrieae*, the calyptra being grooved and long, completely enclosing the sporophyte when young, as in *Ptychomitrium*, and prolonged into an acute apex as if the lid were rostrate.

This species is dedicated to Mrs. Wilmatte Porter Cockerell, in recognition of her devotion to science and her invaluable assistance in securing specimens from this locality.

This genus has been known in American bryological works as *Ptychomitrium*, but the older name has been reinstated by Brotherus in Engler & Prantl, Pflanzenfamilien (**1**^{3}: 440. 1902) while keeping the name of the section, as indicated above. The synonymy is as follows :

Glyphomitrium Brid. Mant. 30. 1819; emend. Mitt. Jour. Linn. Soc. **12**: 105. 1869.

Brachysteleum Reichenb. Consp. 34. 1828.

Ptychomitrium (Bruch) Furnr. Flora 1829, Erg. 2: 19. 1829.

Notarisia Hampe, Linnaea **11**: 379. 1837.

NEW YORK BOTANICAL GARDEN.

Explanation of plate 9

Figs. 1, 1*a* — *Hypnum Haydenii* Lesq.

Fig. 1 × about $1\frac{2}{5}$.

Fig. 1*a* × about 2.

Figs. 2, 2*a* — *Fontinalis pristina* Lesq.

Fig. 2 natural size.

Fig. 2*a* × about $1\frac{1}{2}$.

Figs. 3, 3*a* — *Hypnum Brownii* Kirchner.

Fig. 3 natural size.

Fig. 3*a* × about 5 (?).

Fig. 4 — *Hypnum columbianum* Penhallow. Natural size.

Fig. 5 — *Rhynchostegium Knowltoni* E. G. Britt. × about 9.

Figs. 6, 6*a* — *Glyphomitrium Cockerelleae* E. G. Britt. and Hollick

Fig. 6 × about $1\frac{2}{5}$.

Fig. 6*a* × about 7.

Studies in the North American Convolvulaceae. III. Calycobolus, Bonamia, and Stylisma

Homer Doliver House

The *Dicranostyleae*, to which belong these three genera together with *Cressa* and *Evolvulus*, is characterized by bifid styles and these divisions sometimes again cleft, as in *Evolvulus*, valvular and usually 2-celled, 2–4-seeded capsules. The genus *Calycobolus* (*Prevostea*) has been placed in the *Poraneae* by Hallier, but the characters of the style and capsule in *Calycobolus* are those of the *Dicranostyleae*, while the only character which it has in common with *Porana* is the inequality of the sepals. The genus *Dicranostyles* Benth. is represented in northern South America by *D. scandens* Benth., and the closely allied genus *Lysiostyles* Benth. by *L. scandens*.

Key to the North American genera of Dicranostyleae

Outer sepals enlarged, often colored or otherwise different from the inner sepals. — 1. Calycobolus.
Sepals alike or nearly so.
  Divisions of the style entire; stigmas 2; corolla funnelform.
    Stamens included.
      Plants comparatively stout; sepals leathery, rounded or obtuse. — 2. Bonamia.
      Plants slender; sepals herbaceous, acute or acuminate. — 3. Stylisma.
    Stamens exserted. — 4. Cressa.
  Divisions of the style each 2-cleft; stigmas 4. — 5. Evolvulus.

1. CALYCOBOLUS Willd.; R. & S. Syst. 5: 4. 1819

Twining or suberect, herbaceous or woody plants. Leaf-blades petioled, entire, rarely cordate. Flowers in axillary clusters. Sepals unequal, the outer ones enlarged and differing from the inner in texture, shape, color and sometimes insertion. Stamens included; filaments dilated and pubescent at the base. Ovary 2-celled, 4-ovuled. Style bifid nearly or quite to the ovary, the divisions unequal. Stigmas 2, small, capitate. Capsules ovoid. Seeds smooth or pubescent.

Type species: *Calycobolus emarginatus* Willd. *l. c.* = *Dufourea sericea* H.B.K. = *Prevostea sericea* Choisy.

Dufourea H.B.K. Nov. Gen. & Sp. **3**: 113. 1818. Not *Dufourea* Bory, 1810.

Prevostea Choisy, Ann. Sci. Nat. **4**: 497. 1825. — Mém. Soc. Phys. Genèv. **6**: 492. 1833.— In DC. Prodr. **9**: 437. 1845.

Reinwardtia Spreng. Syst. **1**: 527. 1825. Not *Reinwardtia* Dum. 1822.

Wilberforcia Hook. f.; Planchon, in Hook. Ic. *pl. 796.* 1848.

At least eight species are known, two in Mexico and six in South America. Of the South American ones, the type of the genus, *C. sericeus*, may extend into Central America, and is included in the following enumeration:

Key to the North American species

Foliage densely pubescent.
- Inflorescence few-flowered on short peduncles. Mexican. — 1. *C. velutinus.*
- Inflorescence many-flowered on long leafy peduncles. South American. — 2. *C. sericeus.*

Foliage glabrous or nearly so. Mexican. — 3. *C. Pringlei.*

1. **Calycobolus velutinus** (Mart. & Gal.)

Prevostea velutina Mart. & Gal. Bull. Acad. Brux. **12**^{2}: 259. 1845.

Breweria mexicana Hemsley, Biol. Cent. Am. Bot. **2**: 400. 1882.

Porana velutina Hallier f. Bot. Jahrb. **16**: 538. 1893.

Softly pubescent, more or less erect and slender; leaf-blades oblong-lanceolate, thick, 5–7 cm. long, acute, the base obtuse or rounded; petioles 8–10 mm. long; peduncles about 2 cm. long, few-flowered: the three outer sepals about 15 mm. long, ovate, obtuse, glabrous at maturity, the two inner sepals subscarious and much smaller; corolla 2–2.5 cm. long, sparingly hirsute without; anthers oblong; ovary villous.

TYPE LOCALITY: "In Mexico inter Tehuacan et Oaxacan prope la Venta de Argon."

DISTRIBUTION: Southern Mexico.

2. **Calycobolus sericeus** (H.B.K.)

Dufourea sericea H.B.K. Nov. Gen. & Sp. **3**: 114. *pl. 114.* 1818.

Calycobolus emarginatus Willd.; R. & S. Syst. **5**: 4. 1819.

Reinwardtia sericea Spreng. Syst. **1**: 863. 1825.
Prevostea sericea Choisy, Ann. Sci. Nat. **4**: 496. 1825.

Distinguished from *C. velutinus* by its leaf-blades sericeous-pubescent beneath, the flower clusters ample and terminating leafy branches, and the colored outer sepals.

TYPE LOCALITY: "Crescit in Regno Novae Granatae, juxta urbem Mariquita, alt. 400 hex."

DISTRIBUTION: Northern South America.

3. **Calycobolus Pringlei** sp. nov.

Twining, 5 meters high, herbaceous above, woody below; glabrous except for some minute pubescence on the pedicels and at the base of the sepals; leaf-blades broadly lanceolate or oblong-lanceolate, acute, obtuse or rounded at the base, 4–8 cm. long, glabrous, texture somewhat rough and thick; petioles short, 5–10 mm. long; flowering branches one or more in the axils of the leaves, branching, many-flowered, leafy; pedicels 7–10 mm. long; the three outer sepals elliptical, rounded at the apex, 8–10 mm. long, the two inner ones 3 mm. long or less; corolla 1.5 cm. long and as broad, slightly pubescent in bud, becoming glabrous, deeply 5-lobed, lobes obovate, retuse; anthers short-sagittate, blunt.

MEXICO: On limestone hills, Yantepec, Morelos, alt. 4000 feet, *C. G. Pringle 8751*, November 21, 1903 (type, sheet no. *460794* in the Herbarium of the United States National Museum). Puebla, between Huajuapam, Oaxaca and Retlatzingo, *E. W. Nelson 1987*, November 19, 1894, alt. 4800–6500 feet.

The South American species in addition to *C. sericeus*, above mentioned, are as follows:

Calycobolus amazonicus (Choisy)

Prevostea amazonica Choisy, in DC. Prodr. **9**: 437. 1845.

Calycobolus ferrugineus (Choisy)

Prevostea ferruginea Choisy, Ann. Sci. Nat. **4**: 498. 1825.

Calycobolus glaber (H.B.K.)

Dufourea glabra H.B.K. Nov. Gen. & Sp. **3**: 114. 1818.
Calycobolus pulchellus Willd.; R. & S. Syst. **5**: 4. 1819.
Reinwardtia glabra Spreng. Syst. **1**: 863. 1825.
Prevostea glabra Choisy, Ann. Sci. Nat. **4**: 496. 1825.

Calycobolus spectabilis (Meissn.)

Prevostea spectabilis Meissn. in Mart. Fl. Bras. **7** : 325. 1869.

Calycobolus umbellatus (Choisy)

Prevostea umbellatus Choisy, Ann. Sci. Nat. **4** : 496. 1825.

2. BONAMIA Pet. Thouars, Hist. Veg. Afr. **1** : 17, 32. *pl. 5.* 1804 — J. St. Hil. Expos. Fam. **2** : 349. 1805.

Stout, spreading, herbaceous or sometimes woody or twining plants. Leaves herbaceous or subcoriaceous, rarely cordate. Sepals leathery or coriaceous, equal or nearly so, usually obtuse or rounded. Corolla large or medium-sized, white or blue, hirsute without on the plicae, the limb subentire. Filaments glandular-villous below. Ovary 2-celled, 4-ovuled. Style bifid nearly to the base, the divisions unequal ; stigmas 2, globose. Capsules chartaceous, 4-valved. Seeds smooth, or pubescent on the dorsal angles.

Type species : *Bonamia alternifolia* J. St. Hil.

Breweria R. Br. Prodr. **1** : 487. 1810.

Trichantha Karst. & Triana, Linnaea **28** : 437. 1856.

About 30 species, chiefly in the tropics of the old world.

Key to the North American species

Sepals about 12 mm. long. Southwestern U. S. 1. *B. ovalifolia.*
Sepals 20 mm. long or longer ; corolla 9–10 cm. long. Floridian. 2. *B. grandiflora.*

1. BONAMIA OVALIFOLIA (Torr.) Hallier f. Bot. Jahrb. **16** : 528. 1893

Evolvulus ovalifolia Torr. Bot. Mex. Bound. 150. 1859.

Breweria ovalifolia A. Gray, Syn. Fl. N. Am. **2** : 217. 1878.

TYPE LOCALITY : Mexican side of the Rio Grande below San Carlos.

DISTRIBUTION : Arid regions of the Mexican boundary, Texas to New Mexico.

2. BONAMIA GRANDIFLORA (A. Gray) Hallier f. Bull. Herb. Boiss. **5** : 810. 1897

Breweria grandiflora A. Gray, Proc. Am. Acad. **15** : 49. 1880.

TYPE LOCALITY : Manatee and Sarasota, Florida.

DISTRIBUTION : In sandy soil, Florida.

The treatment of the genus *Stylisma* Raf. by various American authors has been the successive adoption of *Stylisma*, *Bonamia* and *Breweria*, as the generic name of these plants. Dr. Gray first used *Stylisma*, and later took up *Bonamia* and *Breweria* successively. The first edition of Chapman's Flora places the species under *Stylisma*, but in the latter editions *Breweria* is adopted. All of these changes seem to be due to the fact that the Australian genus described by Brown has about the same character of style and ovary. A most important fact however seems to have been overlooked by those who have joined the American species of *Stylisma* to *Breweria*, and that is that the genus *Breweria* possesses a totally different habit and has comparatively stout, firm stems and branches, thick, firm or leathery obtuse or rounded sepals, points which serve to sharply separate the species of *Stylisma* from *Breweria*. As has been shown by Hallier,* the genus *Breweria* R. Br. is congeneric with *Bonamia* Thouars.

3. STYLISMA Raf. Neogenyt. 2. 1825. — Fl. Tellur. 4: 55. 1836

Perennial, slender, weak, prostrate or somewhat twining plants, herbaceous above. Leaf-blades narrow or broad, entire, not cordate. Flowers 1–3, on axillary peduncles. Calyx pubescent or glabrous. Sepals equal or nearly so, herbaceous, pointed, somewhat united at the base. Corolla white, rotate or subfunnelform, the limb plaited, 5-angled or 5-lobed. Filaments filiform. Ovary 2-celled, 4-ovuled. Style divided nearly to the base, the divisions nearly equal. Stigmas 2, capitate. Capsules thin-walled, 2-celled, 2–4-valved. Seeds 2–4, glabrous or minutely pubescent.

Type species: *Stylisma peduncularis* Raf. = *Convolvulus humistratus* Walt. = *Stylisma humistrata* Chapm.

Six species in the southeastern United States and one in northern Mexico.

Key to the North American species

Sepals glabrous or merely ciliate.
  Leaf-blades narrowly linear. 1. *S. angustifolia.*
  Leaf-blades oblong. 2. *S. humistrata.*
Sepals distinctly pubescent.
  Filaments pubescent.
    Foliage sparingly pubescent; mature peduncles 1–3 cm. long; corolla 1.5 cm. long. 3. *S. trichosanthes.*

* Bot. Jahrb. 16: 527, 573. 1893. — Bull. Herb. Boiss. 5: 804. 1897.

Foliage densely brown-tomentose; mature peduncles 4–6 cm. long; corolla 2 cm. long. 4. *S. villosa.*
Filaments glabrous or nearly so.
Peduncles as long as the leaves or exceeding them.
Bracts exceeding the flowers; leaves linear. 5. *S. Pickeringii.*
Bracts not exceeding the flowers; leaves oblong to narrowly lanceolate. 6. *S. aquatica.*
Pedicels sessile in the axils and shorter than the round-ovate leaves. 7. *S. rotundifolia.*

1. **Stylisma angustifolia** (Nash)

Breweria angustifolia Nash, Bull. Torrey Club **22**: 155. 1895.

TYPE LOCALITY: Near Eustis, Florida.

DISTRIBUTION: Sandy soil in high pine lands, Florida.

2. STYLISMA HUMISTRATA (Walt.) Chapm. Fl. Southern U. S. 346. 1860

Convolvulus humistratus Walt. Fl. Car. 94. 1789.
Convolvulus tenellus Desv.; Lam. Encyl. **3**: 559. 1789. — Ell. Bot. S. C. & Ga. **1**: 215. 1817.
Convolvulus Sherardi Pursh, Fl. Am. Sept. **2**: 30. 1814.
Stylisma evolvuloides Choisy, Mém. Soc. Phys. Genèv. **6**: 494. 1833.
Stylisma peduncularis Raf. Fl. Tellur. **4**: 55. 1836.
Breweria Choisyana Steud. Nom. ed. 2. **1**: 224. 1840.
Bonamia humistrata A. Gray, Man. ed. 5. 376. 1867.
Breweria humistrata A. Gray, Syn. Fl. N. Am. **2**: 217. 1878.
Breweria tenella Peter, in Engler & Prantl, Natürl. Pflanzenfam. 4^{3a}: 16. 1901.

TYPE LOCALITY: Carolina.

DISTRIBUTION: Sandy soil, Virginia to Florida and Louisiana.

3. **Stylisma trichosanthes** (Michx.)

Convolvulus trichosanthes Michx. Fl. Bor. Am. **1**: 137. 1803.
Breweria trichosanthes Small, Fl. Southeastern U. S. 939. 1903.

TYPE LOCALITY: Carolina.

DISTRIBUTION: Sandy soil, North Carolina to Florida and Alabama.

4. **Stylisma villosa** (Nash)

Breweria villosa Nash, Bull. Torrey Club **22**: 159. 1895.

TYPE LOCALITY: Near Eustis, Florida.

DISTRIBUTION: Dry soil, peninsular Florida.

5. STYLISMA PICKERINGII (M. A. Curtis) A. Gray, Man. ed. 2. 335. 1856.

Convolvulus Pickeringii M. A. Curtis, Bost. Jour. Nat. Hist. **1**: 129. 1837.

Stylisma evolvuloides var. *angustifolia* Choisy, in DC. Prodr. **9**: 450. 1845.

Bonamia Pickeringii A. Gray, Man. ed. 5. 376. 1867.

Breweria Pickeringii A. Gray, Syn. Fl. N. Am. **2**: 217. 1878.

TYPE LOCALITY: New Jersey.

DISTRIBUTION: Sandy pine regions, New Jersey to Florida, Mississippi and Texas. Also reported from Illinois.

6. STYLISMA AQUATICA (Walt.) Chapm. Fl. Southern U. S. 346. 1860.

Convolvulus aquaticus Walt. Fl. Car. 94. 1788.

Convolvulus erianthus Willd.; Spreng. Syst. **1**: 610. 1825.

Bonamia aquatica A. Gray, Man. ed. 5. 376. 1867.

Stylisma elliptica Raf. Fl. Tellur. **4**: 55. 1836.

Breweria aquatica A. Gray, Syn. Fl. N. Am. **2**: 217. 1878.

TYPE LOCALITY: Carolina.

DISTRIBUTION: In pine lands, Virginia to Florida and Texas.

7. **Stylisma rotundifolia** (S. Wats.)

Breweria rotundifolia S. Wats. Proc. Am. Acad. **23**: 281. 1888.

Evolvulus rotundifolius Hallier f. Bot. Jahrb. **16**: 530. 1893.

TYPE LOCALITY: Chihuahua, Sierra Madre, Mexico.

DISTRIBUTION: In fields and thickets, pine plains, northern Mexico. In general appearances this species has a striking similarity to certain species of *Evolvulus*, especially *E. prostratus* Robinson, but the style has only the two divisions, typical of *Stylisma*.

CLEMSON COLLEGE, SOUTH CAROLINA.

Notes on Carex — II

Kenneth Kent Mackenzie

The species of *Carex* of the sub-genus *Vignea* are very numerous in North America, and are distinguished from one another by slight characters. The differences are often very hard to express in written descriptions, but when pointed out in the plants themselves are usually readily seen, and speaking in general terms the species are constant. The eastern species have become fairly well known, but there are many western forms which have only of late years begun to appear to any considerable extent in collections, and to four of these, all belonging to the section with the staminate flowers uppermost, the present paper will be devoted.

Carex austrina (Small) sp. nov.

Carex Muhlenbergii australis Olney; Bailey, Proc. Am. Acad. **22**: 141. 1886. Not *Carex australis* T. Kirk. 1894.

Carex Muhlenbergii austrinus Small, Fl. S. E. U. S. 218. 1903.

Culms erect, growing in strong clumps, 3–7 dm. high, the upper part roughened on the angles beneath the head, usually noticeably exceeding the upper leaves. Leaves with well-developed blades three to five to a culm, the blades ascending, 2.5–4 (rarely 4.5) mm. wide, 1–3 cm. long, glabrous, but roughened towards the apex and on the margins; spikes densely aggregated in a solitary terminal head, 15–30 mm. long, 8–15 mm. wide, the lower two to four distinguishable, each spike bearing the few inconspicuous staminate flowers above and the ten to many ascending perigynia below; bracts 1–5 cm. long, dilated and much nerved at the base, long-cuspidate and conspicuous; scales broadly ovate, white-hyaline,.with several strong green ribs, strongly cuspidate, about as wide as and usually exceeding the perigynia, conspicuous; perigynia ascending, suborbicular, 4 mm. long, 3 mm. wide, greenish, rounded at base, abruptly narrowed into the serrulate, bidentate beak, which is about one-third the length of the body, nerveless or nearly so on the inner face, strongly nerved on the outer; achene lenticular, the face orbicular, 2.5 mm. long; stigmas two.

This species, which is apparently common from Missouri and Kansas through Arkansas and Oklahoma to Texas, was first named *Carex Muhlenbergii australis* by Olney in 1873 in Hall's *Plantae Texanae* (page 25), without description, and it does not seem to have been published with description until 1886 as cited above. It is quite distinct from *Carex Muhlenbergii* Schkuhr, and merits specific recognition fully as much as other members of this group. The characters separating the two species may be contrasted as follows:

Perigynia spreading, 3 mm. long; lower spikes strongly separated; bracts not broadly dilated at base; scales about the length of and narrower than the perigynia, short-awned. *C. Muhlenbergii.*

Perigynia ascending, 4 mm. long; lower spikes distinct, but not separated; bracts broadly dilated at base; scales (especially the lower in each spike) strongly awned, and exceeding and as wide as perigynia. *C. austrina.*

SPECIMENS EXAMINED:

MISSOURI: Sheffield, *Bush 1991*, June 6, 1904; Swan, *Bush 2936*, May 21, 1905; Sheffield, *Bush 1956*, May 28, 1904; Dodson, *Mackenzie*, May 10, 1896; Courtney, *Bush 2082*, July 9, 1904; Dodson, *Bush 1674*, May 14, 1902.

KANSAS: Bucklin, Ford County, *Hitchcock*, July, 1892.

ARKANSAS: Clay County, *Eggert*, May 25, 1893.

INDIAN TERRITORY: Sapulpa, *Bush 944* and *953*, May 6, 1895, and May 11, 1895; also *1288*, May 25, 1895; between Fort Cobb and Fort Arbuckle, *Palmer 367*, 1868.

TEXAS: Mineola, *Reverchon 2392*, April 22, 1901; Galveston, *Plank*, March 2, 1892; Dallas, *Reverchon 2885*, April 17, 1902; Corsicana, *Reverchon 3624*, April 14, 1903; Houston, *Hall 230*, April 10, 1872 (type); Belknap, *Hayes*, April 6, 1858.

√ **Carex brevisquama** sp. nov.

Culms erect, rather slender, roughened on the angles immediately beneath the head, 2.5–6 dm. high, much exceeding the leaves, growing in clumps, but the scaly rootstocks rather noticeably creeping. Leaves with well-developed blades about three to a culm and attached to its lower part only, the narrow blades erect or somewhat recurved, 8–30 cm. long, 1 mm. wide, roughened on the margins and especially towards the long-attenuate apex; spikes closely aggregated in a solitary, dense, terminal head, usually 15–

20 mm. long and about 7 mm. broad, the individual spikes poorly defined, and having from two or three to about ten ascending or somewhat spreading perigynia at the base of the rather inconspicuous terminal staminate flowers, which form a short cylinder; bracts absent, or occasionally the lowest one present, 8 mm. long or less, awl-shaped, long-attenuate; scales broadly triangular, hyaline, with the central portion brownish straw-colored, acuminate to short-cuspidate, noticeably exceeded by the perigynia; perigynia oblong-elliptical, 3.5 mm. long, 2 mm. wide, flat on the inner, rounded on the outer surface, the body round-tapering at base, margined on the inner surface towards the apex, and rounded and abruptly narrowed into the short, minutely serrulate, bidentate beak, which is about 1 mm. long, the body smooth, polished and nerveless; achenes lenticular, with orbicular face, 2 mm. long, 2 mm. wide; stigmas two.

Several specimens of this distinct plant have been collected within the last few years, and by some collectors have been named *Carex vallicola* Dewey. The original description of this last-named species, however, does not answer to our plant at all, but rather seems to indicate *Carex Hookeriana* Dewey, calling as it does for a plant with developed bracts and large scales. Our plant is readily distinguished from both *Carex Hookeriana* Dewey and its close relative *Carex occidentalis* Bailey by the scales being much shorter than and exposing the perigynia, while in the two species referred to the scales completely cover the perigynia or very nearly so.

SPECIMENS EXAMINED:

WYOMING: Red Desert, Orendo Butte, Sweetwater County, *A. Nelson 7124*, June 11, 1900 (type, in Herb. N. Y. Bot. Gard.); Evanston, *A. Nelson 3000*, May 29, 1897 (very young); Leucite Hills, *Merrill & Wilcox 487*, June 17, 1901.

OREGON: North Pine Creek near Snake River, *Cusick 2519*, May 24, 1901.

√ **Carex neomexicana** sp. nov.

Culms erect, growing in small clumps, 2.5–4 dm. high, much exceeding the leaves, which are clustered towards the base, roughened on the angles, especially above. Leaves with well-developed blades about three to a culm, the blades erect-ascending, 1.5–2.5 mm. wide, 1–3 dm. long, roughened, especially on the margins; spikes few (about five), all aggregated into a rather stiff head 1.5–2.5 cm. long and about 1 cm. wide, the upper spikes not distinguishable, the lower readily distinguishable but little separated, each spike bearing the rather inconspicuous staminate flowers above and the 1–5 ascending perigynia beneath; bracts (except the lowest) inconspicuous and resembling the scales, the lowest bract exceeding its spike, 1 cm. long, slightly enlarged at base and terminating in a long cusp; scales ovate-triangular, the bodies whitish with green midrib, acuminate to cuspidate, about the width of and rather shorter than the perigynia, which are not completely concealed; perigynia ovate-lanceolate, flat on the inner and rounded on the outer surface, glabrous, usually nerved on both surfaces, the whole 4 mm. long, the body about 1.7 mm. wide, tapering at base, scarcely stipitate, tapering somewhat abruptly into the slightly to strongly roughened, strongly bidentate, beak, which is barely 1 mm. long and only one-third the length of the body; achenes lenticular, with short-oblong face, 2.75 mm. long, 1.5 mm. wide; stigmas two.

Dr. Boott long ago noticed that this plant is distinct from *Carex Hookeriana* Dewey, a note in his handwriting attached to one of the Santa Rita specimens of Bigelow cited below and preserved in the Torrey Herbarium calling attention to the fact that it has nerved perigynia, while *Carex Hookeriana* has nerveless perigynia. More complete specimens collected since this note was written have disclosed the fact that other differences exist, which separate this plant from *Carex Hookeriana* as well as from *Carex occidentalis* Bailey. Summarized, the more important distinctions may be contrasted as follows:

Spikes with 1–5 perigynia, the latter 4 mm. long, usually nerved on the inner face; scales whitish, not concealing the perigynia. — *C. neomexicana.*

Spikes with 5–10 perigynia, the latter 2.5–3.5 mm. long, nerveless on the inner face; scales strongly tinged with brown, nearly or quite concealing the perigynia. — *C. Hookeriana.* / *C. occidentalis.*

SPECIMENS EXAMINED:

ARIZONA: Yavapai County, *Rusby 859*, 1883; also *855*.

NEW MEXICO: *Wright 1952*, 1851–2; "New Mexico" *Dewey*; Santa Rita del Cobra on the Rio Mimbras, *Bigelow 1547* (type, in Herb. Columbia College).

Carex tumulicola sp. nov.

Culms erect, growing in strong clumps, 4.5–8 dm. high, exceeding the leaves, roughened on the angles, especially above. Leaves with well-developed blades about three or four to a culm, the blades erect-ascending, 1.5–2.5 mm. wide, 1–3 dm. long, roughened, especially on the margins; spikes five to ten, the lower three to six separate, the upper aggregated and undistinguishable, the whole head slender and often rather flexuous, 2–5 cm. long and less than 1 cm. wide, each spike bearing the few staminate flowers above and the few (10 or less) ascending perigynia beneath; bracts, especially the lower, well-developed, somewhat enlarged at base, prolonged into a long cusp, usually or often exceeding their spikes, and the lowest often exceeding the head; scales ovate-triangular, brownish straw-colored with opaque margin and green mid-rib, acuminate to cuspidate, rather wider and from slightly longer to slightly shorter than and largely concealing the perigynia; perigynia lanceolate, flat on the inner and rounded on the outer surface, glabrous, nerved on both surfaces, especially strongly on the inner, the whole 5 mm. long, the body 1.5 mm. wide, margined above, round tapering at base into a stipe 0.5 mm. long and rather gradually contracted into a rough bidentate beak, which is about one-third the length of the body; achenes lenticular with short-oblong face, 3.25 mm. long, 1.5 mm. wide; stigmas two.

Related to the northern and high mountain *Carex Hookeriana* Dewey, this species seems to take its place in the foothills southerly and easterly of San Francisco, from which region have come all the specimens I have seen. It is quickly distinguished from that plant, as follows:

Perigynia nerveless on inner surface, 3.5 mm. long or less.	*C. Hookeriana.*
Perigynia strongly nerved on inner surface, 5 mm. long.	*C. tumulicola.*

SPECIMENS EXAMINED:

CALIFORNIA: Lake Temescal, Alameda county, *Bioletti*, June 25, 1893 (type, in Herb. Columbia College); Oakland, *Bolander*; Los Gatos, Santa Clara County, *Heller 7309*, April 12, 1904.

Two new willows from the Canadian Rocky Mountains*

WILLARD WINFIELD ROWLEE

During the summer of 1899, Mr. W. C. McCalla spent several months exploring and collecting in the vicinity of Banff, Alberta. At the writer's suggestion he made a special effort to secure a set of willows of the region, in which the stages of development would be shown. Usually collectors have too little time at their disposal to label or otherwise mark individuals in the field and then to go over the ground a second or third time and supplement their first collection, a method very essential in making specimens of *Salix*. Mr. McCalla not only did this but was also well equipped by natural aptitude and previous study to carry on a thorough investigation of the flora. The result of his work was an admirable and valuable set of plants from a region heretofore imperfectly know. Mr. Ball has already recognized, among McCalla's willows, specimens representing his new species, *Salix wyomingensis*. Two other specimens appear to represent new species of *Salix*.

Salix albertana sp. nov.

Low stout shrub; shoots of current and preceding year dark-brown, covered with sparse cobweb-like pubescence, roughened by the leaf-scars and the more or less persistent scales; buds small, brown; leaves broadly elliptic-lanceolate, tapering equally to both ends, minutely glandular-serrulate or entire, clothed both sides with dense appressed silky tomentum when young, becoming less so with age, markedly opaque, petiole stout, 0.5–0.75 cm. long, blade 6–7 cm. long, the broadest 2.5 cm. wide, midrib and primaries prominent, ultimate veins distinctly reticulate; stipules large, the largest 0.75 cm. long, and 0.5 cm. wide, obscurely glandular denticulate, semi-persistent; aments large, sessile, terminal, usually in pairs, appearing before the leaves, silky and densely flowered; pistillate cylindrical, 5–6 cm. long, 1.5 cm. thick, remaining dense at maturity; scale black, nearly equaling the ovary at anthesis, elliptic, obtuse, clothed on the back and margins with long silky hairs; capsule lanceolate, silky-pubescent, sessile, tapering into the long

* Contribution No. 122 from the Botanical Department of Cornell University.

(2 mm.) style which is deeply divided, each division bifid; gland large; stamens 2, filaments glabrous.

The type of this species is Mr. McCalla's *2251*, collected in Alberta, British Columbia, on the "higher mountain slopes in rather wet ground (alt. 6500–7800 ft.), June 30, July 18, and August 30, 1899." Our specimens still retain the balsamic odor which in the fresh plant was as "strong as that of Balm of Gilead, and much like it."

It is quite probable that our species is *S. Barrattiana* var. *angustifolia* Anders. in DC. Prodr. 16^2: 247. In floral characters it is much like *S. Barrattiana* Hooker, as understood by Mr. Bebb and subsequent students, but differs fundamentally in form and vesture of the leaf. One (both are marked "B") of the two pistillate leafy twigs represented in Hooker's plate of *S. Barrattiana* seems to have been based on this shrub. The other pistillate leafy twig, the details of leaf and floral structure, and the description, apply to *S. Barrattiana*, which has "leaves cordate at the base."

Present knowledge would therefore indicate that three species may be recognized in connection with the *Barrattiana* group: *S. Barrattiana* Hooker and *S. Tweedyi* (Bebb) Ball, both of which have leaves thin and green and cordate at the base, but differ in that the former has leaves and capsules with a conspicuous silky vesture; *S. albertana* has thick opaque leaves, acute at the base and apex and agrees with *S. Barrattiana* in vesture. All three have styles and stigmas which are characteristic and all have the same peculiar glands on the margins of the stipules and leaf-blades.

Salix Maccalliana sp. nov.

Shrub 1–2 meters high. Young shoots and leaves minntely puberulent, soon becoming glabrous throughout; bark upon older branches dark-brown; buds yellow, rather large, flattened, pointed; leaves elliptic-lanceolate, 6–7 cm. long, 1.5 cm. wide, tapering equally to both ends, green and glabrous on both sides at maturity, finely but distinctly serrate, the serrations terminating in a characteristic callus, petioles 0.5–0.75 cm. long, the petiole, mid-rib and primary veins light-yellowish and in strong contrast to the green of the rest of the leaf which is obscurely reticulately veiny both sides; stipules none; aments borne on short leafy peduncles, the axis and the upper part of the peduncle hoary-canescent; flowers densely aggregated in the ament at anthesis, the pistillate becoming more lax as the capsules mature; scale membranous and green at first, becoming tawny, with 3 or 4 prominent parallel veins, oblong, more than twice the length of the pedicel, rounded at the apex, crisp-hairy on the back; capsule large, prominently rostrate, clothed with short spreading silky hairs, about 8 mm. long at maturity, pedicel short (1 mm.), about twice the length of the yellow gland; style glabrous, 1 mm. long, surmounted by four stout stigmas; style and stigmas reddish-brown; stamens 2, filaments with a few spreading hairs at the base.

This beautiful shrub is obviously related to *Salix glaucops* Anders., but differs in having glabrous serrate leaves. Its leaves and buds suggest *S. lucida.*

McCalla 2252a (pistillate), *McCalla 2252* (staminate), type. Both collected in Alberta, British Columbia, at alt. 4500 feet, the former "at water's edge along road to Sun Dance Cañon, July 10, 1899"; the latter on "low ground along road to Devil's Head Lake, June 19 and August 19, 1899."

INDEX TO AMERICAN BOTANICAL LITERATURE

(1907)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions their kindness will be appreciated.

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Abel, J. J. & Ford, W. W. On the poisons of *Amanita phalloides*. Jour. Biol. Chem. **2**: 273–288. Ja 1907.

Allison, A. Notes on the spring birds of Tishomingo County, Mississippi. The Auk **24**: 12–25. Ja 1907.

Several pages are devoted to the flora of the county.

Arthur, J. C. New genera of *Uredinales*. Jour. Myc. **13**: 28–32. 1 Ja 1907.

Polioma, *Spirechina*, *Prospodium*, and *Nephlyctis*.

Bailey, W. W. The baobab. Am. Bot. **11**: 115, 116. Ja 1907.

Barnes, C. R. Illustrating botanical papers. Bot. Gaz. **43**: 59–63. 24 Ja 1907.

Beardslee, H. C. The lepiotas of Sweden. Jour. Myc. **13**: 26–28. 1 Ja 1907.

Berger, A. *Beschorneria pubescens* Berger n. sp. Monats. Kakteenk. **17**: 1–3. 15 Ja 1907.

Probably a native of Mexico.

Berry, E. W. Coastal-plain amber. Torreya **7**: 4–6. 7 Ja 1907.

Blanchard, W. H. Connecticut *Rubi*. Rhodora **9**: 4–10. 22 Ja 1907.

Includes descriptions of 3 new species.

Blanchard, W. H. A new blackberry from Massachusetts and Rhode Island. Torreya **7**: 7, 8. 7 Ja 1907.
Rubus multispinus sp. nov.

Britton, E. G. Notes on nomenclature VII. Bryologist **10**: 7, 8. 2 Ja 1907.

Britton, N. L. A new polygalaceous tree of Porto Rico. Torreya **7**: 38, 39. 28 F 1907.
Phlebotaenia Cowellii sp. nov.

Britton, N. L. Two undescribed species of *Comocladia* from Jamaica. Torreya **7**: 6, 7. 7 Ja 1907.

Carothers, I. E. Development of ovule and female gametophyte in *Ginkgo biloba*. Bot. Gaz. **43**: 116–130. *pl. 5, 6.* 16 F 1907.

Chamberlain, C. J. Preliminary note on *Ceratozamia*. Bot. Gaz. **43**: 137. 16 F 1907.

Clute, W. N. Some fruits from a tropical garden. Am. Bot. **11**: 97–105. Ja 1907. [Illust.]

Cockerell, T. D. A. Some new names. Muhlenbergia **3**: 9. 30 Ja 1907.
Isoetes echinospora Brittoni, *Salix cascadensis*, and *Microbahia* (gen. nov.) *Lemmoni*.

Coker, W. C. Fertilization and embryogeny in *Cephalotaxus Fortunei*. Bot. Gaz. **43**: 1–10. *pl. 1 + f. 1, 18–21.* 24 Ja 1907.

Condit, D. Winter key to the Ohio species of *Euonymus*. Ohio Nat. **7**: 60. 15 Ja 1907.

Cushman, J. A. Some desmids from Newfoundland. Bull. Torrey Club **33**: 607–615. 7 F 1907.

Davidson, A. Flora of Clifton, Arizona. Bull. So. Calif. Acad. Sci. **5**: 67–70. 4 Ja 1907.

Detmers, F. Additions to the Ohio flora for 1905–6. Ohio Nat. **7**: 61. 15 Ja 1907.

Dobbin, F. An August outing. Am. Bot. **11**: 112–115. Ja 1907.

Eggleston, W. W. New North American *Crataegi*. Torreya **7**: 35, 36. 28 F 1907.
Descriptions of 2 new species.

Evans, A. W. Hepaticae of Puerto Rico — VII. *Stictolejeunea*, *Neurolejeunea*, *Omphalanthus*, and *Lopholejeunea*. Bull. Torrey Club **34**: 1–34. *pl. 1–4.* 27 F 1907.
Includes *Lopholejeunea Howei* sp. nov.

Fedde, F. *Dendromeconis* generis species novae. Repert. Nov. Sp. **3**: 245, 246. 15 Ja 1907.

Descriptions of 3 new species, all from California.

Fernald, M. L. *Ribes vulgare* and its indigenous representatives in eastern North America. Rhodora **9**: 1–4. 22 Ja 1907.

Fernald, M. L. The variations of *Primula farinosa* in northeastern America. Rhodora **9**: 15, 16. 22 Ja 1907.

Foster, A. S. Observations on the vegetation of the Wallula gorge. Plant World **9**: 287–291. [F 1907.]

Gates, R. R. Pollen development in hybrids of *Oenothera lata* × *O. Lamarckiana*, and its relation to mutation. Bot. Gaz. **43**: 81–115. *pl. 2–4.* 16 F 1907.

Gleason, H. A. A botanical survey of the Illinois River valley sand region. Bull. Ill. State Lab. Nat. Hist. **7**: 149–194. *pl. 8–21.* Ja 1907.

Gow, J. E. Morphology of *Spathyema foetida.* Bot. Gaz. **43**: 131–136. *f. 1–7.* 16 F 1907.

Griffiths, D. Preparation of specimens ot *Opuntia.* Plant World **9**: 278–284. *f. 49, 50.* [F 1907.]

Grignan, G. T. *Rhus typhina laciniata.* Rev. Hort. II. **7**: 10, 11. *f. 1, 2.* 1 Ja 1907.

Grout, A. J. Notes on Vermont bryophytes — 1906. Bryologist **10**: 6, 7. 2 Ja 1907.

Gürke, M. *Opuntia Spegazzinii* Web. Monats. Kakteenk. **17**: 3–5. 15 Ja 1907.

Heller, A. A. New western plants. Muhlenbergia **3**: 10–12. 30 Ja 1907.

Cakile californica and *Ribes Suksdorfii* spp. nov.

Holm, T. The anatomical method. Am. Jour. Pharm. **79**: 56–60. F 1907.

Holm, T. The internal structure of the stem and leaf of *Ruellia ciliosa* Pursh, *Phlox ovata* L. and *Spigelia marilandica* L. Am. Jour. Pharm. **79**: 51–56. *pl. 1, 2.* F 1907.

Holzinger, J. M. Is *Physcomitrium immersum* a gregarious moss? Bryologist **10**: 13. 2 Ja 1907.

House, H. D. Note upon a Guam species of *Ipomoea.* Torreya **7**: 37, 38. 28 F 1907.

Jensen, G. H. Toxic limits and stimulation effects of some salts and poisons on wheat. Bot. Gaz. **43**: 11–44. *f. 1–34.* 24 Ja 1907.

Kauffman, C. H. The genus *Cortinarius* with key to the species. Jour. Myc. **13**: 32–39. *pl. 93–100.* 1 Ja 1907.

Kennedy, P. B. & McDermott, L. F. A new clover. Muhlenbergia **3**: 8. 30 Ja 1907.

Trifolium orbiculatum, native of Montana.

Kern, F. D. The rusts of Guatemala. Jour. Myc. **13**: 18–26. 1 Ja 1907.

Enumerates 40 species, including new species in *Puccinia*, *Aecidium* (2), and *Uredo* (2).

Knowlton, C. H. Newly observed stations for Massachusetts plants. Rhodora **9**: 11–15. 22 Ja 1907.

Lyman, G. R. Culture studies on polymorphism of *Hymenomycetes*. Proc. Boston Soc. Nat. Hist. **33**: 125–209. *pl. 18–26.* F 1907.

McCleery, E. M. Stellate hairs and peltate scales of Ohio plants. Ohio Nat. **7**: 51–56. *pl. 5, 6.* 15 Ja 1907.

MacDougal, D. T. Collecting cacti in southern Mexico. Jour. N. Y. Bot. Gard. **8**: 1–13. *f. 1–7.* [F] 1907.

MacDougal, D. T. Hybridization of wild plants. Bot. Gaz. **43**: 45–58. *f. 1–4.* 24 Ja 1907.

Macfarlane, J. M. Observations on *Sarracenia*. Jour. Bot. **45**: 1–7. 1 Ja 1907.

Maiden, J. H. Notes on some plants which in drying stain paper. Am. Jour. Pharm. **79**: 62–67. F 1907.

Mark, C. G. Color of Ohio flowers. Ohio Nat. **7**: 57–60. 15 Ja 1907.

Massee, G. Plant diseases.— VII. "Cluster-cup" disease of conifers. (*Calyptospora Goeppertiana* Jul. Kühn.) Kew Bull. Misc. Inf. **1907**: 1–3. *pl.* Ja 1907.

Morgan, A. P. North American species of *Lepiota* (concluded). Jour. Myc. **13**: 1–18. 1 Ja 1907.

Includes descriptions of 4 new species.

Nicholson, W. E. William Mitten. A sketch with bibliography. Bryologist **10**: 1–5. *pl. 1.* 2 Ja 1907.

Ortmann, A. E. Facts and interpretations on the mutation theory. Science II. **25**: 185–190. 1 F 1907.

Parish, S. B. Some plants erroneously or questionably attributed to Southern California. Muhlenbergia **3**: 1–7. 30 Ja 1907.

Purpus, J. A. *Echinocactus platensis* Spegazz. Monats. Kakteenk. **17**: 8, 9. 15 Ja 1907. [Illust.]

Native of Argentina.

Renauld, F. Causerie sur les *Harpidia*. Rev. Bryol. **34**: 7–14. [Ja] 1907.

Renner, O. Beiträge zur Anatomie und Systematik der Artocarpeen und Conocephaleen, inbesondere der Gattung *Ficus*. Bot. Jahrb. **39**: 319–448. 15 Ja 1907.

Robinson, C. B. Some affinities of the Philippine flora. Torreya **7**: 1–4. 7 Ja 1907.

Rolfe, R. A. *Cycnoches Loddigesii*. Orch. Rev. **15**: 25, 26. *f. 4*. Ja 1907.

Native of Surinam.

Rolfe, R. A. *Oncidium Waleuwa*. Orch. Rev. **15**: 3. Ja 1907.

Native of Minas Geraes, Brazil.

Rusby, H. H. The wild grains and nuts of the United States. Jour. N. Y. Bot. Gard. **7**: 269–273. [Ja 1907.]

Rydberg, P. A. Studies on the Rocky Mountain flora — XVII. Bull. Torrey Club **34**: 35–50. 27 F 1907.

Includes new species in *Pedicularis*, *Adenostegia*, *Castilleja* (13), *Lupinus* (10), *Trifolium* (4), *Tium*, *Hamosa*, *Xylophacos*, and *Homalobus* (2).

Schaffner, J. H. Synapsis and synizesis. Ohio Nat. **7**: 41–48. *pl. 4*. 15 Ja 1907.

Schlechter, R. *Orchidaceae* novae et criticae. Decas VIII. Repert. Nov. Sp. **3**: 246–251. 15 Ja 1907.

New species in *Pleurothallis* (2), *Stelis*, *Epidendrum* (3), *Camaridium*, *Ornithidium*, and *Ornithocephalus*, all from Costa Rica.

Skan, S. A. *Lomatia ferruginea*. Curt. Bot. Mag. IV. **3**: *pl. 8112*. Ja 1907.

Native of Chile and Patagonia.

Skan, S. A. *Ribes mogollonicum*. Curt. Bot. Mag. IV. **3**: *pl. 8120*. F 1907.

Native of southwestern United States.

Smith, B. G. *Volvox* for laboratory use. Am. Nat. **41**: 31–34. 8 Ja 1907.

Sprague, T. A. The synonymy and distribution of the species of *Tricuspidaria*. Kew Bull. Misc. Inf. **1907**: 10–16. Ja 1907.

Natives of Chile.

Sprague, T. A. *Tricuspidaria dependens*. Curt. Bot. Mag. IV. **3**: *pl. 8115*. Ja 1907.

Native of central Chile.

Stone, W. Some new plants for southern New Jersey. Torreya **7**: 39, 40. 28 F 1907.

Sumstine, D. R. New stations for two plants. Torreya **7**: 36, 37. 28 F 1907.

Thornber, J. J. The Toumey cactus garden. Plant World **9**: 273–277. *f. 45–48.* [F 1907.]

Trelease, W. The century plant, and some other plants of the dry country. Pop. Sci. Mo. **70**: 207–228. *f. 1–22.* Mr 1907.

Trotter, S. Nature names in America. Pop. Sci. Mo. **70**: 63–75. Ja 1907

Underwood, L. M. American ferns — VII. Bull. Torrey Club **33**: 591–605. *f. 1–16.* 7 F 1907.

Includes 2 new species of *Stenochlaena*.

Vail, A. M. Jane Colden, an early New York botanist. Torreya **7**: 21–34. 28 F 1907. [Illust.]

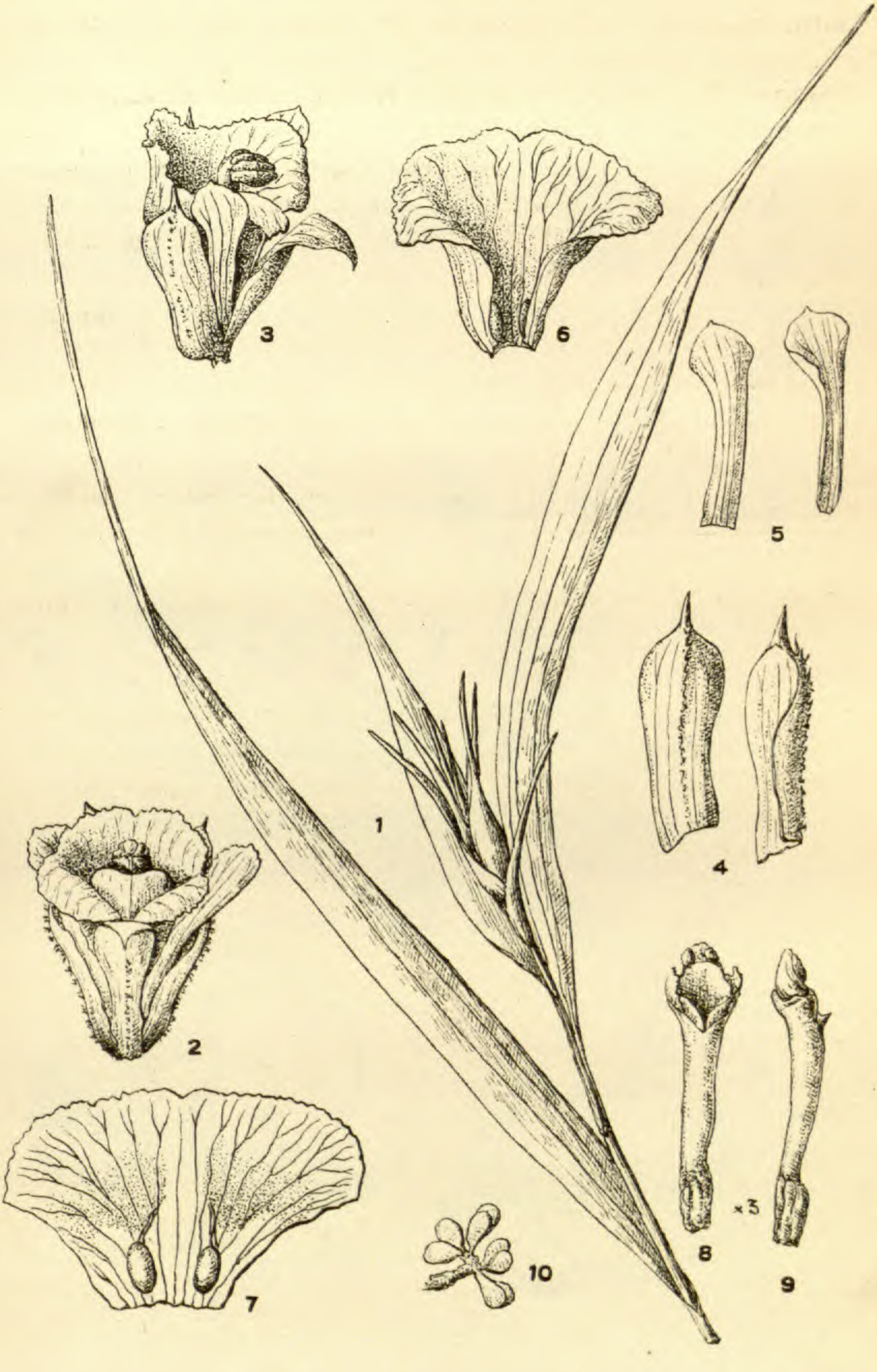
Vail, A. M. Note on a little-known work on the natural history of the Leeward Islands. Jour. N. Y. Bot. Gard. **7**: 275–279. [Ja 1907.]

Weberbauer, A. Weitere Mitteilungen über Vegetation und Klima der Hochanden Perus. Bot. Jahrb. **39**: 320–461. *pl. 4, 5.* 15 Ja 1907.

Woodward, R. W. Notes on Connecticut plants. Rhodora **9**: 10, 11. 22 Ja 1907.

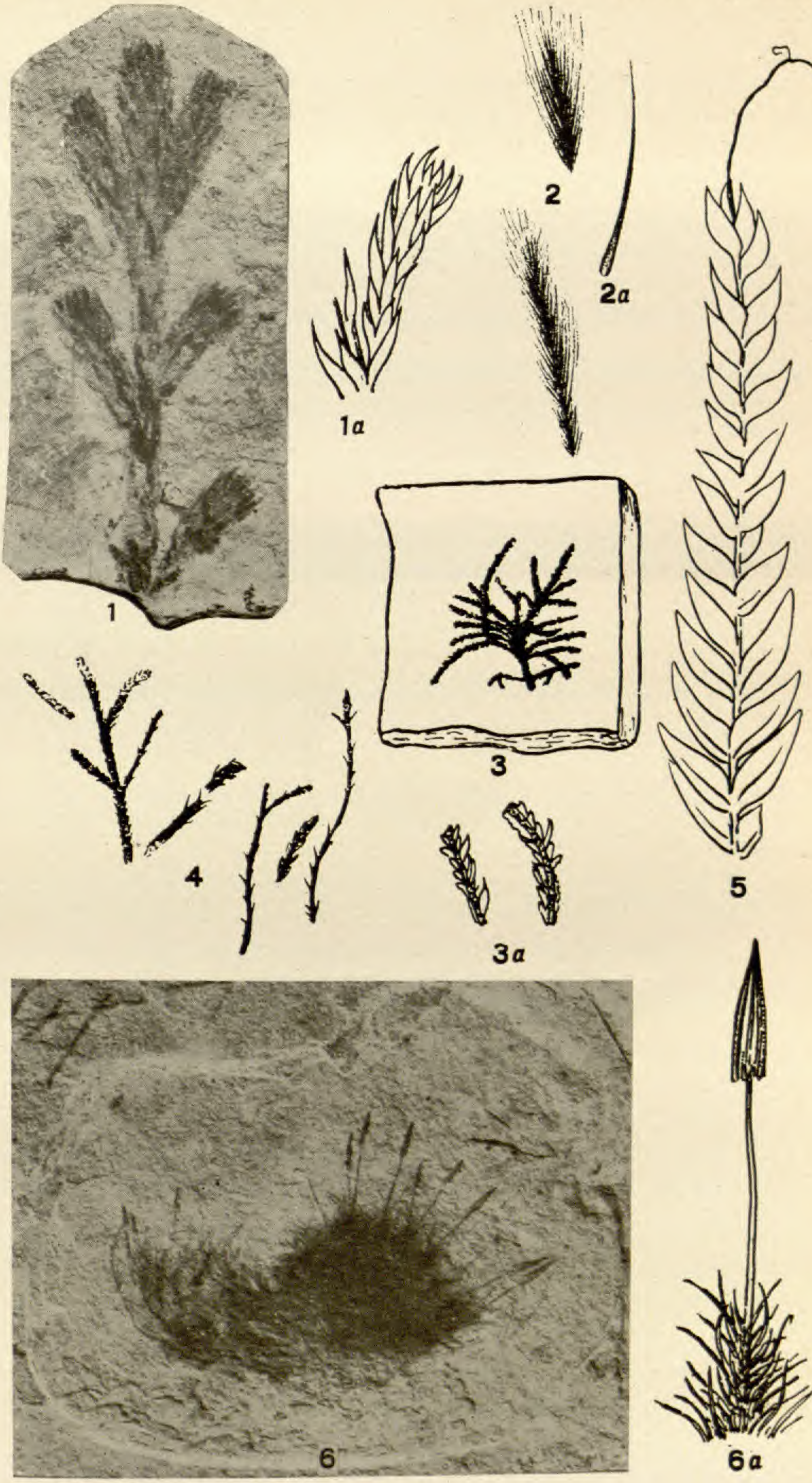
Zahlbruckner, A. Neue Flechten. III. Ann. Myc. **4**: 486–490. 15 Ja 1907.

Includes *Lecanactis salicina* sp. nov., from California.



ELLEANTHUS CARICOIDES Nash.

ZYGOSTATES COSTARICENSIS Nash.



AMERICAN FOSSIL MOSSES

North American Flora

THIS work is designed to present descriptions of all plants growing, independent of cultivation, in North America, here taken to include Greenland, Central America, the Republic of Panama, and the West Indies, except Trinidad, Tobago, and Curaçao and other islands off the north coast of Venezuela, whose flora is essentially South American.

It will be published in parts at irregular intervals by the New York Botanical Garden through the aid of the income of the David Lydig Fund bequeathed by Charles P. Daly.

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Volume 1. Mycetozoa, Schizophyta, Diatomaceae.
Volumes 2 to 10. Fungi.
Volumes 11 to 13. Algae.
Volumes 14 and 15. Bryophyta.
Volume 16. Pteridophyta and Gymnospermae.
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Volumes 20 to 30. Dicotyledones.

The preparation of the work has been referred by the Scientific Directors of the Garden to a committee consisting of Professors L. M. Underwood and N. L. Britton.

Professor George F. Atkinson of Cornell University, Professors Charles R. Barnes and John M. Coulter of the University of Chicago, Mr. Frederick V. Coville of the United States Department of Agriculture, Professor Edward L. Greene of the United States National Museum, Professor Byron D. Halsted of Rutgers College and Professor William Trelease of the Missouri Botanical Garden have consented to act as an advisory committee.

Each author will be wholly responsible for his own contributions, being restricted only to the general style adopted for the work, which must vary somewhat in the treatment of diverse groups.

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CONTENTS

AMERICAN CODE OF BOTANICAL NOMENCLATURE. 167
The embryology of Rhytidophyllum. (Plate 10.) MELVILLE THURSTON COOK 179
Contributions to the Mesozoic flora of the Atlantic coastal plain—II. North Carolina. (Plates 11–16.) . . . . . . EDWARD WILBER BERRY 185
Concerning some West American fungi . . . . DAVID GRIFFITHS 207
INDEX TO AMERICAN BOTANICAL LITERATURE 213

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Vol. 34 No 4

BULLETIN

OF THE

TORREY BOTANICAL CLUB

APRIL, 1907

AMERICAN CODE OF BOTANICAL NOMENCLATURE

The Nomenclature Commission has carefully examined the rules and recommendations adopted by the International Botanical Congress held at Vienna in June, 1905, and compared them with the canons unanimously approved by them at their meeting held in Philadelphia in March, 1904, which were duly transmitted to the Vienna Congress.

The Vienna Congress decided to base its deliberations and its code on the code of nomenclature adopted by the Botanical Congress held in Paris in 1867. At the Philadelphia meeting above referred to, this Commission concluded that better results would be obtained by abandoning the Paris code altogether and substituting for it a simpler set of rules,* more satisfactorily arranged, which should recognize and emphasize the method of establishing and maintaining botanical names by the method of types. The Vienna Congress failed to recognize the principle of types, however, although its results are an advance in several ways over the Paris rules of 1867. This Commission is still of the opinion that the method by types will obtain general recognition and acceptance, inasmuch as it is the only one which promises sufficient definiteness to answer present requirements in biological nomenclature. The present discussion of this subject by zoölogists is illuminating and will lead to important results. To reach greater precision we suggest certain modifications of the rules governing the selection of types enunciated at our Philadelphia meeting.

The Vienna Congress voted unanimously that the principles of nomenclature should not be arbitrary, but subsequently adopted, though not unanimously, a list of several hundred generic names of plants to be excluded from the operation of all nomenclatorial rules. We regard this action as in the highest degree arbitrary, as

* Bull. Torrey Club 31 : 249–261. 1904.

[The BULLETIN for March 1907 (34 : 116–166, *pl.* 7–9) was issued 7 My 1907.]

controverting a cardinal principle ; and no method is provided for fixing the types of the genera which it is proposed to maintain or reject.

The treatment of homonyms was not given the importance at Vienna that this Commission believes necessary, although we are now of the opinion that the canons of the Philadelphia code relating to homonyms were framed in a somewhat more exclusive manner than is desirable, and we recommend some amendments to these canons.

It was unanimously agreed at Vienna to maintain the oldest specific name when a species is transferred from one genus to another, or the oldest subspecific or varietal name when a subspecies or variety is transferred from one species to another ; but, when the rank is changed from species to subspecies or variety, or vice versa, the name need not be maintained, although it is desirable that it should be. To meet this agreement the Philadelphia code requires modifications, as shown by the amendments herewith recommended.

By a close vote, the Vienna Congress called for all descriptions of new species or genera, published after January 1, 1908, to be accompanied by a diagnosis in the Latin language. This requirement reaches the height of arbitrary action, and we do not regard the subject as one over which any botanical congress has jurisdiction. The progressive disuse of Latin, its elimination from the curricula of scientific schools, and the general teaching of two or more modern languages, lead us to regard this action as unnecessary and unwise.

We recommend that the Code adopted at Philadelphia be maintained, as amended, as follows.

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Members and Alternates of the Nomenclature Commission of the Botanical Club of the American Association for the Advancement of Science.

CODE

PART I. PRINCIPLES.

1. The primary object of formal nomenclature in systematic biology is to secure stability, uniformity and convenience in the designation of plants and animals.
2. Botanical nomenclature is treated as beginning with the general application of binomial names of plants (Linnaeus' Species Plantarum, 1753).
3. Priority of publication is a fundamental principle of botanical nomenclature. Two groups of the same category cannot bear the same name.

   NOTE. — Previous use of a name in zoölogy does not preclude its use in botany; but the proposal of such a name should be avoided.
4. The application of a name is determined by reference to its nomenclatorial type.

PART II. CANONS.

Section I. Categories of Classification.

CANON 1. Connected or coherent groups of individuals are termed species.

CANON 2. Species are grouped into genera; genera into tribes; tribes into families; families into orders; orders into classes; classes into divisions.

CANON 3. When additional categories are necessary for the convenient presentation of relationships, they are to be obtained by the recognition of intermediate groups, the names of which are formed by prefixing sub- to the names of the above principal categories.

EXAMPLES. — Subspecies, subgenus, subfamily, suborder.

CANON 4. Other terms, such as group, section, series, and branch, may be used for more convenient temporary arrangement under the above categories, but their names are to have no validity in formal taxonomy.

NOTE. — The term variety is relegated to horticultural usage.

Section II. Formation of Names.

CANON 5. Specific and subspecific names consist of Latin or Latinized adjectives or substantives, the latter being either nominatives in apposition or genitives.

EXAMPLES. — *Hookerianus ; europaeus ; vulgaris ; heterophyllus ; malvicola ; Tulipifera ; Tuna ; Engelmanni ; Sonorae ; Trifolii.*

CANON 6. Generic and subgeneric names consist of Latin or Latinized substantives, or equivalent terms.

EXAMPLES. — *Rosa; Convolvulus; Hedysarum; Bartramia; Liquidambar ; Couroupita ; Tsuga ; Gloriosa ; Impatiens ; Manihot.*

CANON 7. Names for subtribes, orders, and intervening groups, are formed from names of component genera.

(*a*) For names of tribes add -eae, of families -aceae, of orders -ales, to the stem of the generic name.

EXAMPLES.—*Roseae ; Rosaceae ; Rosales.*

(*b*) For names of subtribes add -anae, of subfamilies -atae, of suborders -ares, to the stem of the generic name.

EXAMPLES.—*Rosanae ; Rosatae ; Rosares.*

CANON 8. Names for subclasses and higher groups consist of plural Latin or Latinized substantives.

EXAMPLES.—*Monocotyleaones ; Angiospermae ; Pteridophyta.*

Section III. Publication of Names.

CANON 9. A specific or subspecific name is published when it has been printed and distributed with a description (or in palaeobotany a figure), or with a reference to a previously published description.

EXAMPLES.—*Coursetia arborea* Griseb. Fl. Brit. W. Ind. 183 (1859), is published with a description ; *Cynanchum nivale* Nym. Syll. Fl. Eur. 108 (1855), is published with a reference to the previously described *Vincetoxicum nivale* Bois. & Heldr.; *Pterospermites Whitei* Ward, Ann. Rep. U. S. Geol. Surv. **6** : 556. *pl. 56, f. 5, 6* (1885), a fossil species, is published with a figure, but without a description.

(*a*) In the transfer of a species from one genus to another, the original specific name is retained, unless the resulting binominal has been previously published.

EXAMPLES.—*Bromus giganteus* L. Sp. Pl. 77, is *Festuca gigantea* (L.) Vill. Hist. Pl. Dauph. **2** : 110 (1787) ; *Arum triphyllum* L. Sp. Pl. 965, is to be known as *Arisaema triphyllum* (L.) Torr. Fl. N. Y. **2** : 239 (1843), not as *Arisaema atrorubens* Blume, Rumphia **1** : 97 (1835) ; *Laurus Sassafras* L. Sp. Pl. 371, is to be known as *Sassafras Sassafras* (L.) Karst. Deutsch. Fl. 505 (1881), not as *Sassafras officinale* Nees & Eberm. Handb. Med.-pharm. Bot. **2** : 418 (1831) ; however, *Schoenus pusillus* Sw. Nov. Gen. & Sp. Pl. 20 (1788), when transferred to *Rynchospora*, is not to be known as *Rynchospora pusilla* (Sw.) Griseb. Kar. 123 (1857), because prior to 1857 the same binomial had been used for another species, *Rynchospora pusilla* Chapm. (1849).

CANON 10. A generic or subgeneric name is published when it has been printed and distributed (1) with a generic or specific description (or in palaeobotany a figure) and a binomial specific name, or (2) with a generic and specific name and the citation of a previously published description, or (3) with a reference to a specific description, which is associable by citation with a previously published binomial species.

EXAMPLES.—*Pachysandra* Michx. Fl. Bor. Am. 2 : 177 (1803), is published with a generic and specific description and a binomial specific name; *Brasenia* Schreb. ex Gmel. Syst. 2 : 853 (1791), is published with a generic description and a binomial specific name; *Silphium* L. Sp. Pl. 919 (1753), is published with a specific description and a binomial specific name; *Poacites* Schloth. Petrefact. 416, *pl. 26, f. 1, 2* (1820), a fossil genus, is published with figures and a binomial specific name, but without a description; *Nyssa* L. Sp. Pl. 1058 (1753), is published with a generic and specific name and the citation of previously published descriptions; *Dryopteris* Adans. Fam. Pl. 2 : 20 (1763), is published with a reference to a specific description associable by citation with the previously published *Polypodium Filix-mas* L. Sp. Pl. 1090 (1753), inasmuch as both Adanson and Linnaeus cite *Filix mas* of Fuchs.

CANON 11. Names of subtribes, orders, and intervening groups are published when they have been printed and distributed with direct or indirect citations of component genera.

EXAMPLES.—*Moraceae* Lindl. Veg. Kingd. 266 (1847), is published with the citation of component genera; *Ophioglossales* Engler, Syll. ed. 2, 63 (1898), is published with the citation of component genera.

CANON 12. A name is not published by its citation in synonymy, or by incidental mention.

EXAMPLES.—*Echeveria spicata*, cited by De Candolle, Prodr. 3 : 349 (1828) as a synonym of *Fouquieria formosa*, is not published and does not invalidate *Echeveria* DC. published on page 401 of the same volume; *Acrostichum Plumieri* "Desv. herb," cited as a synonym of *A. viscosum* in Fée, Mém. Fam. Foug. 2 : 46 (1845), is not published, and does not invalidate *Acrostichum Plumieri* Fée, published as a species on page 50 of the same work; *Hormisus opuntioides* Targ., cited by Bertoloni, Amoen. Ital. 316 (1819), as a synonym of *Fucus Sertolara* Bertol. (= *Halimeda Tuna*), is not thereby published.

CANON 13. Of names published in the same work and at the same time, those having precedence of position are to be regarded as having priority.

EXAMPLES.—*Alsine* L. Sp. Pl. 272, is to be regarded as having priority over *Stellaria* L. Sp. Pl. 421; *Aira spicata* L. Sp. Pl. 63, is to be regarded as having priority over *Aira spicata* L. Sp. Pl. 64; *Hibiscus Moscheutos* L. Sp. Pl. 693, is to be regarded as having priority over *H. palustris*, which it precedes on the same page.

Section IV. Application of Names.

CANON 14. The nomenclatorial type of a species or subspecies is the specimen to which the describer originally applied the name in publication.

EXAMPLES.—*Polypodium marginale* L. Sp. Pl. 1091 is typified by the designation of a specimen collected in Canada by Kalm; *Stachys arenicola* Britton, Man. 792 (1901), is typified by the designation of a specimen from Staten Island, New York; *Carex intumescens Fernaldii* Bailey, Bull. Torrey Club **20**: 418 (1893), is typified by a specimen collected at Cedar Swamp, Aroostook County, Maine, by M. L. Fernald.

(*a*) When more than one specimen was originally cited, the type or group of specimens in which the type is included may be indicated by the derivation of the name from that of the collector, locality or host.

EXAMPLES.—*Eriogonum Porteri* Small, Bull. Torrey Club **25**: 41 (1898), is based on several specimens, of which the one collected by T. C. Porter is the type; *Gaillardia arizonica* A. Gray, Syn. Fl. N. Am. 1^2: 353 (1884), is based on several specimens, of which the one collected by Palmer in Arizona is the type; *Cuscuta Cephalanthi* Engelm. Am. Jour. Sci. **43**: 336 (1842), is based on specimens from several hosts, of which the one from *Cephalanthus* is the type.

(*b*) Among specimens equally eligible, the type is that first figured with the original description, or in default of a figure the first mentioned.

EXAMPLES.—*Calyptridium roseum* S. Wats. Bot. King's Exp. 44. *pl. 6, f. 6–8* (1871), is based on at least three specimens, of which the one figured is the type; *Arnica cordifolia* Hook. Fl. Bor. Am. **1**: 331 (1833), is based on two specimens, neither of which is figured, and the one first mentioned, which was collected by Drummond in alpine woods of the Rocky Mountains, is the type.

(*c*) In default of an original specimen, that represented by the identifiable figure or (in default of a figure) description first cited or subsequently published, serves as the type.

EXAMPLES.—*Trillium sessile* L. Sp. Pl. 340, is based on three citations, of which the second is the type, being accompanied by a figure; *Centaurea Scabiosa* L. Sp. Pl. 913, is based on a number of citations, of which the first mentioned is the type, as no figures are cited.

CANON 15. The nomenclatorial type of a genus or subgenus is the species originally named or designated by the author of the name. If no species was designated, the type is the first binomial species in order eligible under the following provisions:

(*a*) The type is to be selected from a subgenus, section or other list of species originally designated as typical

The publication of a new generic name as an avowed substitute for an earlier invalid one does not change the type of a genus.

EXAMPLES.— *Psilogramme* Kuhn, Festschr. 50-Jähr. Jub. Königs. Realschule zu Berlin 332 (1882), is typified by the first-mentioned species of the second section *Eupsilogramme*, and not from species included in the first section *Jamesonia*, which is based on a generic name previously published; *Phania* DC. Prodr. 5: 114 (1826), is typified by *P. multicaulis* DC., the only species of the section *Euphania; Guignardia* Viala & Ravaz, Bull. Soc. Myc. Fr. 8: 63 (1892), which was substituted for *Laestadia* Auers. Hedwigia 8: 177 (1869) not *Laestadia* Kunth in Less. Syn. Compos. 203 (1832), is typified by *Laestadia alnea* (Fr.) Auers., which is the first of the three species given by Auerswald and accompanied by a citation of Fr. Scler. Suec. Exsic. *no. 59*, and not by *Laestadia Bidwellii* (Ellis) Viala & Ravaz, the only species mentioned by Viala & Ravaz at the time the substitution was made.

(*b*) A figured species is to be selected rather than an unfigured species in the same work. In the absence of a figure, preference is to be given to the first species accompanied by the citation of a specimen in a regularly published series of exsiccatae. In the case of genera adopted from prebinomial authors (with or without change of name), a species figured by the author from whom the genus is adopted should be selected.

EXAMPLES. — *Lespedeza* Michx. Fl. Bor. Am. 2: 70 (1803), is typified by *L. procumbens* Michx. *loc. cit. pl. 39*, the species first figured; *Stigmatea* Fr. Sum. Veg. Scand. 421 (1849), is typified by *S. Robertiana* Fr., the fourth species, as there are no species figured and this is the first in the list accompanied by the citation of a specimen in published exsiccatae, Scler. Suec. Exsic. *no. 423*.

(*c*) The application to a genus of a former specific name of one of the included species, designates the type.

EXAMPLES. — *Amsonia* Walt. Fl. Car. 98 (1788), is typified by *Tabernaemontana Amsonia* L., one of its two original species; *Sordaria* Ces. & DeN. Comm. Soc. Critt. Ital. 1: 225 (1863), is typified by *Sphaeria Sordaria* Fr., one of its twelve original species.

(*d*) Where economic or indigenous species are included in the same genus with foreign species, the type is to be selected from (1) the economic species or (2) those indigenous from the standpoint of the original author of the genus.

EXAMPLES. — *Poa* L. Sp. Pl. 67 (1753), is typified by *P. pratensis* L., the first of the economic species; *Sanguisorba* L. Sp. Pl. 116 (1753), is typified by *S. officinalis*, the species indigenous from the standpoint of the author.

(*e*) The types of genera adopted through citations of nonbinomial literature (with or without change of name), are to be selected from those of the original species which receive names in the first binomial publication. The genera of Linnaeus' Species Plantarum (1753) are to be typified through the citations given in his Genera Plantarum (1754).

NOTE. — The Species Plantarum contains no generic references, but the 1754 edition of the Genera Plantarum was evidently prepared at the same time and was in effect a complementary volume of the same work. It accords much more nearly than other editions with the treatment followed in the Species Plantarum, and thus makes it possible to retain more of the Linnaean generic names in their current application.

EXAMPLES. — *Cypripedium* L. Sp. Pl. 951, a genus adopted from Tournefort with a change of his name *Calceolus*, is typified by *Cypripedium Calceolus*, the only species common to both authors; *Seseli* L. Sp. Pl. 259, a genus adopted from Boerhaave, is typified by the second species of Linnaeus, *Seseli montanum*, which is the first in Linnaeus of the species common to both authors; *Silene* L. Sp. Pl. 416, a genus adopted from Dillenius with a change of his name *Viscago*, is typified by *Silene anglica*, the first in Linnaeus of the thirteen species figured by Dillenius; *Fritillaria* L. Sp. Pl. 303, a genus adopted from Tournefort, is typified by the fifth species of Linnaeus, *Fritillaria Meleagris*, which is one of the three species included in *Fritillaria* by both authors, and is selected from these three because it is the one figured by Tournefort.

Section V. Rejection of Names.

CANON 16. A name is rejected when preoccupied (homonym).

(*a*) A specific name is a homonym when it has been published for another species under the same generic name.

EXAMPLES. — *Acer saccharinum* Wang. Amer. 36. *pl. 2, f. 26* (1787), is a homonym of *Acer saccharinum* L. Sp. Pl. 1055 (1753); *Vaccinium myrtilloides* Hook. Fl. Bor. Am. 2: 32 (1834), is a homonym of *Vaccinium myrtilloides* Michx. Fl. Bor. Am. 1: 234 (1803), and is rejected whether the latter species is regarded as distinct or not; *Chrysopsis pilosa* (Walt.) Britton, Mem. Torrey Club 5: 316 (1894), is a homonym of *Chrysopsis pilosa* Nutt. Jour. Acad. Nat. Sci. Phila. 7: 66 (1834), and is to be rejected, notwithstanding the fact that *Erigeron pilosum* Walt. was published in 1788.

(*b*) A generic name is a homonym when previously published for another genus.

EXAMPLES. — *Torreya* Arn. Ann. Nat. Hist. 1: 130 (1838), is a homonym of *Torreya* Raf. Am. Mo. Mag. 3: 356 (1818), of *Torreya*

Raf. Jour. Phys. 89: 105 (1819), of *Torreya* Spreng. Neue Entdeck. 2: 121 (1821), and of *Torreya* Eat. Man. ed. 5, 420 (1829).

(*c*) Similar names are to be treated as homonyms only when they are mere variations in the spelling of the same word; or in the case of specific and subspecific names, when they differ only in adjective or genitive termination.

EXAMPLES. — *Penicillus* and *Penicillium*, *Callitriche* and *Calothrix*, *Pterigophyllum* and *Pteridophyllum*, may be maintained; *Cyathophora* and *Cyathophorum*, *Asterocarpus* and *Astrocarpus*, can not be maintained. *Greenei* and *Greenii*, named for different persons, Greene and Green, may be maintained in the same genus; *virginicus*, *virginianus* and *virginiensis*, *oreganus* and *oregonensis*, *Hookeri* and *Hookerianus*, can not be maintained in the same genus.

CANON 17. A name is rejected when there is an older valid name based on another member of the same group (metonym).

EXAMPLES.— *Meibomia* Heist. ex Adans. Fam. Pl. 2: 509 (1763), is based on *Hedysarum canadense* L. Sp. Pl. 748, and *Desmodium* Desv. Jour. de Bot. II. 1: 122 (1813), is typified by *Hedysarum asperum* Poir. Encycl. Suppl. 6: 408 (1804), consequently if these species are regarded as congeneric the name *Desmodium* is to be rejected; *Boletopsis* P. Henn. Nat. Pflanzenf. 1[1**]: 194 (1899), cannot stand as a genus to include a section bearing the name *Boletinus* Kalchb., the latter having been established as a genus in 1877; *Sisymbrium altissimum* L. Sp. Pl. 659 (1753), *Sisymbrium Sinapistrum* Crantz, Stirp. Austr. ed. 2, 52 (1769), and *Sisymbrium pannonicum* Jacq. Coll. 1: 70 (1786), have different types, but if these are regarded as belonging to the same species, the two later names are metonyms of that of Linnaeus.

CANON 18. A name is rejected when there is an older valid name based on the same type (typonym).

EXAMPLES.— *Miegia* Pers. Syn. 1: 101 (1805), is a typonym of *Arundinaria* Michx. Fl. Bor. Am. 1: 73 (1803), both being based on the same species; *Asplenium Vincentis* Christ, Bot. Jahrb. 24: 109 (1897), is a typonym of *A. Guildingii* Jenm. Gard. Chron. III. 15: 70 (1894), both being based on H. H. Smith's *no. 1346* from St. Vincent.

CANON 19. A name is rejected when the natural group to which it applies is undetermined (hyponym).

(*a*) A specific or subspecific name is a hyponym when it has not been connected with a description, identifiable by diagnostic characters or by reference to a type specimen, figure or locality.

EXAMPLES.— *Gentiana hybrida* Raf. Med. Rep. II. 5: 353 (1808), is a hyponym, as no diagnosis is published; *Lechea furfuracea* Raf. New Fl. Am. 1: 92 (1836), is a hyponym, as its description is not identifiable.

(*b*) A generic or subgeneric name is a hyponym, when it is not associable, at least by specific citation, with a binomial species previously or simultaneously published ; or when its type species is not indentified.

EXAMPLES.— *Adodendrum* Necker, Elem. 1 : 214 (1790), and *Calesiam* Adans. Fam. Pl. 2 : 446 (1763), are hyponyms, because their authors neither named a binomial species nor cited a species which had previously received a binomial name ; *Nudilus* Raf. Atl. Jour. 176 (1833), is a hyponym, as its type species, *N. paradoxus*, has not been identified.

PART III. ORTHOGRAPHY AND CITATION.

Section I. Orthography.

1. The original orthography of names is to be maintained, except in the following cases ; the change not to affect priority.

(*a*) Manifest typographical errors may be corrected.

EXAMPLES.— *Scoria* Raf. is a misprint for *Hicoria* ; *Rumhora* Raddi is a misprint for *Rumohra*, named for K. von Rumohr.

(*b*) Adjectival names of species and subspecies agree in gender with the generic name with which they are associated.

EXAMPLES.— *Polygonum articulatum* L. = *Polygonella articulata* (L.) Meissn.; *Sisymbrium amphibium palustre* L. = *Radicula palustris* (L.) Moench.

(*c*) Generic names derived from personal names should be feminine, and if originally of other forms should be corrected.

EXAMPLES.—*Lippius* S. F. Gray, *Kantius* S. F. Gray, *Pallavicinius* S. F. Gray, should be changed to *Lippia*, *Kantia*, and *Pallavicinia* and yet date from 1821 when originally published.

(*d*) In the case of names proposed in works in which v and j were used as vowels or u and i as consonants they should be corrected to agree with modern usage.

EXAMPLES.—*Euonymus*, not *Evonymus ; Naias*, not *Najas ; Neuropteris*, not *Nevropteris ; Rivularia*, not *Riuularia* (*Rivvlaria*) ; *Jungia*, not *Iungia*.

2. Generic names should be written with initial capital letters.

EXAMPLES.—*Desfontainea*, not *desFontainea ; Durvillaea*, not *d' Urvillaea*.

3. If capital letters are to be used for specific names they should be employed only for substantives and for adjectives derived from personal names.

EXAMPLES.—*Asplenium Trichomanes* L.; *Uromyces Trifolii* (Hedw.) Lév.; *Trichomanes Smithii* Hook. ; *Galium Boryanum* Walp.

4. The publication of names of bilingual derivation should be avoided, but published names are not to be rejected on account of such derivation.

EXAMPLES.—*Liquidambar* is Latin-Arabic; *Fimbristylis* is Latin-Greek; *Actiniceps* is Greek Latin.

5. The names of hybrids may be written as follows:

(*a*) A hybrid may be named by placing the names of the parent species or subspecies in alphabetical order, connected by the sign ×; but in hybrids experimentally produced, or in which the sex of the parents is known, the female parent is to be written first, and the sex indicated by the signs ♀, ♂.

EXAMPLES.—*Carex debilis* × *virescens*; *Digitalis lutea* ♀ × *purpurea* ♂.

(*b*) A hybrid may be named when desirable like a species or subspecies, provided the binomial or trinomial is preceded by the sign ×, designating it as a hybrid.

EXAMPLE.— × *Salix capreola* Kern.

(*c*) A hybrid between species of different genera may be named by attaching the specific name to the generic name of the female parent, or, if the sex of the parents is unknown, to the generic name coming first in alphabetical order.

EXAMPLE.— × *Ammophila baltica* Link = *Ammophila arenaria* × *Calamagrostis Epigeios*.

(*d*) A hybrid derived from parents one or both of which are of hybrid origin, may be named by including the name of the hybrid parent in parentheses.

EXAMPLE.—*Salix* (*aurita* × *repens*) × *cinerea*.

(*e*) Preponderance of one parent over the other may be designated by the signs >, <.

EXAMPLES.—*Mentha longifolia* > × *rotundifolia*; *Mentha longifolia* × < *rotundifolia*.

Section II. Citation of authors.

1. An author-citation following a name refers to the author by whom the name was first published; the author's name may be abbreviated, but never in such a manner as to result in ambiguity.

EXAMPLES. — Spreng. for Sprengel, not Spr., to distinguish from Spruce and others; Michx. for Michaux, not Mich., to distinguish from Micheli; S. Wats. for Sereno Watson, to distinguish from H. C. Watson.

2. In the following cases the name of the original author should

appear in parentheses, followed by that of the author who first published the name in its accepted form and application.

(*a*) A specific name originally combined with a different generic name, or a subspecific name originally combined with a different binomial.

EXAMPLES. — *Moneses uniflora* (L.) A. Gray, for the plant originally described as *Pyrola uniflora* by Linnaeus and subsequently first published as *Moneses uniflora* by Asa Gray; *Chondrophora nauseosa glabrata* (A. Gray) Rydberg for *Bigelovia graveolens* var. *glabrata* A. Gray.

(*b*) A generic name adopted through citation from a publication issued prior to the first edition of Linnaeus' Species Plantarum (1753).

EXAMPLES. — *Linnaea* (Gronov.) L.; *Anthoceros* (Mich.) L.; *Valerianella* (Tourn.) Poll.

(*c*) A name applied to a category different from that in which it was first proposed.

EXAMPLES. — *Salix cordata angustata* (Pursh) Anders., originally *Salix angustata* Pursh; *Actaea rubra* (Ait.) Willd., originally *Actaea spicata* var. *rubra* Ait.; *Ardisia* subg. *Pickeringia* (Nutt.) Mez, originally genus *Pickeringia* Nutt.; *Raphidostegium* (Br. & Sch.) De Not., originally *Rhynchostegium* subg. *Raphidostegium* Br. & Sch.

3. A comma between the name of the plant and the name of the author is undesirable.

EXAMPLES. — *Rumex* L., not *Rumex*, L.; *Phacelia congesta* Hook., not *Phacelia congesta*, Hook.; *Ilysanthes dubia* (L.) Barnhart, not *Ilysanthes dubia*, (L.), Barnhart.

The embryology of Rhytidophyllum

MELVILLE THURSTON COOK

(WITH PLATE 10)

The family *Gesneriaceae* is tropical and sub-tropical in its distribution, but is closely related to certain other families which are much more widely distributed. The writer accepted an opportunity to make a study of the genus *Rhytidophyllum*, which may be considered characteristic of the family, hoping at some future time to be able to make a comparative study of some of the more northern species of the related families. The first studies were made from *R. crenulatum* DC. and most of the figures were drawn from that material. Later, upon securing material of *R. tomentosum* Mart., a comparative study was made. These two species show very distinct external specific differences, but the morphology of the embryo-sac and embryo is practically the same, the ovules and internal structures of *R. tomentosum* being slightly smaller than in *R. crenulatum*. On account of various chemical substances of these plants, which are not thoroughly understood, the technique was rather difficult and the chromic acid mixtures proved absolutely useless. The following mixtures were used with success:

(*a*) Saturated aqueous solution picric acid	100 c.c.
Glacial acetic acid	1 c.c.
(*b*) Saturated 70 per cent. alc. sol. picric acid	100 c.c.
Glacial acetic acid	1 c.c.
(*c*) Saturated aqueous solution picric acid	100 c.c.
Sulphuric acid	2 c.c.
(*d*) Saturated 70 per cent. alc. sol. picric acid	100 c.c.
Sulphuric acid	2 c.c.

The first solution was by far the most successful. The material was then treated in the usual manner, imbedded in paraffine, sectioned and stained.

The ovules assume the anatropous form (*figures 1, 2*) very early. The archesporium originates as a single sub-epidermal cell (*figures 1a, 2*). In one instance only, of a large number examined, was this cell divided into megaspores and then only two cells were formed (*figure 3*). The single archesporial cell elongates without division, in the antipolar direction, the new part being smaller in diameter than the older part (*figures 1b, 4*). This cell then elongates very rapidly, and forms the two- and four-nucleate stages of the embryo-sac (*figures 1c, 5, 6*). At this time the sac is usually about twice as long as wide. Without further enlargement of the sac the nuclei now divide, thus forming the eight-nucleate stage. The egg is large and the synergids very small (*figure 7*), but they stain very deeply. The antipodals (*figures 8, 9*) are about the same size as the synergids and disintegrate very quickly. The polar nuclei (*figure 10*) may unite in any part of the sac, but usually in the antipodal end. The micropyle and the pollen-tube are very conspicuous at this time, and the entrance of the latter obliterates the synergids (*figures 11, 12*). Immediately after the completion of the eight-nucleate stage of the sac the antipodals disintegrate and a very long tube is formed extending to the opposite end of the ovule (*figures 1d, 7, 8, 9, 12*). The formation of this tube is the result of the disintegration of a single row of cells. In a very short time the nucellar cells which surround this tube disintegrate, producing a sac uniform in diameter, extending almost the entire length of the ovule and enclosed by only a few layers of nucellar cells, usually not more than six. This is followed by fertilization of the egg and union of the polar nuclei. The endosperm undergoes its primary division (*figures 12, 13*) before the division of the egg. One of the daughter-nuclei remains in the micropylar part of the sac, while the other enters the tube and the two are separated by a wall (*figure 13*) which persists for a very short time. Similar walls, dividing the two daughter-nuclei of the primary division of the endosperm-nuclei have been described in a number of plants by Hofmeister (4), Johnson (5, 6), Schaffner (10), Cook (1), Strasburger (11), and others. Both nuclei now undergo repeated divisions, forming a cellular endosperm. The endosperm in the micropylar part of the sac disintegrates very quickly, but the other persists for some time (*figures 14, 15*). It is very evident that the disintegration of the endosperm begins at the micropylar end of the sac and progresses rapidly towards the opposite end. In this end of the sac there was always present a single large pyriform cell (*figure 15*) whose origin was difficult to determine, but it appeared to be the result of one of the early divisions of the endosperm.

At the time of the primary division of the endosperm-nucleus some starch was present in the sac and also in the cells immediately surrounding the micropyle, and in a very short time all the cells lining the sac developed starch. Before the disintegration of the endosperm was complete these nucellar cells were also undergoing disintegration and this continued until the entire nucellus had disappeared. In brief, both the endosperm and the nucellus undergo disintegration to feed a rapidly growing embryo and eventually leave the embryo surrounded by the integuments only.

When the embryo-sac is in the eight-nucleate stage (*figure 1d*) the nucellus consists of four to six layers of cells; as the ovule increases in size the cells divide, but the inner cells are continually disintegrating to feed the embryo. At about the time of the appearance of the cotyledons (*figure 23a*) the nucellus consists of four or five layers of cells (*figure 16*), of which the inner cells show the effects of disintegration. After this time no nucellar cells are formed, but those already existing are gradually used by the growing embryo (*figure 25*).

The embryo. — The fertilized egg, by successive divisions, forms an embryo of from four to six cells in linear arrangement (*figures 17, 18*), with the basal cell very much elongated, but not enlarged as in the case of *Capsella Bursa-pastoris* as described by Coulter and Chamberlain (2) and Hanstein (3). The apical cell now divides by two longitudinal walls placed at right angles to each other, thus forming the quadrant stage (*figure 17*). The quadrant is now divided by a cross-wall, thus forming the octant stage. Instead of producing the dermatogen immediately, as in the case of *Capsella Bursa-pastoris* and *Alyssum macrocarpum*, it now divides repeatedly by longitudinal walls (*figure 18*). At the same time the suspensor becomes very large and elongates, pushing itself back into the micropyle and forming an enlargement (*figure 18*). It apparently functions for a short time as a simple haustorium, but very soon disintegrates. However, its old course can still be traced (*figure 19*) in very late stages. In the meantime, the small suspensor cells next to the embryo divide by cross-walls. The embryo now increases in size and the differentiation into dermatogen, periblem and plerome occurs very early (*figures 20–23*). The cell *a* nearest the embryo (*figure 18*), to which we will hereafter refer as the basal cell, now divides by a cross-wall into two cells, *b* and *b'* (*figure 20*). Cell *b'* now divides by longitudinal division into four cells, which form the root-tip (*figures 21, 22, 23a, 23b*). Cell *b* now divides by both transverse and longitudinal divisions (*figures 22, 23*) into four cells of which the upper layer *b''* (*figures 23a, 23b*) forms the dermatogen of the root-tip.

At about the time of the formation of the dermatogen of the root-tip the two cotyledons appear (*figure 23 a*), one of which is usually slightly larger than the other. Examination of a large number of embryos slightly older than *figure 23* indicated that these cotyledons have an independent origin. The endosperm has entirely disappeared by this time and the nucellus is very much reduced (*figure 16*). The embryo now enlarges rapidly, gradually utilizing the last of the nucellar tissue, and when fully mature is surrounded only by the integuments.

Abnormal embryos. — Four abnormal embryos were observed. Two of these embryos (*figure 24*) were about the same age as those in *figure 23* but had elongated without producing cotyledons and without differentiation of tissues into plerome and periblem. The other two abnormal embryos each had three equally well developed cotyledons. They were the same age as in *figure 25*, and were cut in cross sections.

SUMMARY

1. The archesporium is a single sub-epidermal cell.

2. This usually becomes the functional megaspore without previous subdivisions.

3. There is nothing unusual in the formation of the embryo-sac.

4. The formation of the embryo is typical of the dicotyledons as illustrated by *Capsella Bursa-pastoris*, except for variations in the formation of the dermatogen and in the basal (hypophysis) region.

5. The endosperm is of the cellular type and is formed in the usual manner but disintegrates very early.

6. Both endosperm and nucellus are utilized to feed the growing embryo, eventually leaving the embryo surrounded only by the integuments.

I wish at this time to express my thanks to Professor C. F. Baker of the Estacion Central Agronomica, Santiago de las Vegas, Cuba, for assistance in securing the material; to the workers of the New York Botanical Garden for its determination; and to Professor F. E. Lloyd of the Desert Botanical Laboratory, Tucson, Arizona, for reviewing the manuscript and for valuable suggestions.

The *Rhytidophyllum crenulatum* DC. was collected on the walls of Fort Cabañas, Havana, Cuba, and the *R. tomentosum* Mart. was collected on the hills near the village of Managua in the Province of Havana, Cuba. Specimens of both collections are deposited in the herbarium of the New York Botanical Garden.

ESTACION CENTRAL AGRONOMICA,
SANTIAGO DE LAS VEGAS, CUBA.

LITERATURE

1. **Cook, M. T.** Development of the embryo-sac and embryo of *Castalia odorata* and *Nymphaea advena*. Bull. Torrey Club **29**: 211–220. *pl. 12, 13.* 1902.
2. **Coulter, J. M. & Chamberlain, C. J.** Morphology of the angiosperms. (Part II. Spermatophytes.) 1903.
3. **Hanstein, J.** Die Entwicklung des Keimes der Monokotylen und Dikotylen. Bot. Abhandl. **1**[1]: 1–112. *pl. 1–18.* 1870.
4. **Hofmeister, W.** Neuere Beobachtungen über Embryobildung der Phanerogamen. Jahrb. Wiss. Bot. **1**: 82–188. *pl. 7–10.* 1858.
5. **Johnson, D. S.** On the development of the *Saururus cernuus* L. Bull. Torrey Club **27**: 365–372. *pl. 23.* 1900.
6. ———. Seed development in the *Piperaceae* and its bearing on the order. Johns Hopkins Univ. Circ. 178: 28–31. 1905.
7. **Lewis, C. E.** Studies on some anomalous dicotyledonous plants. Bot. Gaz. **37**: 127–138. *pl. 7, 8.* 1904.
8. **Mottier, D. M.** The embryology of some anomalous dicotyledons. Ann. Bot. **19**: 447–463. *pl. 26, 27.* 1905.
9. **Riddle, L. C.** The embryology of *Alyssum*. Bot. Gaz. **26**: 314–324. *pl. 26–28.* 1898.
10. **Schaffner, J. H.** Contribution to the life history of *Sagittaria variabilis*. Bot. Gaz. **23**: 252–273. *pl. 20–26.* 1897.
11. **Strasburger, E.** Ein Beitrag zur Kenntniss von *Ceratophyllum submersum* und phylogenetische Eröterungen. Jahrb. Wiss. Bot. **37**: 477–526. *pl. 9–11.* 1902.

Explanation of plate 10

Figures 1, 19 and 25 were drawn with Zeiss No. 2 ocular and No. C objective and are slightly diagrammatic. All other figures were drawn with Zeiss No. 2 ocular and 1/12 oil-immersion objective.

All figures drawn from *Rhytidophyllum crenulatum*, except figures 2 and 25, which were drawn from *R. tomentosum*.

FIG. 1*a*. Ovule with archesporial cell.

FIG. 1*b*. Ovule with functional megaspore.

FIG. 1*c*. Ovule with sac in four-nucleate stage.

FIG. 1*d*. Ovule with sac in eight-nucleate stage.

FIG. 2. Same as Fig. 1*a*.

FIG. 3. Two megaspores.

FIG. 4. Same as Fig. 1*b*.

FIG. 5. Two-nucleate stage of embryo-sac.

FIG. 6. Four-nucleate stage of embryo-sac. Same as Fig. 1*c*.

FIG. 7. Eight-nucleate stage of embryo-sac showing egg-apparatus and one polar nucleus.

FIG. 8 and 9. The antipodal nuclei.

FIG. 10. The union of the polar nuclei.

FIG. 11. Embryo-sac showing egg, pollen-tube and endosperm nucleus.

FIG. 12. Embryo-sac showing fertilized egg, pollen-tube and two daughter-nuclei formed by the first division of the endosperm-cell.

FIG. 13. Daughter-nuclei formed by the first division of the endosperm-nucleus and separated by a wall.

FIG. 14. Endosperm in the antipodal end of the sac.

FIG. 15. Much older and showing the large pyriform cell.

FIG. 16. Nucellus and integuments. Slightly older than Fig. 23.

FIG. 17. Young embryo showing early divisions.

FIG. 18. Young embryo showing later divisions and haustorial development of the suspensor.

FIG. 19. Remains of haustorial suspensor. Same age as Fig. 20.

FIG. 20–22. Spherical embryo showing dermatogen, plerome, periblem, and basal cells.

FIG. 23, *a* and *b*. Embryos showing origin of cotyledons and the basal cells.

FIG. 24. Abnormal embryo.

FIG. 25. Embryo, two layers of nucellar cells and integuments.

Contributions to the Mesozoic flora of the Atlantic coastal plain — II. North Carolina *

EDWARD WILBER BERRY

(WITH PLATES 11–16)

Although Winchell mentioned the occurrence of fossil plants in Alabama as long ago as 1856,† and Meek & Hayden refer to them in 1857,‡ the first collections were made, so far as I am aware, as recently as 1884. These were sent to Lesquereux. Subsequently additional collections were made by Smith, Langdon, Fontaine, and Ward, but none of these have ever been studied, although Ward furnished Smith with a provisional list of thirty-five species which was published on page 348 of his *Geology of the Coastal Plain of Alabama* in 1894.

These plants conclusively prove the Mid-Cretaceous age of that part of the Tuscaloosa formation from which they were collected, although it is quite possible that the great thickness assigned to this formation by the Alabama geologists may indicate the presence of beds of Older Potomac age, especially since beds of this age are now definitely known from both North and South Carolina, and are said by Darton to be present in Georgia.

The most southerly outcrops heretofore known of plant-bearing beds of Raritan or Magothy age, with which the Alabama beds are comparable, are those found in Maryland, and it is the purpose of the present paper partially to bridge over this interval of nearly eight hundred miles, and to add another link to the chain which has come to connect the Cretaceous floras of Marthas Vineyard, Block Island, Long Island, Staten Island, New Jersey, Delaware and Maryland.

No Cretaceous plants have ever been described from North Carolina, although we find lignite mentioned by Olmsted as early as 1827 as occurring along the Neuse river.§ In Emmons's first

* Published by permission of the North Carolina Geological Survey.

† Proc. Am. Assoc. Adv. Sci. 10^1 : 92. 1856.

‡ Proc. Acad. Nat. Sci. Phila. **9** : 133. 1857.

§ OLMSTED, D. Rep. Geol. N. C. part 2. 1827.

report * petrified wood and lignite are recorded along the Cape Fear river about 18 miles above Fayetteville. Kerr publishing in 1875 † writes of the lignitic beds of the Cape Fear river and mentions the occurrence of "trunks, limbs and leaves of trees," correctly correlating the deposits with similar exposures on the Neuse river near Goldsboro, North Carolina.

Darton, publishing in 1895, in a footnote on page 517,‡ says that Ward had discovered plant remains of Potomac age along the Cape Fear river, although the latter author in a recent publication § states that no characteristic fossil plants have been found in the Potomac of North Carolina. On page 390 of the same work occurs the following paragraph:

"The higher beds farthest down the river yield imperfect specimens of dicotyledonous leaves having affinities with those of the Newer Potomac and are doubtless of that age, but those at Lafayette || and for ten or perhaps twenty miles below, though apparently barren, closely resemble Older Potomac strata, but are transgressed by marine deposits which occupy the top of the bluffs nearly the whole distance."

The first part of this paragraph refers, I suppose, to the lignitic layers such as occur at Big Sugar Loaf Landing, fifty miles below Fayetteville. No leaves appear to have been discovered near Fayetteville, where they are abundant and well preserved. If the latter part of the paragraph just quoted refers to the overlying Pleistocene it may possibly be true; if it refers to the laminated clays and sands of Cretaceous age, it should be added by way of comment, that while they do transgress the Older Potomac at several points, by no means are they uniformly present along the tops of the bluffs, and they are far from being typically marine deposits. Farthest down the river, where the lignitic Cretaceous first appears below the typically Marine Cretaceous, it contains sharks' teeth and other marine remains, but as you come up the river, getting lower and lower in the formation, it becomes more

* McLENAHAN, in Emmons, Rep. Geol. Surv. North Carolina, 173. 1852.

† KERR, W. C. Rep. Geol. Surv. N. C. 1: 148, 149. 1875.

‡ DARTON, N. H. Bull. Geol. Soc. Am. 7: 517. 1895.

§ WARD, L. F. U. S. Geol. Surv. Monog. 48: 374. 1906.

|| This must be intended for Fayetteville, as there is no town of Lafayette on the Cape Fear river.

and more transitional in character, until where it rests upon the Older Potomac it is clearly estuarine. In spite of inaccuracies of detail, however, the inference is correctly drawn that these upper beds are comparable with the Tuscaloosa formation of Alabama (*loc. cit.* 391). The foregoing in a very brief way exhausts the references to the Cretaceous flora of North Carolina.

During the past summer the writer, under the auspices of the North Carolina Geological Survey, made a reconnaissance by boat from the Piedmont to the coast along the Roanoke, Neuse and Cape Fear rivers in North Carolina and the Great Pee Dee in South Carolina. By far the most instructive section is the more or less well known one along the Cape Fear, and while it is not my purpose to discuss the geology in this place, a word or two of explanation is necessary.

In ascending the Cape Fear the Transitional Cretaceous, which consists of very lignitic sands and laminated clays and sands, greatly crossbedded in places and carrying pyrite and glauconite, was first seen in the vicinity of Donohue Creek Landing, about fifty miles above Wilmington. From this point it is exposed at frequent intervals almost as far up as Fayetteville, a distance of over fifty miles, coming to lie with a marked unconformity upon the Older Potomac beds which form the river bluffs for some fifteen miles below that place. As we ascend the river, getting lower down in in the formation, all evidences of marine conditions of deposition disappear, the beds becoming littoral and estuarine in character.

Leaf-remains were observed at a number of points, in most cases the impressions carrying too much lignite and the matrix being too coarse to permit of their successful collection and preservation. Near Court House Landing, about seventy-six miles above Wilmington in Bladen County, these Transition beds reach a thickness of about seventy feet and contain lenses of rather compact brownish drab clay carrying good leaf-impressions which have furnished the bulk of the species enumerated in the following pages. Similar materials were observed at several points along the Neuse river and also at one locality on the Great Pee Dee river in South Carolina. A small collection of identifiable leaves was made in the vicinity of Blackmans Bluff on the Neuse river, at which locality about twenty feet of transitional Cretaceous is exposed. Some of the lignite at this locality was observed to contain amber in small drops, in this respect resembling the Cretaceous deposits of Staten Island, New Jersey, Delaware and Maryland. As previously mentioned, some of the sandy lignitic exposures on the lower Cape Fear river were observed to contain leaves, and in my notes the following are recorded from near Big Sugar Loaf Landing: *Magnolia*, *Laurus*, *Ficus daphnogenoides*, *Sequoia heterophylla*, cone-impression, and fragments of a fern. It was impossible to save this material, so that these identifications may be regarded as tentative for the present.

In the preserved material there are twenty-nine recognizable species. Of these, seven were described by Heer from Greenland, seven were originally described from the Dakota group, and seven were originally described from the New Jersey Raritan. In addition Newberry identified in the Raritan eight more of these species which were originally described by Heer or Lesquereux from other regions than New Jersey. A number of the forms, like *Andromeda Parlatorii* Heer, *Diospyros primaeva* Heer, *Ficus daphnogenoides* (Heer) Berry, and *Sequoia heterophylla* Velen., have been found at nearly all of the localities for Cretaceous plants of Atane, Raritan, Dakota and Magothy age, so that they may be omitted from our calculations.

There are seven forms in this contribution which it has not been possible to identify with previously described remains and which are here described as new. Of these *Quercus* and *Pterospermites* point to the beds being slightly more recent than the Raritan, as does the occurrence of species like *Cinnamomum Heeri* Lesq. and *Magnolia Capellinii* Heer, which are Dakota group plants recorded from the Magothy formation, but not with certainty from the Raritan; although Lesquereux recorded both from beds of that age in his report to George H. Cook included in the clay report of 1878. The striking absence of gymnosperms and pteridophytes, both in North Carolina and Alabama, as compared with New Jersey, may possibly indicate that the physical conditions of the region favored the replacement of the gymnosperms of farther north by evergreen dicotyledons; and the ferns, always a fragmentary and infrequent element in the middle and later Mesozoic floras, were simply not preserved or have not been discovered. A fact of considerable botanical interest is the entire absence of any species of *Laurus* or *Salix* in North Carolina, both genera furnishing a large number and variety of leaves at most Cretaceous localities. Thus, there are 10 species of *Laurus* in the Dakota flora besides the allied genera *Laurophyllum*, *Lindera*, and *Malapoenna*, and 10 species of *Salix*. The New Jersey Raritan has 5 species of *Salix*, 1 of *Laurus*, and 3 of *Laurophyllum*. The Magothy has 4 species of *Laurus*, 1 of *Laurophyllum*, 1 of *Malapoenna*, and 4 of *Salix*.

This absence of laurels and willows is also a feature of the Tuscaloosa formation in Alabama, one very liable to modification, however, when the floras are thoroughly collected and studied.

Because of their geographical position these beds should be provisionally correlated with the Tuscaloosa formation of Alabama; with this reservation, however, that the Tuscaloosa flora, as far as it is known, coincides with that of the Raritan. Lithologically these North Carolina beds are much more like the Magothy of New Jersey, Delaware and Maryland than they are like the Raritan, and it seems probable that when the problem has been worked out for the whole coastal plain it will be found that the Tuscaloosa formation of Alabama as a whole includes sediments of Older Potomac, Raritan and Magothy age, while what is here called the Tuscaloosa formation in North Carolina, already differentiated from the Older Potomac, includes phases corresponding to both the Raritan and Magothy formations of the more northern portions of the coastal plain and to the upper Tuscaloosa and Eutaw formations of the Gulf region.

Except in one or two cases where it seemed desirable, the copious synonymy has been omitted, although in some instances a second citation is added to that of the author of the name in order to refer to especially well illustrated material.

GYMNOSPERMAE

CONIFERALES

SEQUOIA HETEROPHYLLA Velen. Gymnosp. Böhm. Kreidef. 22. *pl. 12. f. 12; pl. 13. f. 2–4, 6–9.* 1885. — Hollick, Trans. N. Y. Acad. Sci. **12**: 3. *pl. 1. f. 18.* 1892. — Smith, Geol. Coastal Plain Ala. 348. 1894. — Ward, Ann. Rep. U. S. Geol. Surv.

15: 378, 380, 382, 392. 1895.—Newb. Fl. Amboy Clays 49. *pl. 6. f. 1–13.* 1896.—Knowlton, Bull. U. S. Geol. Surv. **257**: 132. *pl. 16. f. 5.* 1905.—Berry, Bull. Torrey Club **33**: 165. 1906.—Rep. State Geol. New Jersey **1905**: 139. 1906.

This is the only species of gymnosperm contained in the Carolina material and it is but sparingly represented. Described originally from Bohemia (Cenomanian and Senonian) by Velenovsky, it was recorded in abundance from the Raritan of New Jersey by Newberry, from Staten Island by Hollick, from Delaware and Maryland by the writer, and from Alabama by Smith, so that it is not surprising that it should be found in an intervening region. Knowlton, who records a specimen from the Judith river beds of Montana, quotes Ward (*loc. cit.*) as the authority for its occurrence in the so-called lower and upper Albirupean of Virginia. A reference to the original is indecisive, and since beds of Raritan or Magothy age, with which the Albirupean is generally correlated, are not known to occur in Virginia, the specimen upon which Ward based his statement probably came from some locality in Maryland.

ANGIOSPERMAE

GRAMINALES (?)

PHRAGMITES sp. PLATE 11, FIGURE 5

While from a perusal of the literature it would seem that almost anything is eligible for reference to the genus *Phragmites*, nevertheless there are in the collections from Court House Bluff several well-marked fragments which are clearly referable to this genus, without however implying generic relationship with the existing members of the genus.

While these remains are too imperfect to be of much value, they deserve to be recorded as showing the presence of monocotyledons in the Cretaceous flora of the region. The largest fragment, which is that figured, is 4 cm. in length by 11 mm. in width, with ten well-marked veins, all equal in calibre and with finer striations between them, and occasional transverse veinlets discernable. There is a close resemblance to the Long Island remains which Hollick calls *Poacites*,* but since the original use of this

* Bull. N. Y. Bot. Garden 3: 411. *pl. 73. f. 1.* 1904.

term by Brongniart* should preclude it from Mesozoic terminology, the term *Phragmites* is preferable.

MYRICALES

Myrica elegans sp. nov. PLATE 11, FIGURES 1-4, 6

Leaves 4-7 cm. long and 1.5-2 cm. wide, broadly lanceolate in outline. Like the living species, the margin is variable, ranging from forms in which it is rather angularly crenate with an approach to serrate in some of the teeth, through forms in which the crenations become more and more rounded until the other extreme shows relatively broad-bladed leaves with scalloped margins. The latter are quite different in appearance from the former, but are united to them by many intermediate forms of which the more pronounced types are figured. Midrib straight, moderately stout, petiole, if present, not preserved, secondaries numerous, 9-12 on a side, sub-opposite, equidistant, leaving the midrib at a wide angle which becomes more acute toward the tip of the leaf, curving slightly and running directly to the marginal points.

This is perhaps the commonest species at Court House Landing, and is represented by many individuals all more or less imperfect because of the arenaceous nature of the matrix and the presence of more or less gypsum. There is no *Myrica* recorded from the Tuscaloosa formation in Alabama. In New Jersey the Raritan has five or six species, of which *Myrica Newberryana*, *M. raritensis* and *M. acuta* are somewhat similar to the Carolina leaf but still entirely distinct, *Myrica raritensis* Hollick being a descendant in all probability of *Myrica brookensis* Font., the single species known from the Older Potomac of Virginia. There are two species found in the Cretaceous of Staten Island, two in the Magothy formation of New Jersey and Maryland, and nine or ten in the Dakota group of the west, all very distinct from the leaf in hand.

Myrica occurs earlier and is much more varied in America than in Europe, where the maximum development seems to have been during the Tertiary, the few Cenomanian and Senonian species not showing any similarities to the leaves under consideration. The Greenland Cretaceous furnishes five species, one of which, *Myrica praecox* Heer, from the Patoot beds of the west coast (Senonian?), resembles *Myrica elegans* more closely than

* Mém. Mus. Hist. Nat. 8: 138. 1822.

any other leaves with which comparisons have been made. It is a somewhat smaller leaf with a rounded tip and marginal crenations which are wide but lacking the crenulations of the rounded crenations of the Carolina leaf. Various American Tertiary species of *Myrica* are similar enough to be looked upon as possible descendants of this Cretaceous species; for instance, Lesquereux's *Myrica rigida* and *M. callicomaefolia* from the Green river shales. There is considerable resemblance to a number of European Tertiary species, hardly worth noting however in this connection. There is also a general resemblance to those Tertiary forms which Heer and Unger referred to *Comptonia vindobonensis*, except that the margin is serrated in the latter, while in those leaves which lack the serrations, as those which Ettingshausen and Saporta have referred to this species, the leaf is long and narrow. Among leaves which might be mistaken for *Myrica*, similarities may be noticed to some of the leaves which Lesquereux refers to *Rhus*, *e. g.*, *Rhus acuminata*, while the leaves of some species of *Quercus* often approach this style of leaf as may be seen in *Quercus Marioni* Heer and *Quercus Johnstrupi* Heer from the Greenland Cretaceous.

FAGALES

Quercus Pratti sp. nov. PLATE 11, FIGURE 9

A single fragment of what was rather a good-sized leaf of *Quercus* occurs in the material from Court House Bluff. It is 6 cm. long and 3.5 cm. wide, and does not show base, tip or margins. The midrib is stout and flexuous, although the latter character seems to be due to the manner of preservation which has bent what would be otherwise a straight midrib. Secondaries numerous, regular, parallel, alternate and stout; they leave the midrib at a wide angle and are nearly straight.

This fragment closely resembles *Quercus Ellsworthiana* and *Q. Wardiana* from the Dakota group, and if the outline was also analogous to that of those leaves, it would show an ovate or obovate, rather thick leaf with a repand or undulate margin, remotely suggestive of the modern chestnut oaks. There is also some resemblance to the leaves which Lesquereux refers to *Juglandites*, and to *Quercus sphenobasis* Hos. & V. D. Marck from the Senonian of Westphalia.

Quercus is a decidedly upper Cretaceous and later type, for while three species of *Quercophyllum* have been described from the older Potomac of Virginia their botanical relations are extremely doubtful. The New Jersey Raritan has yielded but a single fragment of a leaf which Newberry doubtfully refers to *Quercus Johnstrupi* Heer, while there are none reported from Alabama, although six are known from the Magothy formation. Nor is the genus present in the lower Cretaceous of England, Portugal, or Bohemia. In Greenland the Atane beds have six species and the Patoot beds eight, while the Dakota group contains the remarkable number of eighteen, exceeding even the number in the European Senonian, where *Quercus* is so prominent an element.

URTICALES

Planera cretacea sp. nov. PLATE 11, FIGURES 7, 8

Ovate-lanceolate, rather unsymmetrical leaves, 3–7 cm. long, by 1–2.7 cm. wide, tapering at the base and tip, the latter gradually narrowing to an acute point. Margin entire below, with sharply serrate teeth above. Midrib moderately stout. Secondaries leaving the midrib at an acute angle, alternate or sub-opposite, parallel and curving, becoming obliterated toward their tips in the lower part of the leaf and extending into the serrations in the upper part. Represented by several imperfect specimens from Blackman's Bluff and two or three better preserved fragments from the locality one half mile below Blackmans Bluff on the Neuse river.

Planera seems to be unknown in the Mesozoic rocks of Europe, while the various forms found in the Tertiary of that region, often showing a considerable range in variation, are referred to the single comprehensive and probably polymorphic species *Planera Ungeri* Ettings.

In this country there is one species in the Raritan of New Jersey * and a second in the Patoot beds of the west coast of Greenland, both smaller and quite distinct from the Carolina leaf, which does, however, somewhat resemble *Carpinites microphyllus* and *Betula atavina* Heer from the Patoot beds. The genus is largely developed in the American Eocene with six or seven species, the Green river shales furnishing the majority of forms, and at the famous locality of Florissant,† Colorado, containing hundreds of

* Hollick has recently described a fragmentary leaf from Gay Head, Marthas Vineyard, as *Planera betuloides*. U. S. Geol. Surv. Monog. 50 : 57. *pl. 8. f. 22.* 1906.

† Possibly of Oligocene age.

specimens. The existing species, which is so common in our southern states, has been found as far north as New Jersey in the Pleistocene.

FICUS DAPHNOGENOIDES (Heer) Berry, Bull. Torrey Club **32**: 329. *pl. 21.* 1905. PLATE 11, FIGURES 10, 11

This widespread Cretaceous species, previously recorded from the coastal plain of Marthas Vineyard, Long Island, Staten Island, New Jersey, Maryland, and Alabama, is represented by a number of imperfect specimens from Court House Bluff.

FICUS WOOLSONI Newb.; Hollick, Trans. N. Y. Acad. Sci. **12**: 33. *pl. 2. f. 1, 2c.* 1892. PLATE 12, FIGURE 1

This determination is based on the single imperfect specimen from Court House Bluff shown in the figure. The species is abundant in the New Jersey Raritan, and has also been recorded from Staten Island, Delaware, and the Tuscaloosa formation of Alabama.

FICUS INAEQUALIS Lesq. Fl. Dakota Group 82. *pl. 49. f. 6–9; pl. 50. f. 3.* 1892. PLATE 12, FIGURES 2, 3

There are a number of imperfect specimens in the material from Court House Bluff which have been referred to this species. Originally described from Kansas, it has been detected by Smith in the Tuscaloosa of Alabama. The North Carolina leaves differ somewhat from Lesquereux's type, being somewhat larger with more remote secondaries. The leaf-substance does not appear to be thickened and the venation is rather thin for this genus. The leaves are markedly inequilateral and show a tendency in their lower secondaries toward a palmate venation, which is only suggested, however.

RANALES

DEWALQUEA GRÖNLANDICA Heer, Fl. Foss. Arct. **6**^{2}: 87. *pl. 29. f. 18, 19; pl. 42. f. 5, 6; pl. 44. f. 11.* 1882.

Another widespread Cretaceous form of doubtful botanical affinity. The present material is imperfect and comes from Blackmans Bluff. The species, which was described originally from Greenland, has been collected on Staten Island, and in New Jersey and Alabama.

MAGNOLIA CAPELLINII Heer, Phyll. Crét. Nebr. 21. *pl. 3. f. 5, 6.* 1866. PLATE 12, FIGURES 4, 5

A clearly defined and widespread Cretaceous species represented by several good specimens in the material from Court House Bluff, which, taken together, show the whole leaf with the exception of a small portion of the extreme base. The texture is coriaceous, the midrib is straight and stout, the secondaries are regular, alternate and camptodrome; the tip is acute and very slightly produced as in some of Heer's forms from Greenland, * in fact, the Carolina leaves resemble more closely those from Greenland than they do the other leaves which have been referred to this species. It is true that Heer includes a leaf with a rounded tip with the others but this should probably be referred to the same author's *Magnolia obtusata.* The type leaves from Nebraska as well as those from Long Island and New Jersey are somewhat smaller. The species has also been recorded from Vancouver Island by Dawson and from Bohemia by Velenovsky, although the leaves which the latter figures as *Magnolia Capellinii* are rather doubtful fragments and not nearly so similar to the other leaves of this species as, for instance, his *pl. 7, f. 7,* which he identifies as *Magnolia amplifolia* Heer.

Magnolia Newberryi PLATE 13, FIGURE 6

Magnolia longifolia Newb.; Hollick, Trans. N. Y. Acad. Sci. **12**: 36. *pl. 3. f. 9.* 1892. (Not *M. longifolia* Sweet.)

This leaf has already been found on Marthas Vineyard and Staten Island, at Woodbridge, New Jersey, and in the Tuscaloosa formation in Alabama. It is one of the largest of our fossil magnolias, its oblong leaves sometimes measuring a foot in length and four inches in width. The North Carolina material is from Court House Bluff and consists of the specimen figured and its counterpart. It shows the imperfect central part of a large leaf and is 11 cm. long by 5.5 cm. in width and does not show either margins, tip or base indicating that the entire leaf fully equaled some of Newberry's larger leaves in size. The midrib is very strong as are the characteristic secondaries.

The name given to this species by Newberry had unfortunately

* HEER, Fl. Foss. Arct. 6^2: *pl. 25. f. 1, 3; pl. 45. f. 1.* 1882.

been used by Sweet * for an existing species and therefore has to be abandoned, while *macrophylla*, which at once suggests itself, was used by Vukotinovic in 1870 for a fossil species, so that the species under consideration may well be named in honor of its describer, Professor Newberry.

Liriodendron dubium sp. nov. PLATE 14, FIGURE 3

Leaf about 6–7 cm. long and 5 cm. broad at the widest part, which is in the lower half of the leaf. The petiole is not preserved but the midrib is very thick. The secondaries are all of small calibre, of equal rank and very numerous ; they branch from the midrib at an angle of 45 to 50 degrees and are nearly straight and parallel. The tip, which is not preserved, was probably pointed. There are two lateral lobes on the perfect side of the specimen. Basal part of the leaf roughly semicircular in outline and markedly decurrent. The only tertiary venation shown is the small straight nervilles connecting the secondaries, the venation being obscured toward the margin.

While this species is founded upon the imperfect specimen figured and its counterpart, there is little doubt of its affinities with the Cretaceous species of *Liriodendron.* It is just the size of *Liriodendron primaevum* and *L. Meekii* and of *Liriodendropsis simplex* and *L. angustifolia*, being wider, however, than the latter. The venation is of exactly the type which obtains in the two latter species, and the thick midrib is an additional character of most of the species of *Liriodendron.* While the outline is not that which we are accustomed to associate with this genus, there are many modern *Liriodendron* leaves which approximate it and one such is reproduced on PLATE 14 for comparison. With regard to the stage of *Liriodendron* development represented it may be said that while the venation has not advanced beyond the *Liriodendropsis* type the outline is somewhat beyond *Liriodendron primaevum* and *L. Meekii*, even hinting at that of *Liriodendron oblongifolium*, retaining however, in all probability, the pointed tip of the progenitor of the genus, although this is conjectural, and there may have been another pointed lobe on each side and an apical sinus between them as in *L. oblongifolium.* However, pointed leaves in this genus are not the anomaly that they seem to be, for we already have one fossil species with a pointed tip, *Liriodendron semialatum* Lesq.

* Hort. Brit. II. 1826 (Ed. 1).

from the Dakota group, and the writer has collected a variety of pointed leaves from the modern tree, a number of which have already been figured.*

LIRIODENDRON sp. (*cf.* L. PRIMAEVUM Newb.).

Collections made at Blackmans Bluff on the Neuse river contained a small-leaved *Liriodendron* which appears in my notes under the above heading. The specimen was destroyed in transit so there is no means of telling except in the light of future collections whether this was simply a leaf of the preceding species or whether Newberry's species is represented. Both species of *Liriodendropsis* occur in the Tuscaloosa clays of Alabama, and it would not be at all surprising to find *Liriodendron primaevum* also present.

SAPINDALES

CELASTROPHYLLUM CRENATUM Heer, Fl. Foss. Arct. 7: 41. *pl. 62. f. 21.* 1883. — Newb. Fl. Amboy Clays 99. *pl. 48. f. 1–19.* 1896. PLATE 13, FIGURE 5

As Newberry well says, Heer's type of this species is in many ways more like the Raritan *C. Newberryanum* than it is like the leaves which he hesitatingly refers to Heer's species, still the latter vary greatly in size and outline and some are so close to the type that he did not feel justified in considering them distinct. The North Carolina specimen is a practically complete leaf 7 cm. long by 4 cm. wide, about the size of the largest of those figured by Newberry, somewhat obovate in general outline with an inequilateral base. It is comparatively somewhat narrower than the New Jersey leaves and the secondaries are more remote than in the majority figured. The venation is otherwise identical. The margin is very similar, the coarse crenations, if anything, being more aquiline and like those of *C. undulatum* Newb. as shown on *pl. 26, f. 2* of the Amboy Clay flora. The summit is rounded. The marginal teeth are somewhat variable and disappear entirely toward the base of the leaf. The petiole is not preserved.

This is a remarkably fine species and typical of the leaves referred to this genus as it is so largely developed during mid-Cretaceous times. Both this species and *C. undulatum* Newb. are

* BERRY, Torreya 2: *pl. 1. f. 4, 11; pl. 2. f. 12–15.* 1902.

reported from the Tuscaloosa clays of Alabama, while the New Jersey Raritan has ten species, the Magothy two, the Dakota group six and Greenland five. It is represented in the Cenomanian of Europe and Saporta & Marion record seven species from the Paleocene of Belgium. It is also represented at later geological horizons, while several species are recorded from the Older Potomac beds.

RHAMNALES

CHONDROPHYLLUM NORDENSKIÖLDI Heer, Fl. Foss. Arct. 3^2: 114. *pl. 32. f. 11, 12; pl. 30. f. 4b.* 1874. PLATE 13, FIGURE 1

This leaf is intermediate in outline between *C. Nordenskiöldi* and *C. orbiculatum* Heer, from the Atane beds of Greenland. It approaches the former in general outline and also resembles it more closely in the character of the venation, differing in the possession of a wider, apparently slightly sheathing base, although this feature as shown in the specimen may be due to pressure acting on a short and stout petiole. Outline somewhat obovate instead of oval.

C. orbiculatum is not very different from Heer's other species, but has a thicker midrib, pinnate secondaries, and orbicular form. Two additional species are referred to this genus from the New Jersey Raritan, both of which are entirely distinct from the Carolina leaf. In addition, *C. orbiculatum* has been reported from Staten Island, and Lesquereux has identified both this and Heer's other species in the Dakota group, referring them to the genus *Hedera* where they may possibly rightly belong. The North Carolina material comes from one half mile below Blackmans Bluff on the upper Neuse river.

MALVALES

Pterospermites carolinensis sp. nov. PLATE 14, FIGURE 2

Rather thick, broadly ovate leaves with a slightly cordate base, about 10 cm. long by 6.5 cm. broad. Margin entire except in the upper part of the leaf, where it was probably undulate as there is an indication of such on the left margin just below where the leaf is broken away. Petiole preserved for 1.5 cm., very stout. Midrib straight, stout, becoming enlarged below to join the petiole. Secondaries subopposite, strong, distant, two pairs branching from the base of the midrib, the lower at an angle of nearly 90 degrees, giving off several tertiaries which arch along the margin; the second branching at an angle of about 45 degrees, strong and nearly straight, giving off 5 or 6 camptodrome branches on the marginal side; in fact what has been called the lowest secondary may be a branch of this vein which separates from it at its extreme base. Balance of the secondaries branch at an angle of about 50 degrees and are more curved upward in their courses. Nervilles largely simple, straight or curved.

Represented in the collections from Court House Landing, North Carolina, by the specimen figured and its incomplete counterpart.

There are two recorded species of *Pterospermites* in the United States Cretaceous, one (*P. modestus* Lesq.) occurring on Staten Island and in the Tuscaloosa of Alabama, both of which are very distinct from the Carolina leaf, which does, however, resemble somewhat one of the two species (*P. cordifolius*) which Heer records from the Atane beds of the west coast of Greenland. There is also considerable resemblance to the leaves from the Wyoming Laramie referred by Lesquereux to *Apeibopsis? discolor*, and to several of the leaves of *Ficus* found in the Montana formation.

During the Eocene there were species in Alaska and Europe and the genus continued through the Tertiary with upwards of a dozen species in the Miocene.

Pterospermites credneriifolius sp. nov. PLATE 13, FIGURE 4.

This species is unfortunately founded upon an imperfect specimen, 5 cm. long by 4 cm. wide, of the terminal part of a leaf with truncated apex and slightly dentate margin. The midrib is stout and widens rather rapidly below. Secondaries regular, sharply defined but thin, branching from the midrib at an acute angle and running with but a slight curve to the marginal dentations.

If leaves of the genus *Credneria* Zenker, which form so prominent an element in the upper Cretaceous floras of Europe, were commonly recognized in America, I would say that this leaf was referable to that genus; or, did the remains consist of more extensive or complete material, it might be possible to identify it with the *Credneria denticulata* of Zenker, which Richter * makes a variety of *Credneria Zenkeri* and which is abundant in the Senonian

* RICHTER, Die Gattung *Credneria* Zenker. 13. *pl. 2. f. 6, 7; pl. 6. f. 1, 12.* Engelmann, Leipzig, 1906.

of Saxony. To be sure, certain Dakota group leaves such as *Populites = Platanus = Cissites affinis* Lesq., *Cissites Brownii* Lesq., *Sassafras = Cissites harkerianus* Lesq., *Cissites = Platanus Heerii* Lesq., *Cissites acuminatus* Lesq., and *Sterculia Saportanea* (Lesq.) Knowlton seem very similar to those remains from abroad which are referred to *Credneria*, but the proof or disproof of their generic identity can only be determined by a critical investigation and revision of the whole subject.

While such incomplete material as we have from Court House Bluff, North Carolina, is scarcely worthy of being described as a new species, nevertheless since it is likely to be referred to it has seemed best to give it a name and one which would suggest the possible generic affinity which it is hoped may be verified at some future time.

THYMELAEALES

CINNAMOMUM HEERII Lesq. Am. Jour. Sci. **27**: 361. 1859.— Fl. Dakota Group 105. *pl. 15. f. 1.* 1892.

PLATE 13, FIGURES 2, 3

This species is very close to *Cinnamomum intermedium*, from which it differs in having a shorter, fuller, and basally rounded leaf-blade with thicker veins. Leaves are so rarely found in a perfect state, and basal portions of *Cinnamomum* leaves being those largely collected, we may distinguish such fragments by the much fuller and rounded base combined with the thicker veins. The species which Newberry called *C. intermedium* is such a common form that I have no doubt if we could identify the leaves of all stages of growth we would find that *C. Heerii* was simply the shorter fuller leaves of the same tree which bore the more lanceolate leaves known as *C. intermedium*. At least this is my opinion of the leaves as they occur in the Dakota group and Magothy. The leaves from Nanaimo and Orcas Island referred to *C. Heerii* by Lesquereux and Newberry respectively seem to be different, but as I have only seen figures this cannot be certain. *C. Heerii* is reported from Texas by Knowlton, from Marthas Vineyard by Hollick, and from South America by Kurtz. It is another of those types of leaf, evidently Lauraceous, which are so common on this continent during the later Mesozoic and in Europe during the Tertiary.

The North Carolina material is from Court House Bluff.

UMBELLALES

Aralia Newberryi PLATE 15, FIGURE 1

Aralia palmata Newb. Fl. Amboy Clays 117. *pl. 39. f. 6, 7; pl. 40. f. 3.* 1896.

Since this name has been used several times for members of the living flora, I have changed it as above.

This fragment of a trilobed leaf from Court House Bluff seems allied to this species of *Aralia*, especially to those forms from New Jersey referred to it by the writer. There are a variety of similar leaves which have been described from New Jersey and elsewhere in the genera *Aralia*, *Sassafras*, etc., without any definite understanding of their true affinity. Thus this leaf is somewhat similar to *Aralia grönlandica* Heer, to *Sassafras hastatum* Newb., and to some of the forms which have been referred to *Sassafras acutilobum* Lesq. Without the basal part of the leaf it is impossible to identify it except provisionally.

HEDERA PRIMORDIALIS Sap. Le Monde des Pl. 200. *f. 29.* 1879. —Newb. Fl. Amboy Clays 113. *pl. 19. f. 1, 9; pl. 37. f. 1–7.* 1896. PLATE 16

Leaves of this type appear to be rather common at Court House Bluff and they agree very well with this species. While none were found in a perfect condition, figures 1, 3 and 4 give us nearly the whole leaf except the tip. Shape reniform or cordate with a deep basal sinus and 4–6 primaries palmately branching from the top of the petiole, which was stout. Venation entirely characteristic of the species as illustrated by Newberry. This species is reported by Heer from the Atane beds of Greenland but his specimens are fragmentary and not entirely convincing. More typical specimens are illustrated by Velenovsky from the Cenomanian of Bohemia. The Carolina leaves are somewhat larger than the other leaves of this species but are otherwise manifestly identical. The genus *Hedera* is well characterized in the mid-Cretaceous by numerous species of Raritan and Dakota age.

MYRTALES

EUCALYPTUS GEINITZI Heer, Fl. Foss. Arct. 6^2: 93. *pl. 19. f. 1c*, et seq. 1882. PLATE 15, FIGURE 4

Myrtophyllum (*Eucalyptus?*) *Geinitzi* Heer, Fl. Moletein 22. *pl. 10. f. 3, 4.* 1872.

Myrtophyllum Warderi Lesq. Fl. Dakota Group 136. *pl. 53. f. 10.* 1892.

Represented in the material from Court House Bluff by five fragmentary specimens beside the nearly perfect leaf figured. Leaf coriaceous but not thick, lanceolate, fully 18 cm. long, 2.2 cm. wide at the widest part which is near the middle from which point the leaf tapers nearly uniformly above and below, the margins being if anything slightly straighter below, decurring on the extremely stout petiole. Midrib also very stout, slightly flexuous, apparently prominent in life, while the secondaries were thin and nearly immersed in the leaf substance. Secondaries very numerous, leaving the midrib at a very acute angle curving outward slightly and then upward, and running parallel and straight to join the marginal vein, which forms a hem all around the leaf and is but slightly looped from secondary to secondary and less than one millimeter from the margin.

The genus *Myrtophyllum* was established by Heer in 1869 in his Moletein flora for leaves allied to *Eucalyptus*, with *Myrtophyllum* (*Eucalyptus ?*) *Geinitzi* as the type. Having found similar leaves in Greenland and supposed *Eucalyptus* fruits at the same horizon, he referred this species to *Eucalyptus* without question in 1882, in vol. 6 of his Fl. Foss. Arct. A great variety of leaves have been referred to this species, while numerous other Cretaceous species of *Eucalyptus* have been described, some apparently identical with it. While the type carries the generic term *Myrtophyllum* with it into synonymy, that term should possibly be retained for the reason that when the present unsatisfactory state of our knowledge of these species is cleared up it is more than probable that *Myrtophyllum* will have to be retained for a part of the forms at present included under *E. Geinitzi*, and also because of the doubt as to their being *Eucalyptus* leaves at all, due to the discrediting of the fruits, so that it may be found desirable to drop the name *Eucalyptus* altogether and to take up *Myrtophyllum* for all of these leaves. *Myrtophyllum Warderi* was based on the lower half of a leaf from Kansas with which the Carolina material is identical. Some of the leaves referred to *E. Geinitzi* are also of this type, as, for instance, the Block Island leaf figured by Hollick (Ann. N. Y. Acad. Sci. **11**: *pl. 4. f. 1.* 1898) which specimen has, however, less ascending secondaries and a thinner midrib.* I have compared Lesquereux's type (*2754* United States National Museum) with my material and with the figures of Heer's type and find that they are identical.

EUCALYPTUS? ATTENUATA Newb. Fl. Amboy Clays 111. *pl. 16. f. 2, 3, 5.* 1896.

A single fragment of a leaf identical with Newberry's New Jersey leaves, so named, is contained in the collection from Court House Bluff. This species has also been detected by the writer in the Magothy formation, and it is reported by Smith from the Tuscaloosa formation of Alabama.

Eucalyptus linearifolia

Eucalyptus? nervosa Newb.; Hollick, Bull. Torrey Club **21**: 56. *pl. 174. f. 10.* 1894. — Newb. Fl. Amboy Clays 112. *pl. 32. f. 3–5, 8.* 1896.

Fragmentary remains of this species were found at Blackmans Bluff on the upper Neuse river. It is a form common in the coastal plain Cretaceous and has been reported from Block Island, Long Island, New Jersey and Alabama. Since Newberry's name is unfortunately preoccupied by *E. nervosa* F. Muell. (Miq. Nederl. Kruidk. Arch. **4**: 139. 1859) it becomes necessary to rename this species.

ERICALES

ANDROMEDA PARLATORII Heer, Phyll. Crét. Nebr. 18. *pl. 1. f. 5.* 1866. — Newb. Fl. Amboy Clays 120. *pl. 31. f. 1–7; pl. 33. f. 1, 2, 4, 5.* 1896. — Berry, Bull. Torrey Club **31**: 79. *pl. 1. f. 1, 2.* 1904. PLATE 15, FIGURE 2

This ubiquitous species is represented in the collections from Court House Bluff by the basal part of two leaves similar to the one figured. These are larger than Heer's type but similar to the leaves from the coastal plain usually referred to this species, some figures of which are cited above. The species occurs in considerable numbers from Greenland to Alabama and west to Minnesota and Kansas.

* Hollick has recently transferred certain forms of *Eucalyptus Geinitzi* from Glen Cove, Long Island, to *Myrtophyllum Warderi*, keeping the two distinct. U. S. Geol. Surv. Monog. **50**: 97. *pl. 35. f. 13.* 1906.

ANDROMEDA NOVAE CAESAREAE Hollick, in Newb. Fl. Amboy Clays 121. *pl. 42. f. 9–12, 28–31.* 1896.

A single characteristic leaf of this species was found at Blackmans Bluff on the Neuse river. Described originally from the New Jersey Raritan, it has been detected by the writer in the Magothy formation at Grove Point, Maryland, and Smith has reported it from the Tuscaloosa formation of Alabama.

Andromeda grandifolia

Andromeda latifolia Newb. Fl. Amboy Clays 120. *pl. 33. f. 6–10; pl. 34. f. 6–11; pl. 36. f. 10.* 1896. PLATE 15, FIGURE 3

Leaves of irregular size, some becoming very large, with stout midrib, coriaceous texture, camptodrome venation, and a margin inclined to be repand or irregular. The botanical affinity of this species, which occurs with, and somewhat resembles *Andromeda Parlatorii*, is unknown. It has been found in New Jersey and Alabama and on Long Island. The Carolina leaf is of large size and was found at Court House Bluff.

It becomes necessary to rename this species since *Andromeda latifolia* Newb. is preoccupied by *A. latifolia* Wright, in Sauv. Anal. Acad. Ci. Habana **6**: 250 (1870), a Cuban plant.

KALMIA BRITTONIANA Hollick (?), Trans. N. Y. Acad. Sci. **12**: 34. *pl. 2. f. 6–8.* 1892.

A specimen of an Ericaceous leaf from one half mile below Blackmans Bluff on the Neuse river is provisionally referred to this species described from the Cretaceous of Staten Island; without implying that it is related to *Kalmia*, which is doubtful.

EBENALES

DIOSPYROS PRIMAEVA Heer, Phyll. Crét. Nebr. 19. *pl. 1. f. 6, 7.* 1866.

Fragmentary specimens from Court House Bluff are rather larger than the usual run of leaves of this species but are otherwise identical. Many of these Cretaceous species from Carolina average larger in size, and it may be that this region was relatively more humid during the mid-Cretaceous. It is difficult to suppose that the temperature was higher, since all of the evidence derived from the floras has shown a uniform flora as far north as Greenland with some of the species crossing the equator and extending to the southern part of South America.

This species is an abundant and widespread one ranging from Greenland to Alabama along the eastern coast and from Nebraska and Kansas to Texas in the interior region.

GENTIANALES

ACERATES sp., Hollick, in Newb. Fl. Amboy Clays 124. *pl. 32. f. 17; pl. 41. f. 4, 5.* 1896.

A specimen which is comparable to this Raritan species is contained in the material from one half mile below Blackmans Bluff on the Neuse river.

I doubt, however, whether any of these Cretaceous leaves described under this genus are related to the modern *Asclepiadaceae*, a highly specialized and recent type.

JOHNS HOPKINS UNIVERSITY,
BALTIMORE, MARYLAND

Explanation of plates 11-16

PLATE 11

Figs. 1–4, 6. *Myrica elegans* sp. nov. Court House Bluff, N. C.

Fig. 5. *Phragmites* sp. Court House Bluff, N. C.

Fig. 7. *Planera cretacea* sp. nov. One half mile below Blackmans Bluff, N. C.

Fig. 8. *Planera cretacea* sp. nov. Blackmans Bluff, N. C.

Fig. 9. *Quercus Pratti* sp. nov. Court House Bluff, N. C.

Figs. 10, 11. *Ficus daphnogenoides* (Heer) Berry. Court House Bluff, N. C.

PLATE 12

Fig. 1. *Ficus Woolsoni* Newb. Court House Bluff, N. C.

Figs. 2, 3. *Ficus inaequalis* Lesq. Court House Bluff, N. C.

Figs. 4, 5. *Magnolia Capellinii* Heer. Court House Bluff, N. C.

PLATE 13

Fig. 1. *Chondrophyllum Nordenskiöldi* Heer. One half mile below Blackmans Bluff, N. C.

Figs. 2, 3. *Cinnamomum Heerii* Lesq. Court House Bluff, N. C.

Fig. 4. *Pterospermites credneriifolius* sp. nov. Court House Bluff, N. C.

Fig. 5. *Celastrophyllum crenatum* Heer. Court House Bluff, N C.

Fig. 6. *Magnolia Newberryi* Berry. Court House Bluff, N. C.

PLATE 14

Fig. 1. *Liriodendron tulipifera* Linn. Introduced for comparison.

Fig. 2. *Pterospermites carolinensis* sp. nov. Court House Bluff, N. C.

Fig. 3. *Liriodendron dubium* sp. nov. Court House Bluff, N. C.

PLATE 15

Fig. 1. *Aralia Newberryi* Berry. Court House Bluff, N. C.

Fig. 2. *Andromeda Parlatorii* Heer. Court House Bluff, N. C.

Fig. 3. *Andromeda grandifolia* Berry. Court House Bluff, N. C.

Fig. 4. *Eucalyptus Geinitzi* Heer. Court House Bluff, N. C.

PLATE 16

Figs. 1–4. *Hedera primordialis* Sap. Court House Bluff, N. C.

Concerning some West American fungi

David Griffiths

The following species from my personal collections of the past four or five years appear to be new or worthy of record :

Sclerospora Farlowii sp. nov.

Fructification of fungus in leaf-sheaths, especially in the upper expanded one, less frequently in the leaves and culms, and rarely in the spikes ; forming irregular grayish-black discolorations which are darker around the edges of the infected area ; oōspores subglobose, 28 to 45 μ in diameter, deep dark reddish-brown, and often appearing black and opaque, imbedded in tissues of the host, and when isolated having a few irregular fragments of mycelial tissue adhering.

On *Chloris elegans* H.B.K., Cochise, Arizona, October, 1900.

This is one of the commonest fungi throughout southern Arizona and northern Sonora. Several small collections have been made of it by myself. It has been seen many times. Invariably the mode of attack is the same whether it is abundant or not. The effect upon the plant is never serious so far as my observation goes. Indeed, no case has been observed where it was thought that the plants were at all reduced in size by the parasite.

The type is a specimen so marked from the above collection in my private herbarium. A duplicate is in the herbarium of the United States Department of Agriculture, and the same thing is in the herbarium of Professor W. G. Farlow, who has examined the species and to whom it is dedicated.

Ustilago Microchloae sp. nov.

Sori in the inflorescence whose parts are transformed into a jet-black, shining mass in which the individual spikelets are plainly distinguishable, or the entire surface of the rachis and spikelets may be involved in one continuous sorus extending the entire length of the inflorescence, which may be of normal length when only individual florets are affected, or very much shortened in other cases ; spores subglobose, ovoid, and often irregular, very variable, 12 to 18 μ in diameter, shiny jet-black in mass, dark-brown to almost opaque by transmitted light; epispore thin, smooth, contents granular, which is obscured at maturity.

On *Microchloa indica* (L.) Kuntze, on the deserts near San Luis Potosi, Mexico, June, 1904. The species is common in the San Luis Potosi and Aguas Calientes region.

USTILAGO BOUTELOUAE K. & S.

This species, which is not at all well represented in collections, appears to be quite common, and even abundant, in certain localities. My experience with it indicates that it is at home in high altitudes. In 1904, large quantities of it were found in the San Francisco Mountains of Arizona, at an altitude of about 7500 feet, upon *Bouteloua prostrata* Lag. Large areas were found where practically all of the plants were affected. Other collections have been made near the City of Zacatecas, Mexico, at an altitude of nearly 8,000 feet, and the species has been seen in several situations in the Federal District of Mexico on the same host. My material has somewhat larger and darker-colored spores than specimens which have been examined upon *Bouteloua oligostachya* from Kansas.

USTILAGO HETEROGENA P. Henn.

This species appears from my collections to be exceedingly variable in spore-characters, especially in so far as color and echinulation are concerned. Several collections have been made on *Leptochloa mucronata* and on *L. viscida*, all from the general region extending from twenty miles south of Altar, in the Mexican state of Sonora, to Tucson, Arizona. It is quite frequent in this region.

USTILAGO CYNODONTIS P. Henn.

So far as I know this is the first record of this species for this country. It corresponds perfectly with the original description, as well as with the specimen in Sydow's Ustilagineen *no. 304*. It appears to be most closely related to *Ustilago hypodytes* (Schl.) Fr. It has not been seen except at Santa Rosa, California, in 1905. Here it was the exception rather than the rule to find Bermuda grass (*Cynodon dactylon* Pers.) lawns free from this smut. In many instances it would have been difficult to find unaffected plants. In the majority of cases seed-production was practically destroyed by it.

Sorosporium ovarium sp. nov.

Sori in ovaries which are but slightly enlarged, covered by a grayish-brown membrane of plant tissue which ruptures irregularly at the apex exposing the black dusty spore-mass; spore-balls rather firm, irregular, angular-compressed, 50 to 100 μ in greatest diameter; spores subglobose to angular-compressed, 8 to 12 μ in greatest diameter, with thin minutely echinulate epispore.

On *Panicum caespitosum* Swartz, Dublan, Hidalgo, Mexico, September 9, 1905; also on the same host at Puebla, Mexico, August 29, 1906. The above are collections which have been made. The species has been observed on the same host in various localities upon the plateau of Mexico, especially in the vicinity of the Federal District. The species is closely related to *S. Eriochloae* Griff., and, indeed, was collected for that species, so similar are the two in external appearance. It is distinguished from that species, however, by its smaller and minutely echinulate spores.

Urocystis Sophiae sp. nov.

Fructification of the fungus occurring most commonly upon the upper portion of the roots, about 2 cm. below the surface of the ground, but it may occur upon any portion of the root-system, forming wart-like tubercles of irregular shape, measuring from 1 mm. to 1 cm. in greatest diameter; spore-balls irregular in size, from 30 to 45 μ in diameter, firmly united, consisting of from one to four or more cells which are subglobose or angular-flattened by compression, about 15 μ in diameter, and completely surrounded by mostly a single layer of hyaline or slightly tinted cells about 3 μ in diameter; all imbedded in a hyaline fungus-tissue apparently formed of anastomosing and agglutinated mycelial threads.

On roots of *Sophia andrenarum* Cockerell, Tucson, Arizona, March 14, 1903. This was first collected in 1901 along the Santa Cruz River near Tucson, Arizona, but the later collection is made the type because the material is more abundant. This, I believe, is the first record of a root smut in this country.

UROCYSTIS AGROPYRI (Preuss) Schröt.

Quite common on *Melica imperfecta* Trin., at Banning, California, May, 1906. I have also collected it on *Koeleria* sp., on the top of Mt. Lemmon, Arizona, in 1904, where it was so prevalent as to render it difficult to secure enough of the host for identification.

Aecidium Cannonii sp. nov.

Spermogonia mostly epiphyllous, minute, reddish-brown, confined to a central area, which early dies and turns brown, and from which aecidia may or may not be excluded; aecidia hypophyllous, about 1 mm. long, developing centrifugally, commonly beyond the spermogonial area, but sometimes occupying it also, opening at the apex with a lacerated recurved margin; spores irregularly polyhedral, or simply angular by compression, commonly 24 by 30 μ and again about 20 by 30 μ with epispore uniformly thick (about 3 μ), subhyaline, minutely rugose with coarsely granular contents.

The central area of the spot upon the leaf dies early and turns brown as stated above. Sometimes the aecidia develop in the lower side of this area, but commonly only beyond it. The brown area is surrounded by an irregularly blackened zone extending a short distance beyond the aecidia. The spots are commonly 1 cm. or less in diameter. It is quite probable, however, that the seasonal variation may have a decided influence upon the character of the spot formed. As is well known, this plant drops its leaves on the advent of dry weather. If the wet season should happen to be prolonged it might cause a decided difference in the appearance of the attack. I take pleasure in dedicating the species to Dr. W. A. Cannon, who was the first to collect it, and who directed where I could find it.

On leaves of *Fouquieria splendens* Engelm., in Sabiño Cañon, Santa Catalina Mountains, Arizona, September 10, 1904.

AECIDIUM SARCOBATI Peck

Present mycological practice of considering fungi on diverse hosts distinct might, in the absence of field notes, lead to the establishment of a different species upon *Nitrophila occidentalis* from that growing on *Sarcobatus*. The hosts were found growing together at Smoke Creek, Nevada, in August, 1902, and both loaded with aecidia. The peridia of the form on *Nitrophila* are slightly smaller than those on *Sarcobatus*, but there are no other differences.

Puccinia Eurotiae sp. nov.

Sori persistently hypophyllous, circular, usually aggregated and forming an entire black covering over a large section of the lamina of the leaf on each side of the midrib, where they may be elongated or polyhedral by compression, but seldom confluent to such an extent as to lose their individuality; about 1 mm. in diameter, convex, rounded, and about 0.66 to 1 mm. high, at first covered by epidermal tissue and trichomes, but later naked and black; teleutospores oval to obovate, broadly rounded to bluntly pointed above, with comparatively thick epispore either thickened or not at apex, contents subhomogeneous to irregularly guttulate with indistinct nuclear area, 20 to 25 μ by 32 to 42 μ; pedicel long, stout, hyaline, about 120 μ long and 3 μ in diameter, with irregular thickened areas in wall resembling warty excrescences in optical section.

On *Eurotia lanata* Moq., near Lovelock, Nevada, August 10, 1902.

Only two or three badly infested plants were found in this locality. The species has not been observed elsewhere.

UNITED STATES DEPARTMENT OF AGRICULTURE.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1907)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions their kindness will be appreciated.

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Anderson, M. P. Nature study as an education. Jour. N. Y. Bot. Gard. **8**: 32–42. [Mr] 1907.

Arthur, J. C. *Aecidiaceae* (pars). N. Am. Fl. **7**: 129–160. 6 Mr 1907.

Arthur, J. C. *Coleosporiaceae*. N. Am. Fl. **7**: 85–95. 6 Mr 1907.

Arthur, J. C. *Uredinaceae*. N. Am. Fl. **7**: 97–127. 6 Mr 1907.

Arthur, J. C. *Uredinales*. N. Am. Fl. **7**: 83. 6 Mr 1907.

Bailey, W. W. *Ailanthus*. Am. Bot. **12**: 36, 37. Mr 1907.

Bailey, W. W. Squashes and gourds. Am. Bot. **12**: 1–3. F 1907. [Illust.]

Baker, J. G. Raspberries and brambles. Gard. Chron. III. **41**: 33, 34. 19 Ja 1907.

Includes several American species.

Baxter, J. M. Lake deposits. Proc. Miramichi Nat. Hist. Asso. **5**: 21, 22. F 1907.

A list of diatoms from two Nova Scotian lakes.

Baxter, J. M. Microscopic forms in fresh water. Proc. Miramichi Nat. Hist. Asso. **5**: 18–20. F 1907.

Contains a supplementary list of the diatoms and desmids of Chatham, New Brunswick.

Bean, W. J. The western catalpa. (*Catalpa cordifolia* Jaume, [*C. speciosa* Warder].) Kew Bull. Misc. Inf. **1907**: 43–45. F 1907.

Beauverd, G. Une nouvelle Cactacée du Costa-Rica. Bull. Herb. Boiss. II. **7**: 136, 137. 4 F 1907. [Illust.]
Rhipsalis Simmleri sp. nov.

Berry, E. W. Recent discussions of the origin of gymnosperms. Science II. **25**: 470–472. 22 Mr 1907.

Blanchard, W. H. A new blackberry from the vicinity of Philadelphia and Washington. Torreya **7**: 55–57. 19 Mr 1907.
Rubus philadelphicus sp. nov.

Blumer J. C. A simple plan for collectors of ecological sets of plants. Plant World **10**: 40–42. [Mr] 1907.

Bois D. *Aechmea serrata.* Rev. Hort. **79**: 129–131. *f. 39–41.* 16 Mr 1907.
Native of Guadeloupe and Martinique.

Bois, D. *Hippeastrum procerum.* Rev. Hort. **79**: 57, 58. 1 F 1907.
Native of Brazil.

Bois, D. *Rhipsalis foveolata.* Rev. Hort. **79**: 105, 106. *f. 33.* 1 Mr 1907.
Native of southern Brazil.

Brand, A. *Polemoniaceae.* Das Pflanzenreich 4^{250}: 1–203. *f. 1–39.* 19 F 1907.

Bray, W. L. Distribution and adaptation of the vegetation of Texas. 1–108. *pl. 1–14* + *f. 1–4* + *map.* 1907.
Bull. Univ. Texas no. 82.

Britten, J. Bibliographical notes. XLII. — Plants of the Antilles. Jour. Bot. **45**: 118, 119. 1 Mr 1907.

Britton, E. G. The Mitten collection of mosses and hepatics. Jour. N. Y. Bot. Gard. **8**: 28–32. [Mr] 1907.

Britton, E. G. *Rhacopilum tomentosum* (Sw.) Brid. Bryologist **10**: 32, 33. *pl. 5.* 1 Mr 1907.

Britton, N. L. Pioneers of science in America. John Torrey. Pop. Sci. Mo. **70**: 297, 299. *portrait.* Ap 1907.

Brown, B. W. The camera in botanical work. Plant World **10**: 1–5. *f. 1, 2.* [F] 1907.

Burlingham, G. S. Some *Lactarii* from Windham County, Vermont. Bull. Torrey Club **34**: 85–95. 9 Ap 1907.
Includes descriptions of six new species.

Burnham, S. H. A new blueberry from New York. Am. Bot. **12**: 8, 9. F 1907.
Vaccinium Dobbini sp. nov.

Campbell, D. H. Studies on the *Ophioglossaceae*. Am. Nat. **41**: 139–159. *f. 1–17*. 29 Mr 1907.

Claes, F. Habitat of *Odontoglossum crispum*. Orch. Rev. **15**: 36, 37. F 1907; 79, 80. Mr 1907.

Clute, W. N. The advent of spring. Am. Bot. **12**: 4–8. F 1907.

Clute, W. N. Some inconspicuous flowers. Am. Bot. **12**: 33–36. Mr 1907.

Cockerell, T. D. A. Note on a tradescantia. *Tradescantia universitatis*. Muhlenbergia **3**: 54. 28 Mr 1907.

Collins, F. S. Is *Rhinanthus Crista-galli* an introduced plant? Rhodora **9**: 26. 25 F 1907.

Cook, M. T. The embryology of *Sagittaria lancifolia* L. Ohio Nat. **7**: 97–101. *pl. 8*. 12 Mr 1907.

Copeland, E. B. The comparative ecology of San Ramon *Polypodiaceae*. Philipp. Jour. Sci. **2**: Bot. 1–76. *pl. 1–4*. Ja 1907.

Cotton, A. D., *and others*. Plants from Labrador. Kew Bull. Misc. Inf. **1907**: 76–88. Mr 1907.

Dalgity, A. D. The common bracken as food. Am. Bot. **12**: 25–29. *pl.* + *f. 1*. Mr 1907.

DeVries, H. Luther Burbank's ideas on scientific horticulture. Century Mag. **73**: 674–681. Mr 1907. [Illust.]

Diederichsen, J. Ueber die Kakteen in Nordamerika, ihre Verbreitung und Vergesellschaftung. Monats. Kakteenk. **17**: 20–23. 15 F 1907.

Dihm, H. Das Blatt der Gattung *Meliosma* (Sabiaceen) in anatomischer Hinsicht. Beih. Bot. Centr. **21**[1]: 117–147. *pl. 5, 6*. 1 Mr 1907.

Contains notes on 15 American species.

Dobbin, F. Early blossoms. Am. Bot. **12**: 37–39. Mr 1907.

Edwards, A. M. Origin of a fossil lake in New Jersey and identification of it by the *Bacillaria* in it. Nuova Notar. **18**: 39–48. Ja 1907.

Evans, A. W. The genus *Calypogeia* and its type species. Bryologist **10**: 24–30. 1 Mr 1907.

Fernald, M. L. The alpine *Rhinanthus* of Quebec and New Hampshire. Rhodora **9**: 23–25. 25 F 1907.

Includes description of *R. oblongifolius* sp. nov.

Fernald, M. L. Doctor Sarrasin of Quebec. Jour. Bot. **45**: 117, 118. 1 Mr 1907.

Fernald, M. L. Note on *Cirsium muticum*, var. *monticola*. Rhodora **9**: 28. 25 F 1907.

Fink, B. Further notes on cladonias. IX. *Cladonia squamosa* and *Cladonia subsquamosa*. Bryologist **10**: 21–23. *pl. 4*. 1 Mr 1907.

Fussell, L. Botanical names. Proc. Delaware County Inst. Sci. **2**: 71–76. Ja 1907.

Graenicher, S. Wisconsin flowers and their pollination. *Melanthaceae*, *Liliaceae* and *Convallariaceae*. Bull. Wis. Nat. Hist. Soc. II. **5**: 15–45. Ja 1907.

Greenman, J. M. Studies in the genus *Citharexylum*. Field Columb. Mus. Publ. Bot. **2**: 185–190. 25 Ja 1907.

Includes descriptions of 10 new species.

Griggs, R. F. *Cymathere*, a kelp from the western coast. Ohio Nat. **7**: 89–96. *pl. 7* + *f. 1*. 12 Mr 1907.

Gürke, M. *Rhipsalis platycarpa* (Zucc.) Pfeiff. Monats. Kakteenk. **17**: 33, 34. 15 Mr 1907.

Native of Brazil.

Harper, R. A. Sex-determining factors in plants. Science II. **25**: 379–382. 8 Mr 1907.

Harris, W. Grape vine culture. Bull. Dept. Agric. Jamaica **5**: 1–26. *f. 1–6*. Ja 1907.

Hassler, E. Plantae Paraguarienses, novae vel minus cognitae. II. Bull. Herb. Boiss. II. **7**: 161–176. 28 F 1907. [Illust.]

Includes new species in *Dolichopsis* (gen. nov.), *Lonchocarpus* (2), *Rhynchosia* (2), *Cassia*, and *Chorisia*.

Haynes, C. C. Two new species of *Aytonia* from Jamaica. Bull. Torrey Club **34**: 57–60. *pl. 5, 6*. 9 Ap 1907.

Heller, A. A. The flora of Santa Clara County, California — I. Muhlenbergia **3**: 33–36. 28 F 1907;— II. Muhlenbergia **3**: 47–52. 28 Mr 1907.

Hemsley, W. B. Auguste François Marie Glaziou. Kew Bull. Misc. Inf. **1907**: 66–68. F 1907.

Herms, W. B. Notes on a Sandusky Bay shrimp, *Palaemonetes exilipes* Stimpson. Ohio Nat. **7**: 73–79. *f. 1, 2*. 16 F 1907.

Contains a list of the most abundant plants in the coves of Sandusky Bay.

Holm, T. *Rubiaceae*: Anatomical studies of North American representatives of *Cephalanthus*, *Oldenlandia*, *Houstonia*, *Mitchella*, *Diodia* and *Galium*. Bot. Gaz. **43**: 153–186. *pl. 7–9*. 20 Mr 1907.

House, H. D. New species of *Ipomoea* from Mexico and Central America. Muhlenbergia **3**: 37–46. *pl. 1–3.* 28 Mr 1907.

Includes descriptions of 14 new species.

House, H. D. A new species of *Evolvulus* from Colombia. Torreya **7**: 61, 62. 19 Mr 1907.

Howe, M. A. Report on a visit to Jamaica for collecting marine algae. Jour. N. Y. Bot. Gard. **8**: 51–60. *f. 9–14.* Mr 1907.

Hüller, G. Beiträge zur vergleichenden Anatomie der Polemoniaceen. Beih. Bot. Centr. **21**[1]: 173–244. *pl. 8.* 1 Mr 1907.

Kaufman, P. Some foreign nuts. Am. Bot. **12**: 3, 4. F 1907.

Kennedy, P. B. Botanical features around Reno. Muhlenbergia **3**: 17–32. 28 F 1907.

Kindberg, N. C. New or less known *Bryineae* from N. America. Rev. Bryol. **34**: 25–29. [Mr] 1907.

Kunzé, R. E. *Mamillaria Thornberi* Orcutt. Monats. Kakteenk. **17**: 30, 31. 15 F 1907.

Lawson, A. A. The gametophytes, fertilization, and embryo of *Cephalotaxus drupacea.* Ann. Bot. 21: 1–23. *pl. 1–4.* Ja 1907.

Lloyd, F. E. Observations on the flowering periods of certain cacti. Plant World **10**: 31–39. [Mr] 1907.

Lorenz, A. *Lescuraea frigida* in Vermont. Bryologist **10**: 34, 35. 1 Mr 1907.

Lunell, J. The genus *Alisma* in North Dakota. Bot. Gaz. **43**: 209–213. *f. 1.* 20 Mr 1907.

MacDougal, D. T. Hybrids among wild plants. Plant World **10**: 25–37. *f. 7, 8.* [Mr] 1907.

Mackenzie, K. K. The scientific name of our common huckleberry. Torreya **7**: 60. 19 Mr 1907.

Masters, M. T. *Abies magnifica* var. *xanthocarpa.* Gard. Chron. III. **41**: 114. *f. 51–53.* 23 F 1907.

Native of California.

Maza, M. G. de la. Determinacion de plantas cubanas (fanerogamas) II. Revista Fac. Let. y Ci. Univ. Habana **4**: 50–67. Ja 1907.

Millspaugh, C. F. Flora of the sand keys of Florida. Field Columb. Mus. Publ. Bot. **2**: 191–245. 11 Mr 1907.

Moore, A. H. Revision of the genus *Spilanthes.* Proc. Am. Acad. Arts & Sci. **42**: 521–569. 18 Mr 1907.

Recognizes 63 species, varieties, or forms: 10 species described as new.

Mottet, S. *Vaccinium stamineum.* Rev. Hort. **79**: 93, 94. *f. 29.* 16 F 1907.

Native of North America.

Murdoch, J. *Arceuthobium* in the Rangeley region. Rhodora **9**: 28. 25 F 1907.

Olsson-Seffer, H. A botanical station in tropical Mexico. Plant World **10**: 6–11. *f. 3, 4.* F 1907.

Peck, C. H. New species of fungi. Bull. Torrey Club **34**: 97–104. 9 Ap 1907.

New species in *Lepiota*, *Clitocybe*, *Collybia*, *Omphalia*, *Entoloma* (2), *Eccilia* (2), *Flammula*, *Inocybe*, *Naucoria*, *Psathyrella*, *Hydnum*, *Clavaria*, *Peckiella*, *Leotia*, *Dothiorella*, *Helicosporium*, *Rhinotrichum*, and *Armillaria*.

Petzold, V. Systematische-anatomische Untersuchungen über die Laubblätter der amerikanischen Lauraceen. Bot. Jahrb. **38**: 445–474. *plate.* 12 Mr 1907.

Purpus, J. A. *Mamillaria chionocephala* J. A. Purp. Monats. Kakteenk. **17**: 30. 15 F 1907.

Rolfe, R. A. *Acacallis cyanea.* Orchid Rev. **15**: 40. F 1907.

Native of Brazil.

Rolfe, R. A. *Epidendrum densiflorum.* Orchid Rev. **15**: 67. Mr 1907.

Native of Venezuela, doubtfully also of Mexico.

Rudolph, J. *Solanum jasminoides.* Rev. Hort. **79**: 34–36. *f. 7, 8.* 16 Ja 1907.

Native of South America.

Schneider, E. S. *Acanthospermum australe* at Lawrence, Massachusetts. Rhodora **9**: 26. 25 F 1907.

Scotti, L. Contribuzioni alla Biologia fiorale delle "Personatae." VI. (1). Ann. di Bot. **5**: 101–221. 12 Ja 1907.

Many references to American species.

Scribner, F. L. Notes on *Muhlenbergia.* Rhodora **9**: 17–23. 25 F 1907.

One new species and 6 new subspecies.

Selby, A. D. On the occurrence of *Phytophthora infestans* Mont. and *Plasmopora cubensis* (B. & C.) Humph. in Ohio. Ohio Nat. **7**: 79–85. 16 F 1907.

Shaw, G. R. Characters of *Pinus*: the lateral cone. Bot. Gaz. **43**: 205–209. *f. 1, 2.* 20 Mr 1907.

Skeels, H. C. Trees injured by the seventeen-year cicada. Am. Bot. **12**: 9–13. F 1907.

Small, J. K. Exploration of southern Florida. Jour. N. Y. Bot. Gard. **8** : 23–28. [Mr] 1907.

Smith, F. G. Morphology of the trunk and development of the microsporangium of cycads. Bot. Gaz. **43** : 187–204. *pl. 10.* 20 Mr 1907.

Solms-Laubach, H. Graf zu. Ueber unsere Erdbeeren und ihre Geschichte. Bot. Zeit. **65**^{1}: 45–76. 1 Ap 1907.

Many references to American species.

Spalding, V. M. Notes on the vegetation of Box Cañon. Plant World **10** : 11–17. *f. 5, 6.* [F] 1907.

Spalding, V. M. Suggestions to plant collectors. Plant World **10** : 40. [Mr] 1907.

Sprague, T. A. *Caiophora coronata.* Curt. Bot. Mag. IV. **3** : *pl. 8125.* Mr 1907.

Native of the Andes.

Stapf, O. *Blepharocalyx spiraeoides.* Curt. Bot. Mag. IV. **3** : *pl. 8123.* Mr 1907.

Native of Brazil.

Strong, M. A. Further information regarding the occurrence of *Dryopteris Filix-mas* in Vermont. Rhodora **9** : 27, 28. 25 F 1907.

Sumstine, D. R. A new *Lentinus* from Pennsylvania. Torreya **7** : 60, 61. 19 Mr 1907.

Lentinus pulcherrimus sp. nov.

Taylor, N. On some distribution factors in the Sierra Maestra, Cuba. Torreya **7** : 49–55. 19 Mr 1907.

Weingart, W. Bemerkungen zu *Cereus Kalbreyerianus* Wercklé n. sp. Monats. Kakteenk. **17** : 39, 40. 15 Mr 1907.

Native of Colombia.

Weingart, W. *Phyllocactus Purpusii* Weing. n. sp. Monats. Kakteenk. **17** : 34–38. 15 Mr 1907. [Illust.]

Native of Mexico.

Wercklé, C. *Cereus Kalbreyerianus* Wercklé n. sp. Monats. Kakteenk. **17** : 38, 39. 15 Mr 1907.

Native of Colombia.

Wercklé, C. Kakteen in Zentral-Columbien. Monats. Kakteenk. **17** : 17–20. 15 F 1907.

Wheeler, L. A. Spring in Stony Park. Am. Bot. **12** : 30–33. Mr 1907.

Whitman, C. O. The origin of species. Bull. Wis. Nat. Hist. Soc. II. **5** : 6–14. Ja 1907.

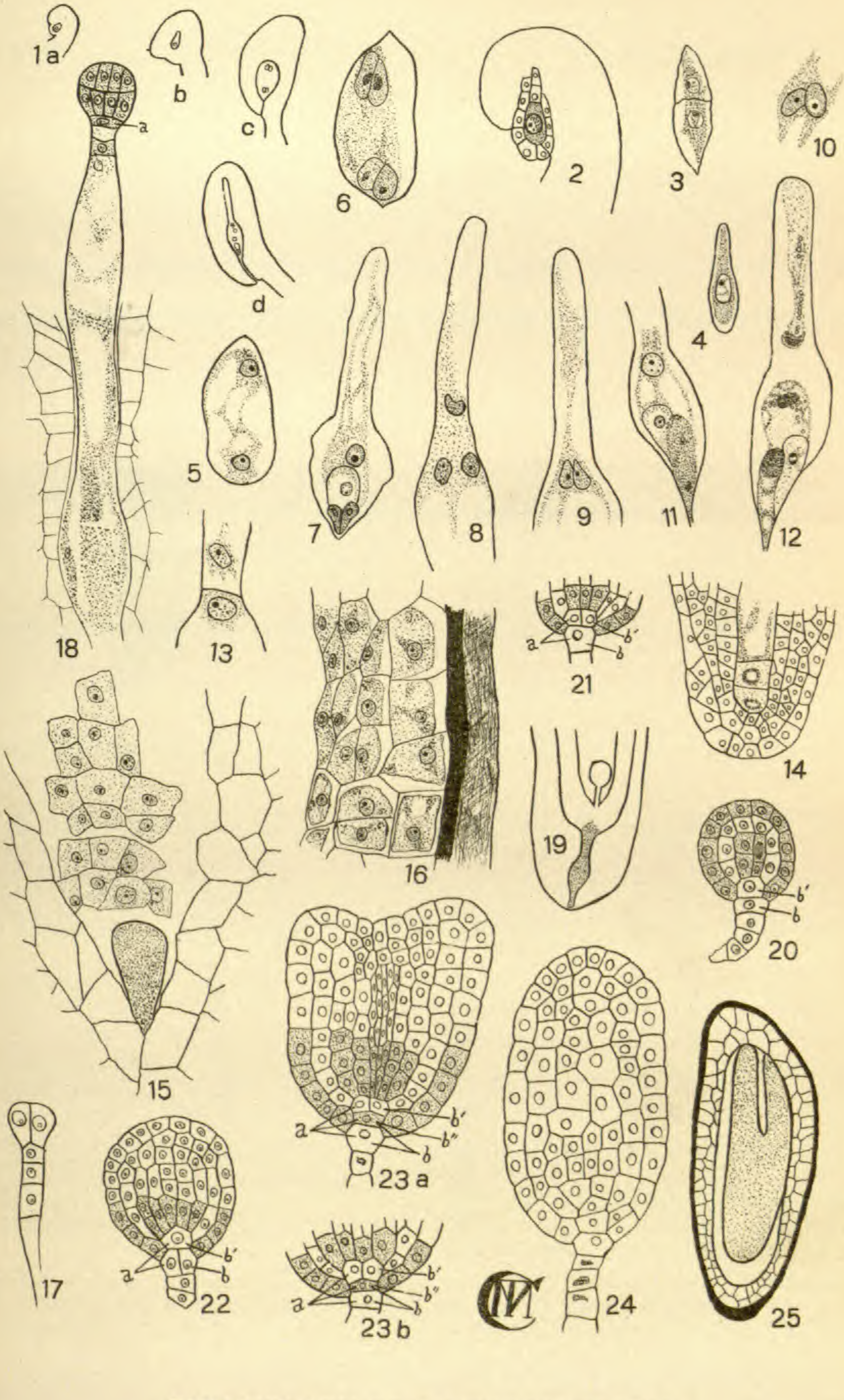
Wilson, G. W. *Melanospora parasitica.* Torreya **7**: 57–59. 19 Mr 1907.

Wilson, G. W. Studies in North American *Peronosporales* — I. The genus *Albugo.* Bull. Torrey Club **34**: 61–84. *f. 1–10.* 9 Ap 1907.
Thirteen species recognized, of which one is new.

Wright, C. H. *Gymnogramme* (*Eugymnogramme*) *hirtipes.* Kew Bull. Misc. Inf. **1907**: 61. F 1907.
New species, native of Colombia.

Wright, C. H. *Tillandsia* (*Anoplophytum*) *argentina.* Kew Bull. Misc. Inf. **1907**: 60, 61. F 1907.
New species, native of the Argentine Republic.

Wright, C. H. *Woodwardia paradoxa,* sp. nov. Gard. Chron. III. **41**: 98. 16 F 1907.
Native of Vancouver Island.



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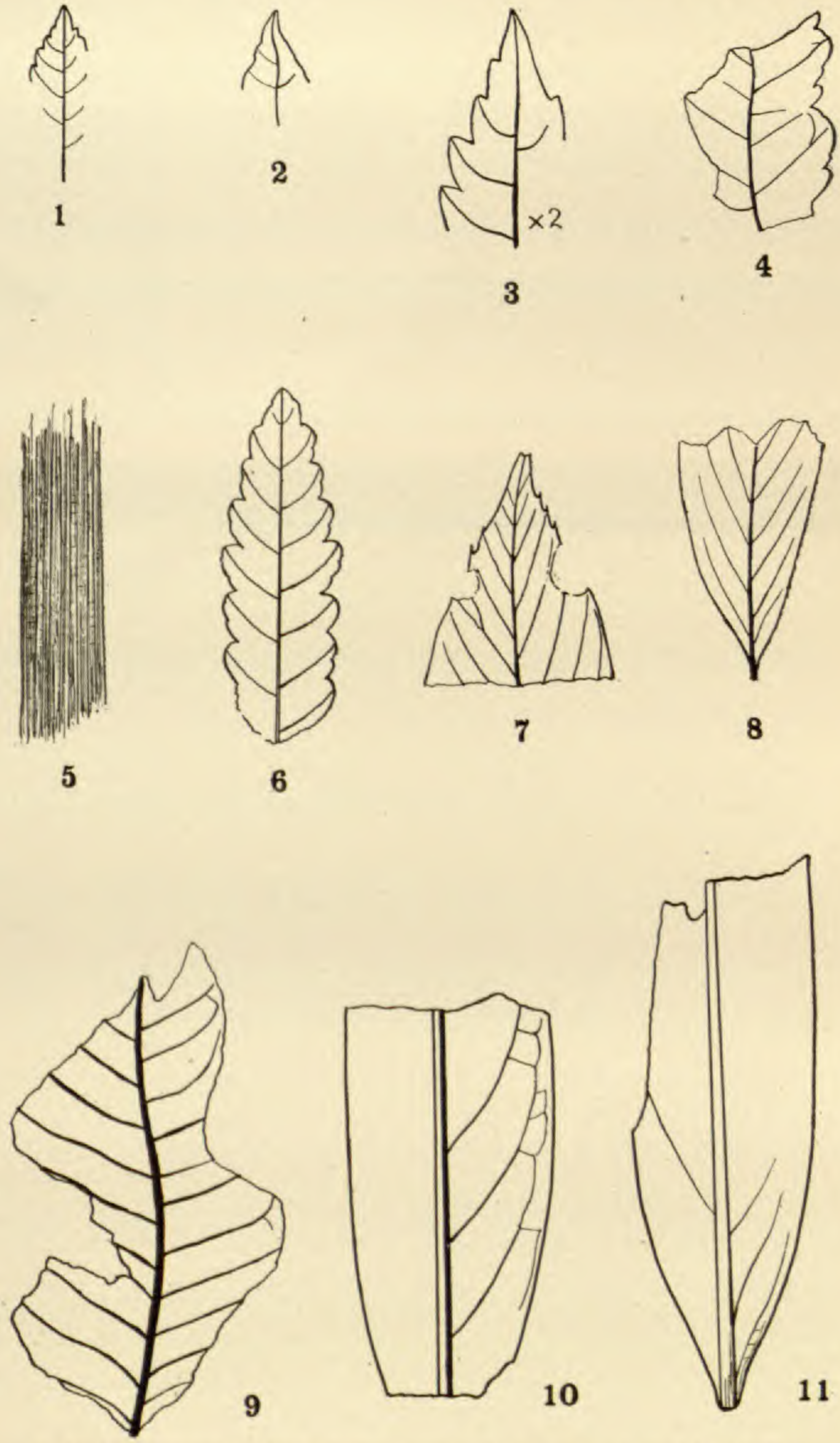

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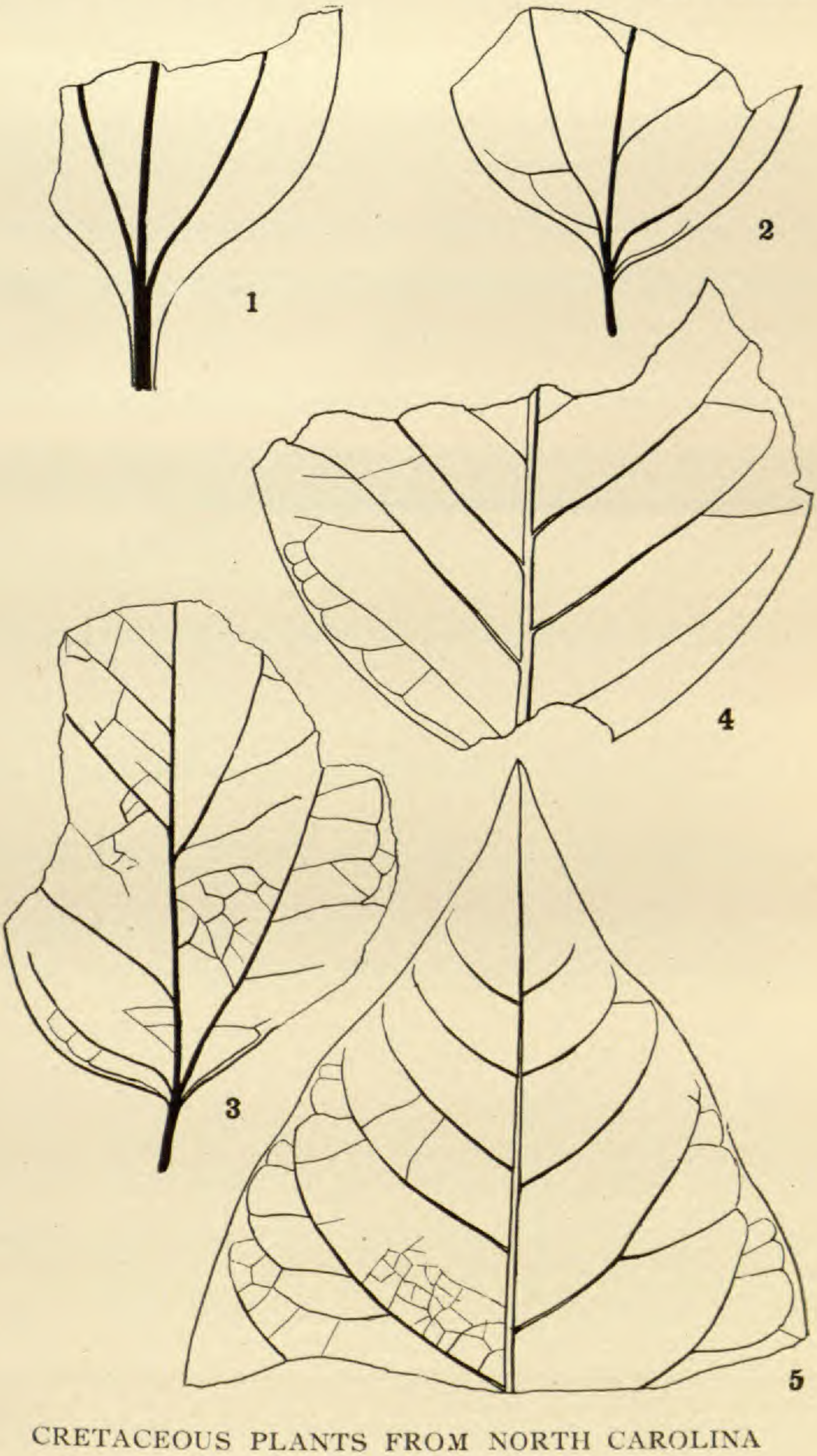

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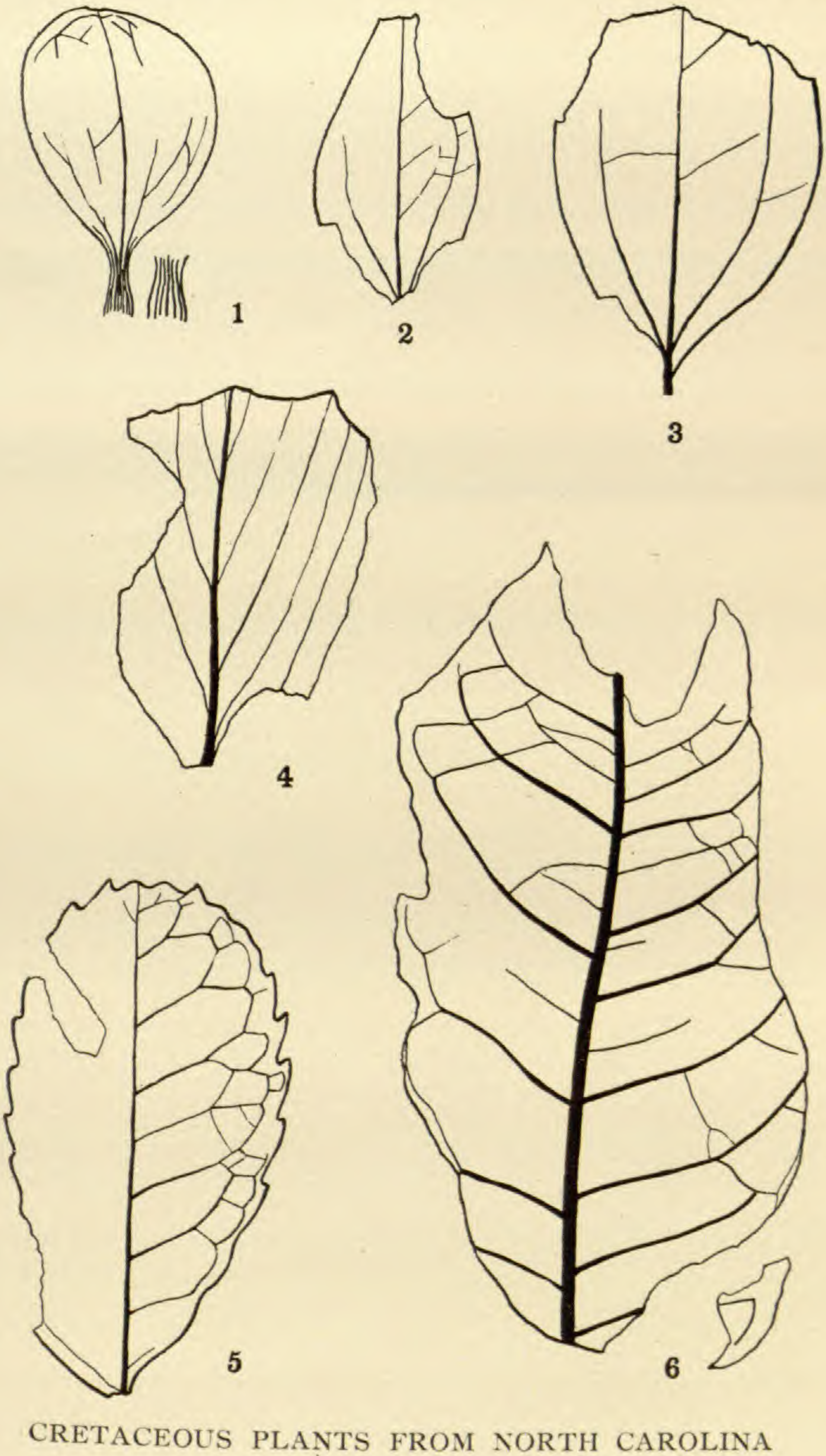

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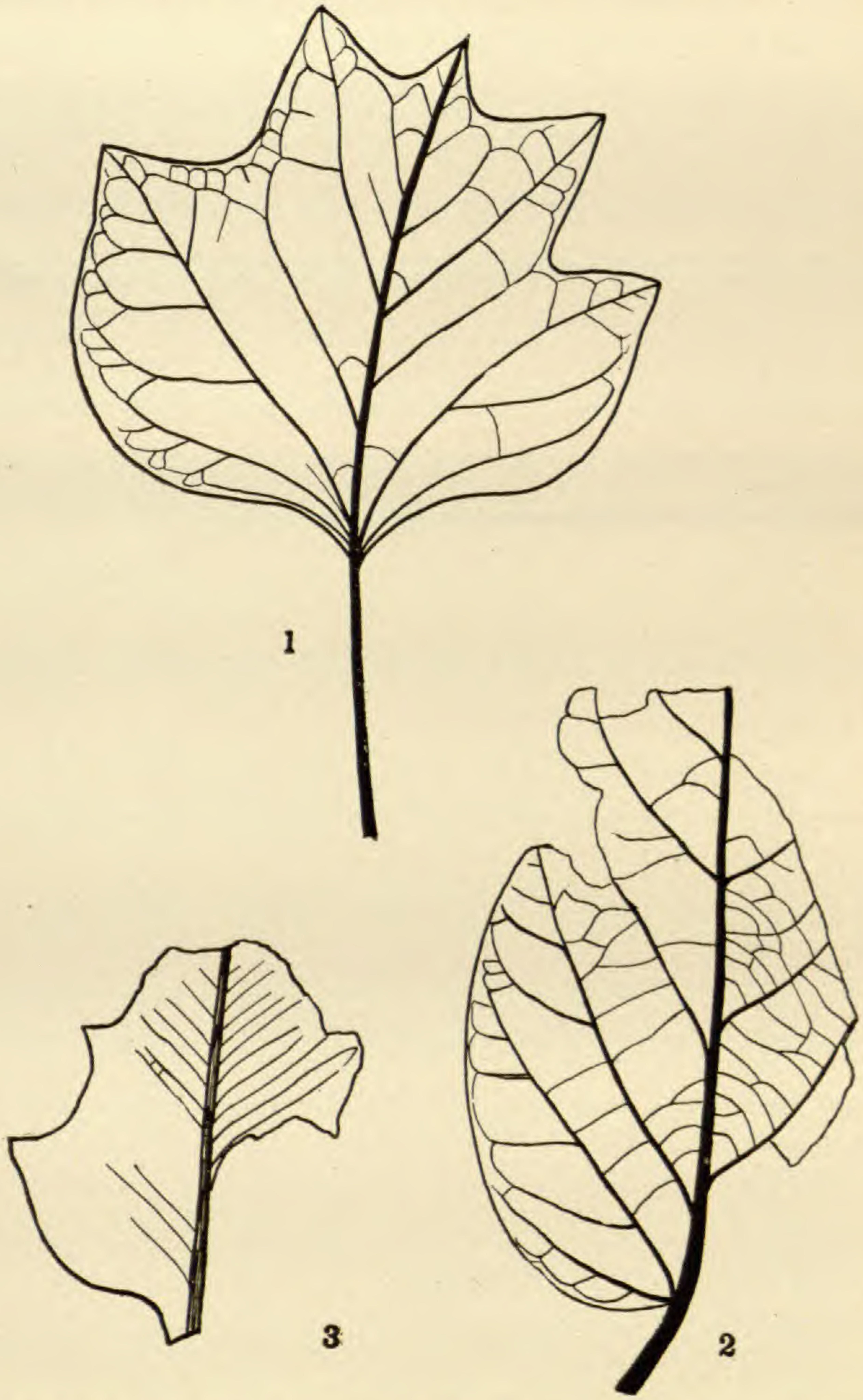

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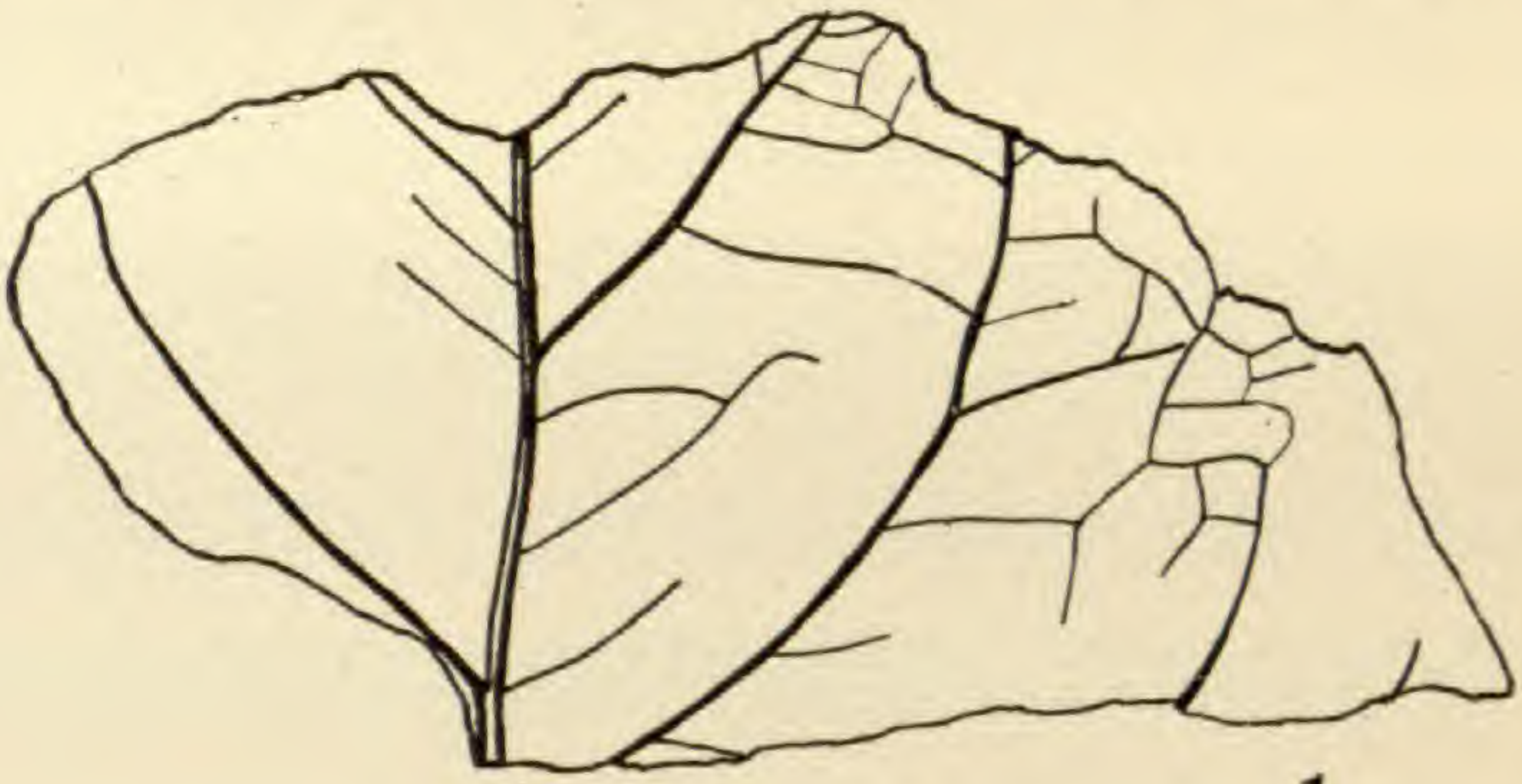

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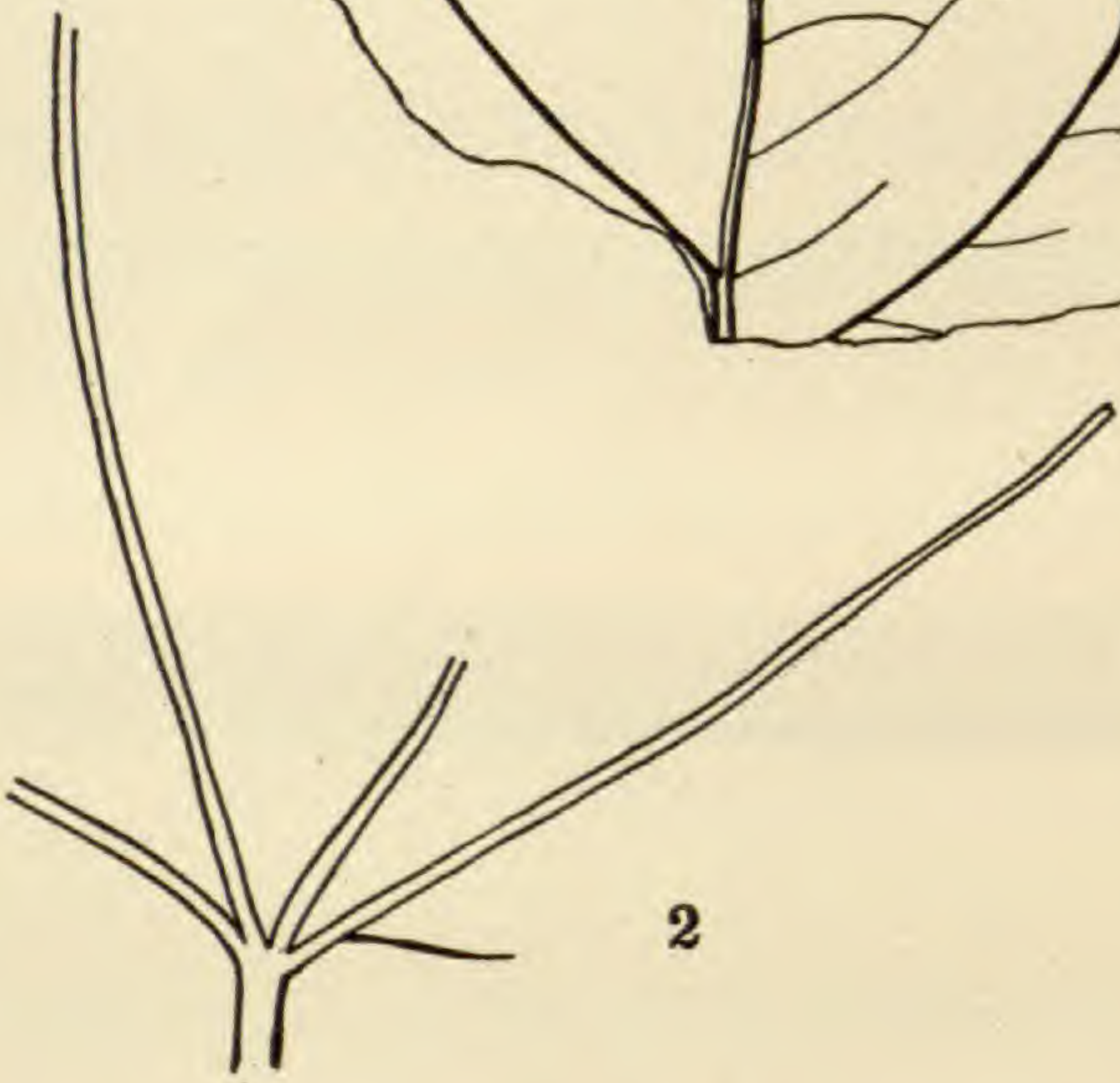

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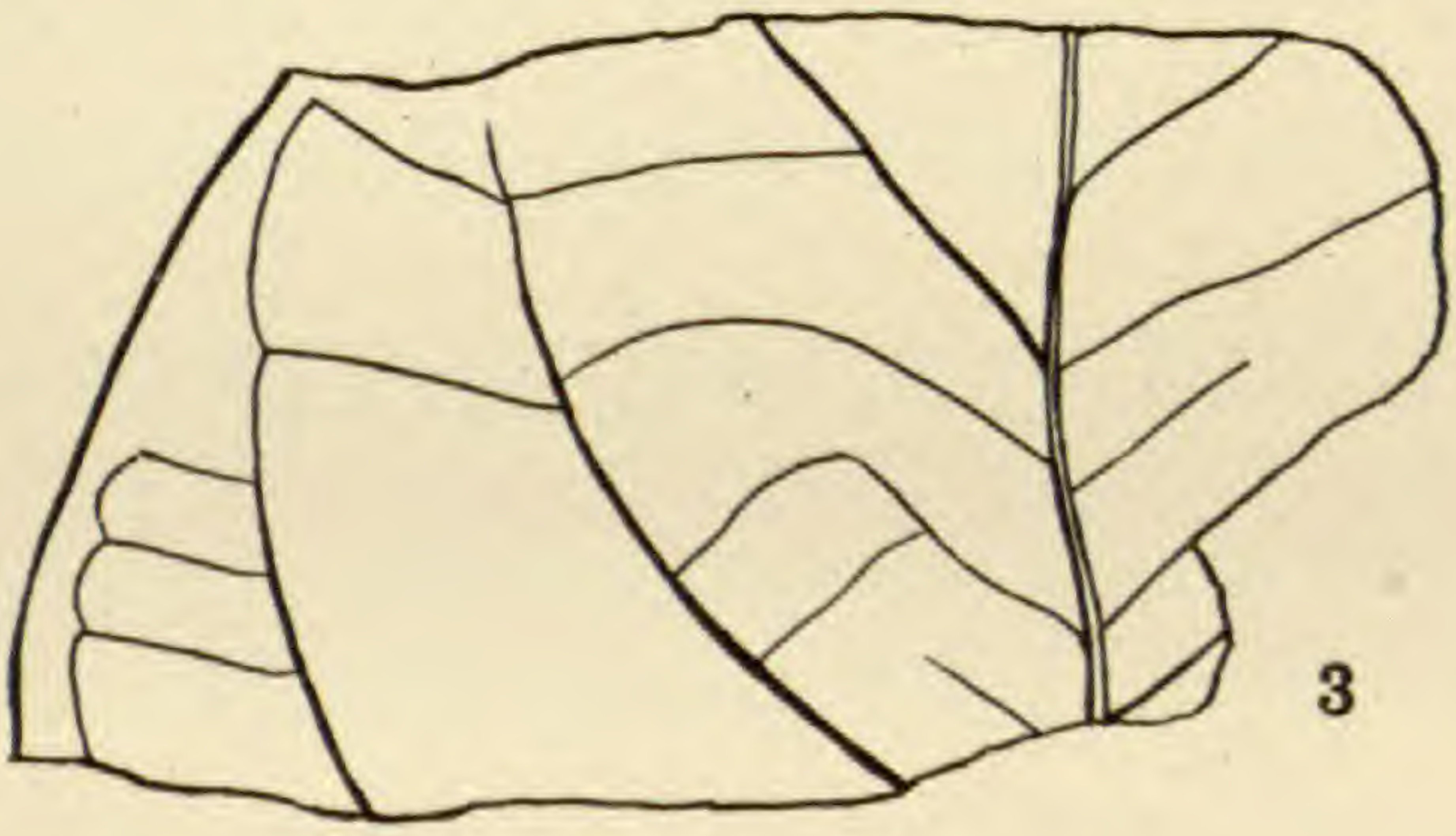

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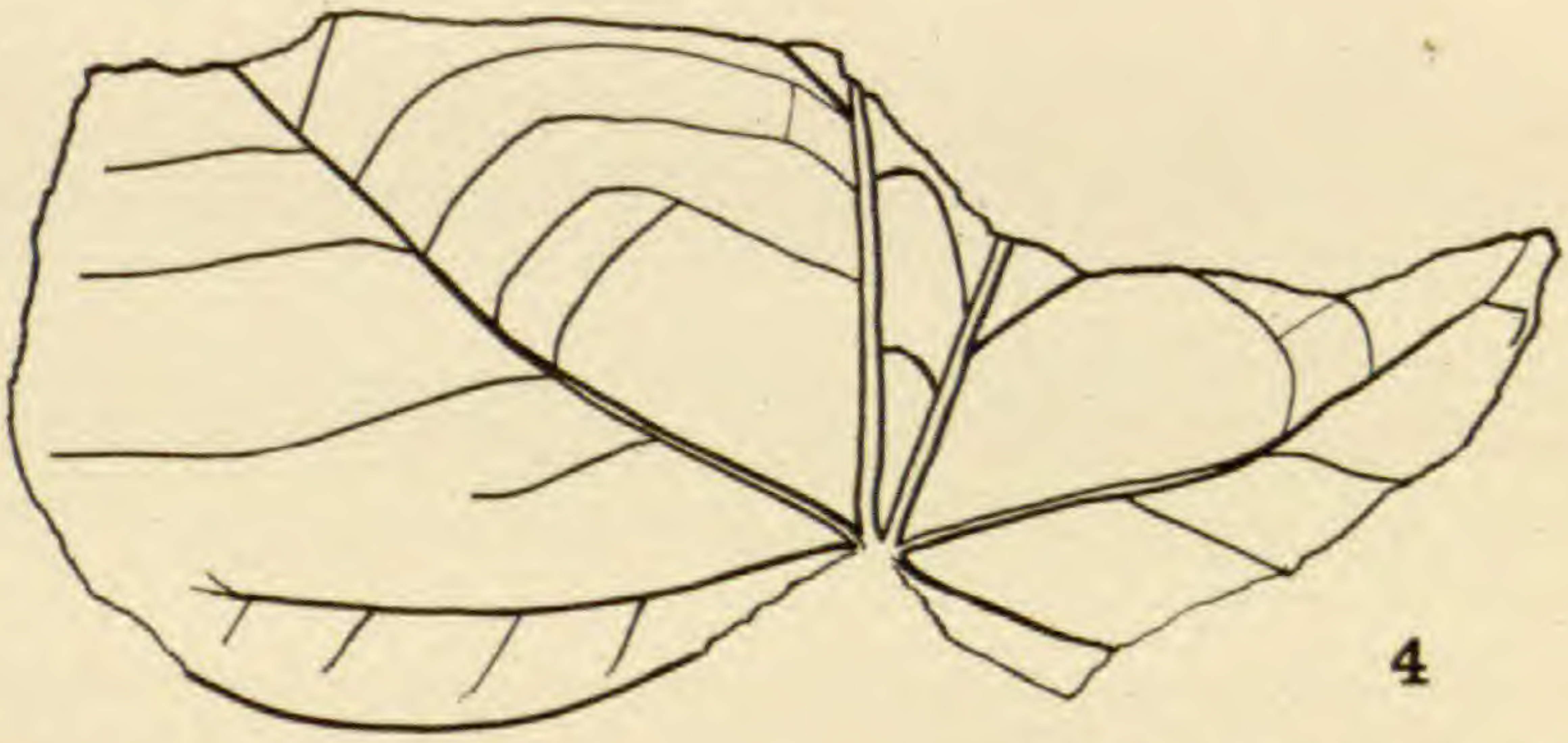

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Vol. 4, No. 3; price, 50 cents:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

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Pettit, Anna Stockton. *Arachis hypogaea* L. Pages 275–296, *plates 83–85* 5 Je 1895.

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CONTENTS

Some features of pollen-formation in the Cucurbitaceae. (Plates 17–21.) JOSEPH EDWARD KIRKWOOD 221
American ferns—VIII. A preliminary review of the North American Gleicheniaceae. LUCIEN MARCUS UNDERWOOD 243
Studies on the flora of Southern California—II. . . . . LE ROY ABRAMS 263
INDEX TO AMERICAN BOTANICAL LITERATURE 267

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JOSEPH EDWARD KIRKWOOD

(WITH PLATES 17-21)

Studies in the development and differentiation of the anther have been frequent in recent years, and in this line we may cite the researches of Gager,[9] Rosenberg,[22] Merrell,[15] and others. In all cases the primordium of the stamen appears as a slight elevation of the tissue which later becomes outwardly differentiated into its characteristic form and inwardly into spores, tapetum, endothecium, etc. Galinski [10] found that in certain of the grasses (*Secale*, *Triticum*) the anther-wall became differentiated into four layers, epidermal, fibrous, degenerating, and tapetal, and that the original pollen-mother-cells may divide several times. In *Zostera* as described by Rosenberg,[22] the elongated archesporial cells cut off from their ends the cells which form the tapetum. But in *Asclepias*,[9] *Silphium*,[15] and a majority of seed-plants, the immediate hypodermal layer has been shown to divide by periclinal walls to form the primary tapetal and primary sporogenous cells, the latter in some cases undergoing repeated divisions. But in the development of pollen, interest has centered chiefly in the mitotic features exhibited during the division of the pollen-mother-cells. Among these the origin of the spindle and the reduction and behavior of the chromosomes have received most attention. The results of these numerous studies have been well summed up by Davis,[7] and Coulter and Chamberlain,[6] and space will not be taken here for a similar task.

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But few plants of the *Cucurbitaceae* have received attention from this point of view. Mirbel[16] studied the development of the anther of *Cucurbita Pepo* and demonstrated the principal facts of the process. In small buds 2 mm. long he found no trace of the locules, but in a slightly later stage he was able to discern the spore-mother-cells and the tapetum. His figures of this condition represent the anther-wall, composed of four layers of cells under the epidermis including the tapetum. In buds 3 or 4 mm. long an additional layer of cells was detected in the anther wall. The development of the pollen-mother-cells, the formation of the tetrads, and the differentiation of the pollen-grain are well described and figured.

Naegeli[19] described certain features in the formation of pollen in *Cucurbita* and in *Bryonia dioica.* He seems to have observed the first division of the microspore-nucleus in *Cucurbita* but not to have interpreted correctly what he saw. He discusses more at length the differentiation of the exine and the behavior of the intine upon the germination of the grain.

To Warming,[25] however, we are indebted for an accurate study of the development of the anthers of *Bryonia alba* and *Cyclanthera pedata.* In both these cases the first periblem layer of the anther divides by periclinal walls. From the outer cells thus formed is developed the anther-wall by succeeding periclinal divisions, and the inner cells become the archesporium. In *Bryonia* the archesporium is a single layer of cells which later forms a mass of spore-mother-cells. Warming says that, as seen in transverse section, the pollen-mother-cells form one to several rows in each angle of the anther. Not all the cells cut off toward the inner side in the division of the hypodermal cell become mother-cells, and sometimes those that do become mother-cells do not divide again until the formation of the tetrads. In *Cyclanthera* the inner cells resulting from the division of the first periblem layer as a rule do not divide again but form mother-cells by growth.

Thus the evidence indicates that in these plants the usual order of development of sporogenous tissue in seed plants is adhered to, but the subsequent history of the archesporium may vary, as it appears at present, in accordance with the form and structure of the anther, in some cases the original archesporial cells remaining undivided, in others giving rise to a considerable mass of pollen-mother-cells.

In this study attention has been given to the development of the pollen in three species of the *Cucurbitaceae* representing as many genera. The forms studied are *Fevillea cordifolia* L., *Micrampelis lobata* (Michx.) Greene, and *Cyclanthera explodens* Naud.

In *Fevillea* at the time when the anther begins to form the archesporium appears. At this time the anthers are rounded bodies, more or less flattened laterally by mutual contact. Growth takes place more rapidly in a radial direction, and a little later by reason of lateral pressure they become almost triangular in cross-section. At the two angles of each anther on the periphery a group of cells retain their meristematic character while the rest become more vacuolated and react less strongly to stains.

In the two outer angles of each anther a layer of cells contiguous to the epidermis divides by periclinal walls, thus giving rise to the primary sporogenous and primary parietal cells. Both of these again undergo divisions. The parietal series gives rise to four layers of cells, so that the external wall of the anther early comes to consist of five layers of cells including the epidermis. In this region of the anther the greater number of sporogenous cells divide repeatedly so that an almost cylindrical mass of spore-mother-cells is developed in each angle of the anther.

As usual, the layer of sterile cells adjoining the sporogenous tissue is developed as a tapetum and presents the usual appearance of such a tissue. The cells of this layer have two or more nuclei each, and the size and chromatic content of these nuclei, as well as their deeply staining cytoplasm, mark them off in sharp contrast from the adjoining sterile tissue. The tapetal cells retain their appearance of activity almost to the time of maturity of the pollen.

The usual process takes place in the formation of microspores. These are enclosed for some time in a somewhat gelatinous envelope before they round off and develop the thick exine. The division of the nucleus of the spore takes place quite late if at all. Although almost mature anthers were sectioned, no case was found in which a microspore contained more than one nucleus.

In *Micrampelis* several cells immediately below the epidermis divide by periclinal walls. These cells are distributed along the ridges which later plainly mark off the positions of the locules. The series thus formed gives rise to three layers of cells, one of which forms the tapetum. Outside of the tapetum only three layers of cells including the epidermis are to be found in the mature anther.

The primary sporogenous cells enter directly upon a period of growth, becoming spore-mother-cells without divisions. The mother-cells form a linear series, sometimes broadening into a narrow plate but never dividing to form a cylindrical mass as in the case of *Fevillea*. These cells become large and prominent and each gives rise to four microspores. Here as in the preceding case the nucleus of the microspore does not divide to form vegetative and generative nucleus until quite late.

In *Cyclanthera* when the rudiment of the androecium has begun to assume the form of a disk the hypodermal cells prepare for periclinal divisions in two zones, one above the other. The cells in the two narrow bands thus situated divide as in the previous types to form the primary parietal and primary sporogenous cells (FIGURE 11). The former divide again to three layers, which with the epidermis constitute the outer wall of the locule (FIGURE 12). The primary sporogenous cells do not divide to increase the number of spore-mother-cells, but merely enter upon a period of growth until the time arrives for the formation of the macrospores. Four microspores are formed from each spore-mother-cell in the usual order. They remain for some time in a pyramidal arrangement surrounded by a transparent, seemingly gelatinous envelope, and during this time the exine begins to thicken and the nucleus assumes a less chromatic aspect. As they separate the microspores become rounded off and begin to develop their characteristic markings. Almost mature pollen-grains were observed in the sections, but each contained only one nucleus. The tapetum retains its active appearance until the spores are almost mature.

But the chief interest in pollen-formation in these forms is not in the facts just cited, but in the details of the process as they appear in the division of the mother-cells. In the few members of the *Cucurbitaceae* here under consideration, the course of development leading up to the formation of the pollen differs in no important particular. Some apparently minor differences have been noted which will be mentioned. The history of the microspores has been most carefully followed in *Micrampelis*, which is a favorable object for such a study. The principal stages in the formation of the microspore have also been noted in *Fevillea*, *Melothria*, *Cucurbita moschata*, *C. Pepo*, and *Cyclanthera*.

So far as the writer is aware no examination has been made of the cytology of the pollen-mother-cells of any of the *Cucurbitaceae*, though certain features of the vegetative cells have been studied by Zacharias.[27]

Though less favorable in some respects than some other subjects for such studies, certain features have been observed which seem worthy of attention.

The history of the microspore from this point of view begins with the formation of the primary sporogenous cell. At the conclusion of the mitosis which forms it, the sporogenous cell is not distinctly different in appearance from any of its hypodermal neighbors. A considerable number of those in its immediate vicinity have a decidedly meristematic character. At this time the cytoplasm of these cells is relatively thin as compared with the later states. The mitotic figure which is concerned in the first division of the hypodermal cell is a multipolar one, at least in the metaphase, and its chromatin is massed together in a compact zone at the equator.

The primary sporogenous cells become directly the pollen-mother-cells. They enter upon the growth period immediately after their formation, and soon become very conspicuous by reason of their size and structure. The expansion of their nuclei is the first distinctive feature shown in their growth, and this without any apparent increase in chromatic substance makes the nuclei appear quite clear, except for the single large nucleolus and their chromatin network. In appearance the cytoplasm consists of a very fine network of granular threads. The granules stain darkly and the cytoplasmic body has a grayish cast with the haematoxylon stain. At this time there is no perceptible arrangement of the cytoplasmic substance and it is equally dense in all parts. With the growth of the cell the granules increase in size slightly up to the time of the division. At about the time of synapsis the cytoplasm undergoes an interesting change. At this time the position of the nucleus in the cell is more or less eccentric and the nucleolus and the chromatin mass are usually on the side of the nucleus nearest the cell-wall. The cytoplasm, which up to this time has shown no special differentiation, now displays a number of fine fibers running tangent to the nucleus along the arc lying opposite the chromatin mass. These fibers may be traced distinctly to the periphery of the cytoplasm, where they appear to connect with the plasmatic membrane. The cell at this time presents an appearance much as if the nucleus by rapid expansion had placed under tension some of the fibers of the cytoplasmic reticulum (FIGURE 24). Toward the periphery of the cell an apparent branching of the fibers was often noticed and frequently thicker portions which stained darkly were plainly seen. If there is any significance in these fibers it is not apparent. As the nucleus resumes its position at the center of the cell at the close of the synapsis period they are no longer visible but the meshes of the cytoplasmic reticulum appear drawn out in a radial direction from the nucleus, which is a characteristic condition just preceding the prophase. There is, however, no indication of fibers such as appear in *Cobaea*,[13] *Larix*,[1] or *Equisetum*.[20] As these changes take place there is a drawing away of the ectoplasm or "*Hautschicht*" from the cell-wall, so that the mother-cells, instead of remaining angular, become practically spherical. Cannon[3] noted the same phenomenon in the spore-mother-cells of cotton and regarded it as the normal and regular process in those cells. The same conclusion seems to be justified here by the evidence at hand and by the subsequent history of the cells arising from the ensuing divisions. The spherical form is probably an advantage in the exact division of the cells into tetrads after the manner in which they usually occur. The nucleus, which in the earlier stages shows a perfectly even curvature of its membrane, now begins to contract and its outlines are less regular. This irregularity becomes more and more pronounced until the membrane is finally dissolved in the prophase of the first division.

In FIGURE 23 are represented certain cytoplasmic bodies whose history we have made an effort to follow. At a certain stage in the development of the mother-cells they are quite conspicuous even under a relatively low magnification (75 diameters). They are a series of short, crooked, darkly-staining fibers, which lie approximately parallel to one another on one side of the nucleus and about half way from the nucleus to the wall. They make their first appearance when the mother-cells are about half or two thirds grown and persist until the cytoplasm assumes the radial structure. As this change takes place they gradually disappear. About the time that the dark bodies disappear certain minute darkly-staining granules may be seen scattered promiscuously through the cytoplasm in its radial stage and during mitosis.

The rod-like bodies are remarkably constant features in *Micrampelis*, and appear when different staining reagents are used. It was first thought that they were portions of the nuclear chromatin which had been struck out into the cytoplasm in the process of cutting, but when it is observed that in the same section where many pollen-mother-cells are visible these bodies lie on all sides of the nuclei, such a conclusion as to their origin must be abandoned. Moreover in the same section some cells show them disposed horizontally, others show them in transverse section as a group of small black dots. It has been said that the fibers lie about parallel but occasionally they may assume a more or less radial arrangement around a certain point in the cytoplasm. They remain quite distinct up to the time when the cytoplasm begins to draw away from the cell-wall. The ends of these rods seem to weave in with the cytoplasmic meshes, especially toward the periphery of the cell where the reticulum is coarser. During the progress of the tetrad divisions the spherical, darkly-staining masses may be seen scattered through the cytoplasm, but near the close of the division they become clustered about the nuclei, and thus are divided among the microspores. They increase in size with the development of the spores and become very conspicuous until the pollen-grains near maturity when they gradually disappear. Bodies of an apparently similar nature have been found by Strasburger [21] in the pollen-mother-cells of *Larix*, and Allen[1], working upon the same subject, refers them to the class of extranuclear nucleoli and believes them to be proteid matters precipitated by fixing agents. But he finds them also in liquid surrounding the pollen-mother-cells, where they seem never to occur in *Micrampelis*.

The history of these bodies in *Micrampelis* is against such an interpretation, inasmuch as it would be difficult to account for their collection in the form described in a circumscribed portion of the cytoplasm. Moreover the change of form which they undergo seems to indicate that they are something more than mere passive by-products. Strasburger maintains that the cytoplasmic nucleoli bear an intimate relation to the kinoplasm, and supports his contention by citing the behavior of such bodies in *Larix* and other plants, in which they appear in connection with the spindle and other parts of the spindle-fibers and disappear at the conclusion of the division. He believes, however, that they are derived from the nucleolus, inasmuch as they appear as the nucleolus disappears and vanish again with its reappearance in the daughter-nucleus.

In this view Mottier[18] concurs, and chiefly on the basis of their staining reaction states that "there is no doubt that these bodies represent nucleolar substance." He suggests furthermore that the presence or absence of extranuclear nucleoli may depend upon the activity or condition of the cell, in view of the fact that they may be present in or absent from cells of the same tissue in the same stage of development. That the bodies here under consideration in *Micrampelis* are of the same nature as those described by Mottier in *Lilium* is difficult to say, though it seems a fair assumption that they are.

In *Micrampelis* no relation between these bodies and the nucleolus could be established. They appear in the cytoplasm long before the disappearance of the nucleolus and the nuclear membrane (FIGURE 24). That nucleolar material in solution might diffuse out through the nuclear membrane and be precipitated again in the cytoplasm is possible, but it seems highly improbable, and if so it might reasonably be expected to diffuse equally in all directions. In *Micrampelis*, however, the appearance of the darkly-staining granules is at first in a particular part of the cytoplasm and that the region occupied by the fibers above referred to. These cytoplasmic fibers seem similar to those observed by Duggar[8] in *Symplocarpus* and by Lloyd[14] in *Crucianella*. In neither of these works, however, does it appear that they bear any relation to the extranuclear nucleoli. Duggar refers to the almost simultaneous appearance of the fibers and darkly-staining granules, and regards both as due to the nuclear changes in synapsis. Lloyd regards the appearance of such cytoplasmic fibers as possibly due to the streaming of hyaloplasm or kinoplasm, from the fact of their similarity in appearance to features described by Wilson[26] and others working upon other material. That such a kinoplasmic streaming toward the nucleus occurs in *Micrampelis* is strongly suggested by the marked radial elongation of the cytoplasmic meshes during the prophase of the first division (FIGURE 25), but this feature is uniform throughout the cell.

A careful study of the material at hand has convinced the writer that in this case the extranuclear nucleoli arise from the conspicuous cytoplasmic fibers which make their appearance during the growth of the pollen-mother-cells. These fibers, at first thin and delicate, become thicker and stain more darkly, sometimes appearing as a series of nodules strung together, and again as thick crooked masses. As their development proceeds the fibers disappear and the round cytoplasmic nucleoli multiply and for a time appear in the area occupied by the fibers (FIGURES 23–68). It is recognized, however, that the phenomena observed may be open to more than one interpretation. The fibers observed lie in the center of the largest amount of cytoplasm in the cell and they must be taken as evidence of a cytoplasmic activity of some sort. It is possible that, these being the centers of special activity, they are the points at which the disposition of certain cytoplasmic products first takes place.

If we are to regard the spherical bodies in the cytoplasm of the spore-mother-cells of *Micrampelis* as extranuclear nucleoli, according to Strasburger's view, we must account for their persistence in the cytoplasm through all stages from one generation of cells to another. It does, nevertheless, seem that they are associated with the kinoplasm, inasmuch as they appear in the rod-like form to be a part of the cytoplasmic reticulum. That they are actually connected with the spindle at any stage of its development could not be determined accurately, though their position would often favor such a view. During the metaphase certain fibers may be seen straying out into the cytoplasm from the poles of the spindle, and seem to be in contact with the dark bodies scattered through it, and when at the conclusion of the division the contracting mantle-fibers have drawn the chromosomes to the poles and the daughter-nuclei have organized, the wandering fibers have also disappeared and the dark bodies have assembled about the nuclei. Hither, however, they may have been carried passively, as there is a congestion of the granular cytoplasm about the daughter-nuclei, leaving a comparatively clear broad zone across the equator of the spindle through which the division of the cytoplasm ultimately takes place.

With the organization of the tetrads the cytoplasm undergoes a change and instead of appearing fibrillar it begins to assume an alveolar aspect. It is during this stage that the activity of the cell is directed mainly toward the differentiation of the spore and the storage of a food reserve, which would, of course, account for the predominance of trophoplasm and the relatively slight quantity of kinoplasm present. As the spore enlarges the cytoplasm is distributed about its wall and only as it nears maturity does the central vacuole entirely disappear. The spore then becomes filled with granular proteinaceous matter. The differentiation of the exine begins while the tetrads are still clinging together, and is first evident by a thickening at the points where the germinal pores are afterwards to appear. In the mature spores, as usual, these are the thinnest places in the exine. The dark cytoplasmic bodies usually become segregated into some part of the spore as it approaches maturity and the cytoplasm in their vicinity usually stains more darkly than elsewhere.

Great interest centers in the behavior of the kinoplasm during the process of cell-division, and Strasburger[24] has given careful consideration to the various expressions of its activity, showing that it is concerned not only with the development of the spindle but also with the formation of plasmatic membranes. The predominance of kinoplasm over trophoplasm is one of the most conspicuous features of the spore-mother-cells of plants, and this may appear in a variety of ways. In certain cases a distinct perinuclear zone appears just before the first division and stains very darkly, and from the fibers of this zone and the linin of the nucleus the spindle is formed, as in *Cobaea*[13], *Lavatera*[2], *Cassia*[12], *Gossypium*[3], and other plants. On the other hand, the pollen-mother-cells of *Equisetum*[20], *Larix*[1], *Lilium*[17], and *Pisum*[4] show an entirely different condition of the cytoplasm in this respect. In these types the perinuclear zone does not exist and the origin of the achromatic figure is not so restricted. In several forms distinct fibers could be seen radiating from the nucleus toward the periphery of the cell and these fibers by folding over form a felted layer from which a multipolar spindle is later differentiated, and finally the multipolar spindle becomes bipolar by the fusion of the several poles into two. Allen[1] even suggests that this is a general process occurring in all spermatophytes. While this generalization seems not to be well founded, it does appear that we may generally refer the divisions of the spore-mother-cells in the higher plants to one type or the other. It has already been suggested (Cannon[4]) that the perinuclear zone may inhibit the formation of the spindle in the peripheral cytoplasm as it occurs in *Pisum*.

The process of mitosis as it occurs in *Micrampelis* presents some features which distinguish it from most cases. It has been pointed out above that the cytoplasm assumes a radial structure as the time approaches for the first division of the spore-mother-cell. At the same time the separation of the plasmatic membrane from the cell-wall enables the cell to assume a spherical form. The contraction of the cytoplasm is accompanied by the contraction of the nucleus so that the latter becomes angular and exceedingly distorted. Up to this time no special differentiation of the cytoplasm can be detected, but soon a few fibers can be seen running more or less parallel with the nuclear membrane; here they form a very thin reticular layer. While this change is taking place in the cytoplasm the nuclear structures are also changing. The chromatin is collecting into chromosomes and the linin appears as an almost colorless network of fine fibers which run in all directions. At this time the cytoplasm adjoining the nucleus stains a little more darkly than the rest, and as the nuclear wall dissolves, pencils of fine fibers may be seen pushing out from the nucleus into the surrounding cytoplasm. These bundles of fibers originate from the reticulum adjoining the nucleus. Soon the fibers are seen traversing the nuclear vacuole, which rapidly disappears and several poles project out from the nuclear position.

The linin fibers can no longer be distinguished as such, having been merged with those from the cytoplasm. The spindle now becomes bipolar, and the interpolar fibers are brought out in sharp contrast to the others by their stronger absorption of the stain.

Three kinds of fibers were visible: the mantle-fibers which run out from the poles of the spindle into the cytoplasm toward the equatorial region; the fibers which attach to the chromosomes and appear to draw them to the poles; and the interpolar fibers which occupy the center of the spindle and are easily distinguished throughout the anaphase and telophase. All of these except the contractile fibers are of a more or less sinuous form. The interpolar fibers are considerably thicker in their middle region, and such parts are colored quite darkly by the haematoxylon stain. During the first division the poles of the spindle do not seem to reach the peripheral cytoplasmic membrane but terminate at some distance from it (FIGURE 28). Outside of the space occupied by the spindle itself the cytoplasm is of a densely granular character, but even in relatively thin sections (3 μ) no extensions of the spindle to the "*Hautschicht*" could be seen.

The conception of an anchorage for the spindle by kinoplasmic fibers extending to the outer membrane, as expressed by Strasburger,[24] seems here hardly to be justified. It seems apparent, however, that the mantle-fibers may fix the spindle in its position by a connection with the cytoplasmic reticulum. The necessity for the fixation of the poles of the spindle in the *Hautschicht*, in order to facilitate the drawing apart of the chromosomes by contraction of the fibers, is not quite apparent. It is suggested that the interpolar fibers may act as a sort of stay, which, with a certain degree of rigidity, would facilitate the separation of the chromosomes by the contraction of the overlying fibers. The evidence at hand as to the character of the interpolar fibers certainly favors such a view.

The spindle of the second division originates like that of the first and is also multipolar in its early stages. The fibers of the cytoplasmic kinoplasm traverse the nuclear vacuole and soon obliterate it. No evidence could be found at any time of a reticulum next the nuclear wall. The spindle forms from the kinoplasmic fibers which grow in from the cytoplasm. The spindle-fibers from the first division frequently persist through the second and after the grand-daughter nuclei are formed they may be seen connected by fibers of both preceding mitoses. The spindles of the second mitosis lie in parallel planes usually at right angles to each other but often parallel. Thus the tetrads usually appear in the ordinary pyramidal arrangement but sometimes they are all in one plane. The division of the cytoplasm takes place by constriction, a narrow groove marking off the line of division. This groove deepens until the spores are fully separated.

The nuclear contents of the cells under consideration have been difficult objects for study on account of the minute size of the chromosomes. The nucleoli are often large and conspicuous and at certain stages are apparently vacuolated. In the period of development just succeeding the cutting off of the tapetal cell, the primary sporogenous cell is distinguished from its neighbors by its dense and darkly-staining cytoplasm. The nuclei of the primary tapetal and primary sporogenous cells are at first to all appearance similar. In both the chromatin is arranged about the nuclear wall in irregular masses so that the nuclear vacuole at first appears to contain only a large nucleolus. In this case, in which the spore-mother-cell is derived directed from the primary sporogenous cell, the period of growth is begun at once and the nuclear changes keep pace with the development of cytoplasmic structures. The linin of the nucleus soon becomes more apparent and its fibers may be seen passing in different directions through the nuclear vacuole. The chromatin soon shows a tendency to cling less closely to the nuclear wall and it may be seen strung along the linin network in small irregular masses. A marked increase in the quantity of chromatin is characteristic of this stage and the lines of the nuclear reticulum are thickly beaded with chromatin granules.

The reticulum now resolves itself into a continuous thread which gradually becomes more uniform. While this change is taking place all the chromatin with the nucleolus becomes crowded into one side of the nuclear vacuole and synapsis results. Often the chromatin in synapsis may be seen as a much coiled thread with many sharp convolutions, sometimes extending almost across the nucleus. During this process the nucleolus remains undiminished in size and staining properties.

At the conclusion of the synapsis period the chromatin appears in thread-like form. The longitudinal cleavage of the thread is quite plain before its transverse divisions are apparent. A considerable shrinkage of the chromatin now takes place and at the time just before the differentiation of the spindle, it has contracted to sixteen irregular masses which in some instances appear quadruple; these portions representing the division of the chromatin giving rise to the chromosomes are very small and irregular in form. The chromosomes of *Micrampelis*, by numerous counts, number sixteen in the pollen-mother-cell.

In the earlier, presynaptic condition of the chromatin an interesting condition was observed. Instead of forming a single thread, a condition such as appears in FIGURE 33 is often apparent. The thread appears to be doubled and the chromatin-masses occur frequently in pairs. Overton [21] has described the same features in *Thalictrum purpurascens*, and Cardiff [5] finds it the regular condition in *Acer platanoides* and several other plants. In *Thalictrum* the number of the chromatin-masses agrees with the number of somatic chromosomes and the inference is that these presynaptic masses of chromatin which enter synapsis in pairs are the chromosomes of the original mother-cells (archesporium). In *Micrampelis* the double thread in a presynaptic condition is not always easily demonstrated, but in certain cases appears distinctly. The chromatin soon becomes massed around the nucleolus and synapsis results. In this condition the identity of the nuclear structures is entirely obscured, the chromatin forming a dense, darkly staining mass. It is difficult to believe that this appearance in preparations of beautifully fixed material is purely an artifact, and the opinion is gaining ground that the condition of synapsis represents the final fusion of hitherto only associated elements of different parentage, a view which agrees with other facts commonly observed during the division of the spore-mother-cell. Synapsis in the material here under consideration differs in no essential from the condition usually described, so far as could be determined. At the close of the period of synapsis the chromatin emerges in the form of a much coiled thread which shows a distinct longitudinal division (FIGURE 37). A transverse segmentation is soon apparent (FIGURES 39, 40, 41), and the chromosomes thus formed contract into short, thick, and irregular masses (FIGURE 42). As this change is taking place the nuclear wall is becoming irregular and the incipient stages of spindle-formation appear in the cytoplasm. The evidence of true tetrad formation is not very abundant at this point, but in certain cases a double division of the chromosomes appeared to be quite clear (FIGURES 43, 44). The chromosomes at this stage become so nearly isodiametrical that it becomes practically impossible to distinguish between a longitudinal and a transverse division of the chromosome.

The first division is clearly of heterotypic form. The chromosomes appear united in the form of rings in the metaphase of the division (FIGURES 46, 47). The spindle fibers are attached to opposite sides of the ring and the separation takes place midway between the points of attachment of the spindle-fibers. The relation of the chromosomes to the fibers appears in FIGURE 50. After the separation of the chromosomes in the early anaphase of the division they round off into almost spherical bodies to which are attached certain bundles of spindle-fibers. In a transverse section of the spindle these can readily be seen and correspond in number to the chromosomes. The chromosomes during the anaphase can be readily counted and number sixteen (FIGURES 51, 52), a number found by Strasburger [23] and Guignard [11] in certain orchids. Owing to their minute size and the compact condition of the mitotic figure in the vegetative cells the number of chromosomes could not be determined, but it appears to be easily more than sixteen.

As the chromosomes draw closer together toward the apex of the spindle they become crowded together and lose their identity, so that as the daughter-nuclei are organized in the telophase they can no longer be distinguished from one another. They present the appearance of having become fused into a spireme (FIGURES 53, 54), which finally resolves itself into a reticulum, with a tendency toward pairing of the most conspicuous chromatin masses (FIGURE 55). This appearance is only transient, however, as the nucleus passes quickly into the prophase of the second division, when the chromatin appears in dense masses, at first angular and connected with many radiating fibers (FIGURE 56), later rounded off and peripherally disposed in the nuclear vacuole (FIGURES 57, 58).

The second division shows a thick mass of chromatin on a narrow spindle. The chromosomes here diverge in the anaphase and migrate to the poles of the spindle as two compact masses in which the form and relations of the chromosomes are entirely obscured. Only in the late telophase do the chromosomes separate from one another and distribute themselves in the newly formed nuclei (FIGURE 63). The chromatin masses soon became distributed along the threads of the nuclear reticulum (FIGURE 64), which becomes much more open and enlarged with the development of the spore.

Most of the material used in this study was fixed in an acetic acid-alcohol mixture, consisting of one part glacial acetic acid and two parts 70 per cent. alcohol, which in most cases gave excellent results. The material was preserved in 85 per cent. alcohol, cleared in xylol, and embedded in paraffine. Other methods were also used, particularly in the study of *Micrampelis*, where the peculiar cytoplasmic conditions suggested the advisability of trying different reagents. In this case accordingly three methods of fixation were used viz., acetic-alcohol, sublimate acetic mixture, and the weaker Flemming solution. The stains employed were Hajdenhain's iron haematoxylon, sections counterstained with Bismarck brown, Flemming's safranin-gentian-violet-orange, also cyanin-erythrosin and fuchsin-iodin-green combinations. Particular attention was given to the rod-like bodies in the cytoplasm of *Micrampelis* and the different stains were tried on the material of each fixation. In order that conditions might be otherwise the same, certain clusters of flowers of various stages of development were embedded and sectioned, forming several series of ten to fifteen slides, which were numbered in their proper sequence, and different stains applied to slides of alternate numbers in the series. In the material fixed with acetic-alcohol the rod-like bodies appeared when the preparations were stained with iron-haematoxylon or with safranin-violet-orange. When fixed with sublimate-acetic (1 per cent. acetic) mixture the same cytoplasmic structures appeared as in the preceding case, if stained with iron-haematoxylon, safranin-violet-orange or cyanin-erythrosin combinations. In material fixed with Flemming's solution they were found only when stained with the safranin-gentian-violet and orange G. The sections were cut from 2μ to 6μ in thickness.

When by such manipulations the pollen-mother-cells of the same anthers were treated with different stains as well as those of different anthers and different fixation, the chances that the unusual structures observed in the cytoplasm are due to the reagents is minimized.

SUMMARY AND CONCLUSIONS

1. The development of the pollen was followed in several forms. In each case the layer of cells immediately below the epidermis in each anther lobe divides by a periclinal wall to form primary tapetal and primary sporogenous cells. The former again divide to form two or three layers in the wall of the pollen-sac, the latter undergo repeated divisions in the case of *Fevillea* to form a mass of pollen-mother-cells, but in *Melothria*, *Micrampelis* and *Cyclanthera* no such divisions were observed. In these features the development of the sporogenous tissue and the pollen is essentially the same as described for other members of the *Cucurbitaceae* by Mirbel, Warming and others, and is in accord with the condition found in most of the seed plants.

2. The division of pollen-mother-cells was given special attention in *Micrampelis*. The principal feature of interest here is the presence of certain darkly-staining, rod-like bodies in the cytoplasm. These appear before the mother-cells have reached their full size and persist for some time, gradually breaking up as the cell prepares for its first mitosis and appearing to resolve themselves into many minute granules which stain darkly. These granules become more conspicuous between the first and second mitoses and gradually disappear as the spore approaches maturity. No evidence was gathered as to their function, though they seem to be of kinoplasmic origin. In this they are extranuclear in origin and are not derived from the nucleolus as has been observed in the case of *Larix* and some other forms.

3. The cytoplasm appears to be distinctly fibrillar. In certain cases the fibers of the reticulum are apparently stretched in lines tangential to the nucleus during the period of its rapid expansion. As the time of the first division approaches the cytoplasm presents the aspect of fibers radiating from the nucleus. The fibrillar aspect disappears with the formation of the spindle.

4. The spindle originates partly from the linin of the nuclear reticulum but mostly from the thin weft of fibers which appears about the nucleus as its wall is gradually dissolved. As the form of the nucleus changes from spherical to angular the spindle-fibers are collected into numerous pencils pointing different directions. These gradually collect to form a bipolar spindle which stands in the center of the large mother-cell and has no apparent connection with the plasmatic membrane. The form of the spindle is narrow and sharply pointed, some of its fibers spreading far out into the cytoplasm.

5. The chromatin in early stages in the development of the spore-mother-cell is inconspicuous, but as the time for division approaches it becomes distributed in paired masses through the nuclear reticulum. The masses are regarded as representing chromosomes. They finally become merged into a compact mass as synapsis approaches.

6. Synapsis here seems to be a normal phenomenon in the life of the cell. The chromatin becomes massed about the nucleolus at one side of the nuclear vacuole. From this condition it merges from a coiled thread split longitudinally, which soon segments into sixteen double pieces. These pieces become compactly massed at the equator of the spindle, contracting into rounded masses. The separation of the chromosomes is according to the heterotypic form of mitosis. The reduced number of the chromosomes is sixteen.

7. In the telophase of the first division the chromatin forms a thread which is gradually dissolved into small granules and masses almost as in the resting nucleus. The second mitosis is inaugurated by the reassembling of this chromatin into irregular masses, which become more evenly rounded and divided into two in the ensuing metaphase. Owing to the size and rounded form of the chromosomes, the characters of a homotypic mitosis were not discernible, but the appearance of the figure is essentially different from that of the first mitosis. In the telophase of the second division the chromatin distributes itself in the form of a beaded network which persists long into the development of the spore.

SYRACUSE UNIVERSITY.

LITERATURE

1. **Allen, C. E.** The early stages of spindle formation in the pollen-mother-cells of *Larix*. Ann. Bot. **17**: 281–312. *pl. 14, 15.* 1903.

2. **Byxbee, E. S.** The development of the pollen-mother-cells of *Lavatera*. Proc. Calif. Acad. Sci. III. **2**: 63–82. *pl. 10–12.* 1900.

3. **Cannon, W. A.** Studies in plant hybrids: spermatogenesis of hybrid cotton. Bull. Torrey Club **30**: 133–172. *pl. 7, 8.* 1903.

4. —— Studies in plant hybrids: spermatogenesis of hybrid peas. Bull. Torrey Club **30**: 519–543. *pl. 17–19.* 1903.

5. **Cardiff, I. D.** A study of synapsis and reduction. Bull. Torrey Club **33**: 271–306. *pl. 12–15.* 1906.

6. **Coulter, J. M. & Chamberlain, C. J.** Morphology of angiosperms. New York, 1903.

7. **Davis, B. M.** Studies on the plant cell. Am. Nat. **38**: 367–395; 431–469; 571–594; 725–760; **39**: 217–268; *f. 1–18.* (Parts I–IV, 1904. Part V, 1905.)

8. **Duggar, B. M.** Studies in the development of the pollen grains in *Symplocarpus foetidus* and *Peltandra undulata*. Bot. Gaz. **29**: 81–98. *pl. 1, 2.* 1900.

9. **Gager, C. S.** The development of the pollinium and sperm-cells in *Asclepias Cornuti* Decaisne. Ann. Bot. **16**: 123–148. *pl. 7.* 1902.

10. **Galinski, S. J.** Ein Beitrag zur Entwickelungsgeschichte des Androeceums und des Gynaeceums der Gräser. Bot. Centralb. **55**: 1–17; 62–72; 129–135; *pl. 1–3.* 1893.

11. **Guignard, L.** Nouvelles études sur la fécondation. Ann. Sci. Nat. Bot. VII. **14**: 163–296. *pl. 9–18.* 1891.

12. **Hus, H. T. A.** Spindle formation in the pollen-mother-cells of *Cassia tomentosa* L. Proc. Calif. Acad. Sci. III. **2**: 329–354. *pl. 30–32.* 1904.

13. **Lawson, A. A.** Some observations on the development of the karyokinetic spindle in the pollen-mother-cells of *Cobaea scandens* Cov. Proc. Calif. Acad. Sci. II. **1**: 168–188. *pl. 33–36.* 1898.

14. **Lloyd, F. E.** The comparative embryology of the *Rubiaceae*. Mem. Torrey Club **8**: 1–112. *pl. 1–15.* (Part I, 1899. Part II, 1902.)

15. **Merrell, W. D.** A contribution to the life history of *Silphium*. Bot. Gaz. **29**: 99–133. 1900.

16. **Mirbel, C. F. B.** Complément des observations sur le *Marchantia polymorpha.* Mém. Inst. France **13**: 39–74. *pl. 8–10.* 1835.

17. **Mottier, D. M.** Beiträge zur Kenntniss der Kerntheilung in den Pollenmutterzellen einiger Dikotylen und Monocotylen. Jahrb. Wiss. Bot. **30**: 169–204. *pl. 3–5.* 1897.

18. —— Fecundation in plants. Publication No. 15, Carnegie Institution of Washington. 1904.

19. **Naegeli, K.** Zur Entwickelungsgeschichte des Pollens bei den Phanerogamen. Zurich, 1842.

20. **Osterhout, W. J. V.** Über Entstehung der karyokinetische Spindel bei *Equisetum.* Jahrb. Wiss. Bot. **30**: 159–168. *pl. 1, 2.* 1897.

21. **Overton, J. B.** Über Reduktionsteilung in den Pollenmutterzellen einiger Dikotylen. Jahrb. Wiss. Bot. **42**: 121–153. *pl. 6, 7.* 1905.

22. **Rosenberg, O.** Über die Embryologie von *Zostera marina.* Bih. Handl. Svensk. Vetensk. Akad. **27**(3)[6]: 1–26. *pl. 1, 2.* 1901.

23. **Strasburger, E.** Über Kerntheilung und Zelltheilung im Pflanzenreich. Hist. Beitr. I. Jena, 1888.

24. —— Über Cytoplasmastructuren, Kern- und Zelltheilung. Jahrb. Wiss. Bot. **30**: 375–405. *f. 2.* 1897.

25. **Warming, E.** Untersuchungen über pollenbildene Phyllome und Kaulome. Bot. Abhandl. **2**: 1–90. *pl. 1–6.* 1873.

26. **Wilson, E. B.** Experimental studies in cytology, I. A cytological study in artificial parthenogenesis in sea-urchin eggs. Archiv. Entwickelungsmechanik der Organismen **12**: 529–596. *pl. 11–17, f. 1–12.* 1901.

27. **Zacharias, E.** Über das Verhalten des Zellkerns in wachsenden Zellen. Flora **81**: 217–266. 1895.

Explanation of plates 17-21

PLATE 17. *Micrampelis*

1. Transverse section through part of young anther showing the formation of primary tapetal and primary sporogenous cells. × 720.

2. Longitudinal section through somewhat older anther. The primary sporogenous cells have become the spore-mother-cells. × 720.

3. Transverse section through anther of still later stage. Spore-mother-cells usually in a single row in each locule of the anther. × 720.

4. Second division of spore-mother-cell. Tapetum and anther-wall. × 720.

5. Microspore, tapetum, and anther-wall. × 720.

6. Later stage of same. × 720.

7. First division of spore nucleus. × 562.

8. Division of spore nucleus completed. Generative cell near the wall. × 660.

9. Mature pollen grain. Generative cell elongated. Nucleus occupies most of the cell, and differentiation obscure. Vegetative nucleus to the right. × 660.

PLATE 18

Cyclanthera

10. Vertical section through one side of the androecium, showing division of hypodermal cell in the formation of primary tapetal and primary sporogenous cells. × 480.

11. Slightly later stage of the same. To the right are shown initial sporogenous and tapetal cells, *s* and *t* respectively. × 480.

12. Spore-mother-cells in synapsis stage. × 420.

13. Spore-mother-cells approaching first mitosis of mother-cell. × 480.

14. Mitosis of mother-cell. × 480.

15. Microspores and anther-wall. × 480.

Fevillea

16. Vertical section through anther rudiment. × 480.

17. Transverse section through young anther. Spore-mother-cells shaded; tapetum not yet differentiated. × 480.

18. Later stage of same. Tapetum, T. × 480.

19. Section through part of anther showing spore-mother-cells in synapsis. Tapetal cells strongly developed. × 480.

20 and 21. Successive stages in microspore formation. Multinucleate tapetal cells. × 480.

PLATE 19. *Micrampelis*

Mitosis of pollen-mother-cells. Figures are drawn with an Abbé camera lucida. Lens combination Zeiss 2 mm. immersion objective and compensating ocular 18. Magnification of figures 1,172 diameters.

22. Normal resting cell.

23. Appearance of rod-like cytoplasmic bodies.

24. Synapsis. Cytoplasmic fibers tangent to nucleus. Disappearance of rods and appearance of darkly staining granules.

25, 26. Contraction of nucleus and preparation for division.

27. Showing origin of spindle.

28–30. Metaphase, anaphase, and telophase of first division.

31. Mother-cell showing nuclei resulting from the first and second divisions. The section includes but three of the four nuclei.

32. Young microspore.

PLATE 20. *Micrampelis*

Plates 20 and 21 deal chiefly with the changes taking place in the nuclear structures during the first and second divisions of the pollen-mother-cells of *Micrampelis*. Magnification 2,200 diameters.

33. Relatively early condition of the nucleus in mother-cell.

34. A condition somewhat later than 33. Before synapsis.

35. Synapsis.

36. Conclusion of synapsis.

37. Slightly later than 36. Spireme emerging from synapsis and showing longitudinal cleavage.

38. Double chromosomes as seen after transverse divisions of the spireme.

39–41. Appearance of the nuclei at the stage showing transverse divisions of the spireme.

42, 43. Showing condensation of the chromosomes. It is at about this time that spindle formation begins to be apparent in the cytoplasm.

44. Appearance of some of the chromosomes taken from various nuclei at about the same stage as shown in figure 43.

45. Metaphase of first division.

48. Anaphase of first division showing form of chromosomes and relation of mantle-fibers to the same. Interpolar fibers stain darkly.

49. Section through mantle-fibers attached to chromosomes; sixteen in number.

PLATE 21. *Micrampelis*

46, 47. Metaphase of first divisions; heterotypic form.

50. Chromosomes as they appear in the metaphase of the first division attached to the fibers.

51, 52. Chromosomes as they appear in the anaphase, numbering sixteen.

53, 54. Formation of spireme in telophase of first division.

55. A condition of the nucleus reached at the conclusion of the first division.

56, 57. Prophase of second division.

58, 59. Showing persistent spindle between nuclei in prophase of second division.

60–62. Anaphases of the second division.

63. Daughter-nucleus in telophase of the second division.

64, 65. Transition from condition shown in 63 to the reticulate resting nucleus.

66–68. Showing transformation from dark cytoplasmic fibers to the extranuclear nuclei.

American ferns — VIII. A preliminary review of the North American Gleicheniaceae

LUCIEN MARCUS UNDERWOOD

The oldest known of the American representatives of this family was figured by Plumier in 1703 (*plate 28*) and this plate was taken by Linnaeus in 1753 as the type of *Pteris dichotoma* and in 1759 as the type of *Acrostichum furcatum*. After various vicissitudes this oldest species of the genus — probably because of its rarity, for it grows, apparently, only in the extinct craters of the Lesser Antilles — passed into forgotten synonymy. The first recognition of generic value in the family was made in 1793, by Sir J. E. Smith, who based the genus *Gleichenia* on *Onoclea polypodioides* of Linnaeus, an Australian species. This was followed in 1804 by Willdenow's genus *Mertensia*, based on five pectinate species, part of which were American. This generic name could not hold because of the earlier *Mertensia* Roth (1793) in the *Boraginaceae*; and this fact was noted as early as 1806, by Bernhardi, who then established the genus *Dicranopteris* in its place, basing his name on *Polypodium dichotomum* Thunb. from Japan.* It is this genus to which our American species pertain.

Robert Brown published *Platyzoma* in 1810 with a single Australian species, and in 1861 Mettenius established *Stromatopteris* with a single species from New Caledonia.† We believe that all of these represent valid genera and may be separated by the following tabulated characters:

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* DICRANOPTERIS Bernh. Neues Jour. Bot. Schrad. 1^2: 38. 1806. In the face of this publication Willdenow still used *Mertensia* in 1810 as Swartz had done before him in the first *Synopsis Filicum* (1806). Raddi, Desvaux, Brackenridge, and Sturm all published under this name, and Fée continued to recognize *Mertensia* and publish species in the genus until 1869. In 1856 Hasskarl again recognized the fact that *Mertensia* for a fern genus was preoccupied and substituted the name *Mesosorus* for it.

† It is a curious coincidence that *Platyzoma*, established by an Englishman, is reduced to synonymy by recent German writers, while *Stromatopteris*, established by a German and still maintained by them, is not accepted in the *Synopsis Filicum* of Hooker & Baker.

Stems simply pinnatifid or pinnate.*
  Sori borne on the ends of ordinary veins; rootstocks creeping. PLATYZOMA.
  Sori borne on horseshoe-shaped receptacles; rootstocks erect. STROMATOPTERIS.
Stems pseudo-dichotomous, once to many times forking.
  Sori borne on the ends of veins; segments in the form of rounded lobes. GLEICHENIA.
  Sori borne dorsally on the veins or at a fork; pinnae pectinate. DICRANOPTERIS.

Of the above genera *Dicranopteris* is found in both the Old World and the New, extending in range from Japan to the Straits of Magellan. The other genera are confined to the southern hemisphere of the Old World. As stated above *Platyzoma* and *Stromatopteris* are monotypic, while *Gleichenia* has several species ranging from South Africa to Java and Australia.† The species of *Gleichenia* are frequent in cultivation in the conservatories of the Old World, but we have never seen any of the species of *Dicranopteris* in cultivation anywhere. The development of the sexual stage is only incompletely known, having been partially studied by Rauwenhoff,‡ but in Jamaica at least the early stages of several species are abundant on the clay banks from germinating spores to young sporophytes in all stages. The young stages of the various species could profitably be studied at the Cinchona laboratory, as all four of Diels' sections of the genus are abundantly represented within easy reach of that station.

Some of the larger members of the genus *Dicranopteris* form thickets so deep that we have seen tunnels cut through them in which men could walk erect, and once, at Tweedside, Jamaica, Mr. Maxon and the writer walked for more than half a kilometer on the bent-down branches of tangles that had overgrown an unused bridle-path, our guides, tired of cutting paths, forcibly throwing themselves upon the tangles and we following on the springing elastic masses never once touching the ground and often a meter or more above it. Nearly all the species show a pseudodichotomy, and in each fork the growing axis remains in the form of a dormant bud ready to spring up as soon as the necessities of the plant demand additional foliar expansion. The accompanying diagram

* One of the South American species of the genus *Dicranopteris* has simple pectinate stems. Too little is known of the species, however, to base any conclusions on it.

† In *Synopsis Filicum* six species of § *Eugleichenia* are recognised, but there are others.

‡ N. P. W. RAUWENHOFF: La génération sexuée des Gleicheniacées. Arch. Néerl. 24: 157–231. *pl. 4–10.* 1890.

will illustrate the normal progress of one of the species, and it must be noted that in the main the diagram represents the plant at its simplest condition except at one point (above c') where a bud of the second order of forks is represented as producing a lateral extension of the plant, a condition possible at every one of the secondary and tertiary forks.

On account of these features some of the larger species of *Dicranopteris* do not lend themselves to what has facetiously been called "lie flat botany" since they occupy too much space in every direction to be easily reduced to the limits of the ordinary herbarium sheet, and still reveal the distinctive characters of the species. Neither "rough dry botany" nor "bottle botany" will succeed much better in transferring the distinctive characters of the larger species to the laboratory, and photography, while revealing habit in the mass, can add little to the details that go to separate technically one species from another. They must be lived with in their native haunts to impress firmly their distinctive characters. The ordinary field botanist, without knowing the necessities of the case, meets a proposition in the form of a *Dicranopteris* tangle, and simply breaks off one of the small terminal portions of possibly a fork of the second or third order with no hint of the main stem or habit of growth and brings it to some herbarium for preservation as a stumbling-block for the future. Such material unfortunately formed the basis for some of the "type specimens" of the genus and they can only be elucidated and correlated after extensive study of the plants in the field. Field-work of an intelligent character alone will ever disentangle the muddles in this genus. The *hortus siccus* will furnish some of the types but they must be interpreted by the field study in their respective type localities.

The terminology of the parts of these peculiar plants requires special notice and can best be explained by reference to the diagram (FIGURE 1). We commence with a young simple upright branch* *W*. This normally forks twice, producing a bud at x'

* This upright branch from the creeping rootstock is circinate when young and is apparently homologous with the "frond" or leaf of the ordinary fern. Like the analogous case in some of the *Lygodieae* it is utterly impractical to use such a terminology here in descriptive work. It would be particularly absurd to speak of such a tangle as we have mentioned above as "leaves" or "fronds" and yet such they appear to be morphologically.

and also at $a'a'$; at the latter points we may have pairs of pectinate pinnae simply (as shown on the right) or in some species we may have a second forking (as shown on the left), or in still other species this may be continued still further. Each species when

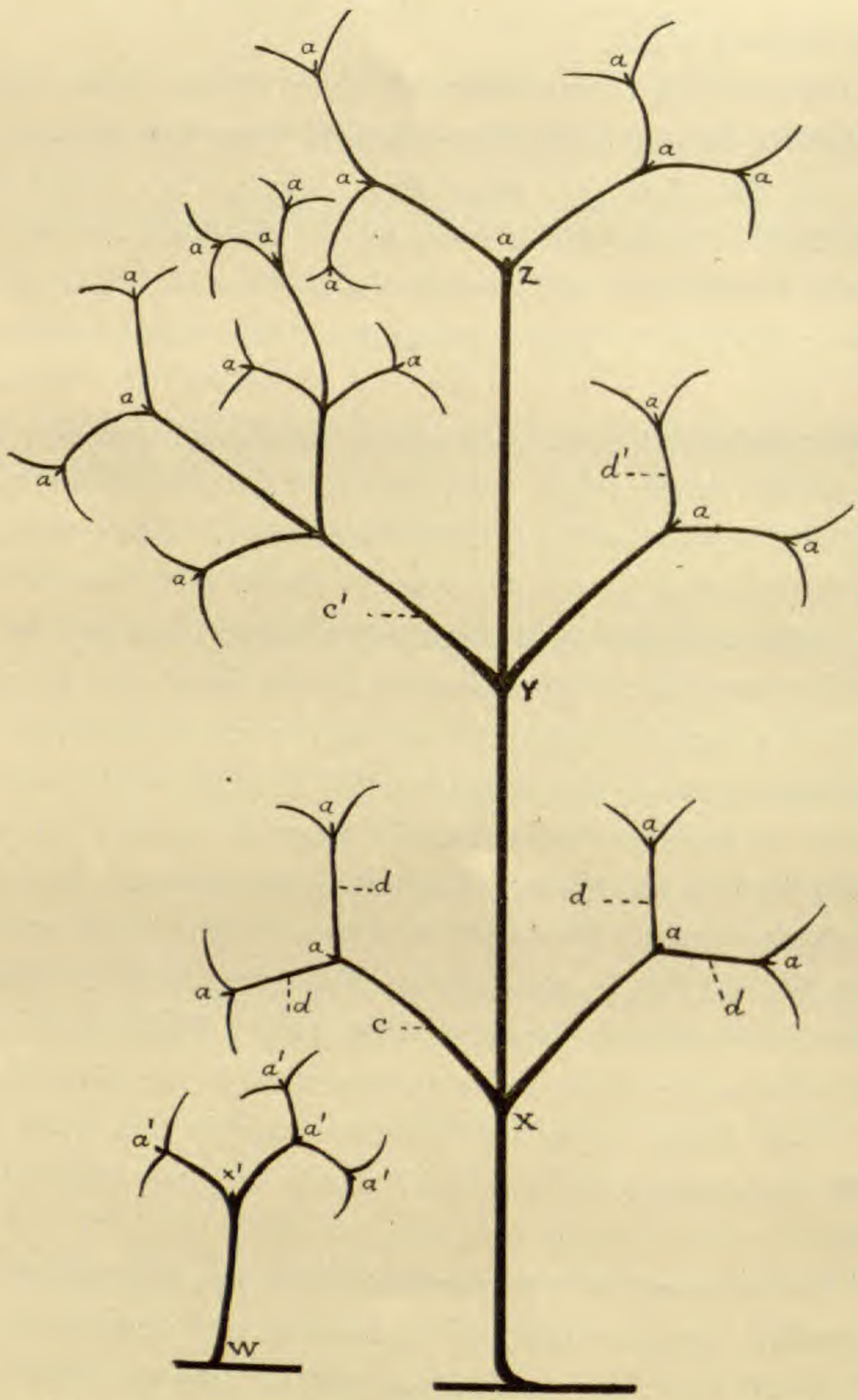

FIG. I. Diagram of method of branching in *Dicranopteris*.

normally mature appears to have a definite limit to the number of successive forkings of the same members. So far the problem is simple, but see what happens later. At some period the bud at

x' unfolds and (*cf.* larger figure) a second fork is produced at Y which by successive forkings duplicates the simple condition first observed. The system of forks at Y may be distinguished from those below as *forks of the second order*. From Y a terminal bud may produce later a *fork of the third order* (Z) and its terminal bud may continue the process as long as the tissue of the main stem retains the power to convey nourishment. Even this condition is comparatively simple, if it would remain so, as it does in certain species; but in others, buds everywhere developed at the lateral forks as at a, a, a, a, may unroll and produce an interminable array of complications. A moderate example of this is shown at the left-hand fork above Y; from this simple example it will not be difficult to imagine the possibilities of complication arising in a vigorous upright stem. The primary branches at c, c, may be called the *primary internodes*; at d, d, d, d, we have the *secondary internodes*, and so on through the entire series of the pseudo-dichotomy.

In the field it is of prime importance to get the primary fork in a normal condition; in it the characters of the bud-scales and the extent of the decurrence of the segments on the secondary and primary internodes is of great importance. Often these are both naked except for a casual stipule-like segment at the bud itself; in others the secondary is pectinate like the upper pinnae while the primary is naked; in others still the primary is pectinate on the inner side or in some species on both sides; so far as we have been able to see, these characters are fairly constant. One species (*D. pectinata*) presents a modification of this method of forking, the alternate forks producing merely a pair of pectinate pinnae, while the opposite one produces a second fork of which the alternate internode again produces a pair of pinnae, while the other goes on as before, thus forming an apparently zigzag axis and withal most graceful sprays, as the species is vine-like and often reaches a length of several meters.

Hooker and Baker recognized twenty-one species in their *Gleichenia* § *Mertensia* * (which is *Dicranopteris*) eight of which are

* *Synopsis Filicum* ed. 2. 12, 15, and 449. 1874. Besides this two of Mettenius' species published in 1864 are included in the Index and referred to p. 449 of the text, but no mention of them occurs on that page or elsewhere in the work.

exclusively American and two others are regarded as common to the tropics of both hemispheres, while the other eleven are exclusively Old-World species ranging from Japan and Hawaii to Tasmania and South Africa. Strikingly in contrast with this treatment is the arrangement given by Sturm of the Brazilian species,* of which he describes twenty-five; almost half of which (twelve) are reduced by Hooker and Baker under the single species, *Gleichenia pubescens*, with their characteristic lack of recognition of specific characters. Sturm's treatment, although nearly a half century away from the present, is the only critical and reliable one the American species have ever received, but concerns the South American species only. The species extending into Mexico and the West Indies have never received special attention, but their treatment has usually been that of *Synopsis Filicum*, in which the species are massed under four names as follows:

1. *Gleichenia longissima* Blume. (Type from Java!)

2. *Gleichenia pubescens* H. & B. (Type from Venezuela and never examined by the authors of *Synopsis Filicum*!)

3. *Gleichenia pectinata* Presl. (Type from Caracas, Venezuela; a common tropical American species.)

4. *Gleichenia dichotoma* Willd. (Type from Japan!) †

The four categories which these tangles typify were made to stand for four sections of the genus by Diels,‡ and some of them on account of differences in spore characters, have been thought worthy of higher rank.§

1. Of the four tangles mentioned above, the first was founded on a Javan plant, and represents a large group of species, two of

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* *Flora Brasiliensis* 1[1]: 219–238. 1859.

† We have now no reason for believing that any species are common to the Old World and the New.

‡ *Die natürlichen Pflanzenfamilien* 1[4]: 353–355. 1900.

§ Spore characters, except in a few genera, have never been considered in separating ferns specifically or generically. And yet we have two very distinct types of spore that appear to be somewhat fundamentally connected with the division of the spore mother-cell. One of these is the ordinary "reniform" or diplanate type which in reality is simply a quarter of a sphere divided axially and rounded on the sharp edges; the other, producing the so-called "sphaero-tetrad" or triplanate type, is formed by a division into 4's radiating from the center of the sphere with subsequent rounding of the edges. It would be interesting to know if the gametophyte bears any relation to this diverse origin of the spore.

which are found in the American tropics and a considerable number of species are widely distributed in the Old World.* The members of this group are distinguished by forming a single fork, each branch of which develops directly into a long bipinnate portion; as in the other sections the bud at the fork may develop into forks of the second and third orders forming an indefinite growth at the end of the axis. This group forms the section *Diplopterygium* of Diels.

2. The species of the second group, which form the section *Holopterygium* of Diels, have the characteristic forking indicated in FIGURE 1, with the segments decurrent on the nodes sometimes even to the primary ones. It was in this section that Sturm characterized a dozen South American species in 1859, and a resurvey of the same area at the present time would probably double that number; this work we hope later to be able to accomplish when the types in European herbaria have been studied still further, for without this no progress is possible. Most of the West Indian and Mexican species have been confused with *Gleichenia bifida* and *G. pubescens*, both originally described from South America, but a study of type material has convinced me that neither of these species occurs in present collections north of Panama. This is strictly in accord with the conclusion reached long ago by

* Among other members of this group the following species submerged by reduction to synonymy, which we have studied at Kew and Berlin, we regard worthy of specific recognition:

Dicranopteris glauca (Thunb.).

Polypodium glaucum Thunb.; Houtt. Nat. Hist. **14**: 177. 1783. (Type from Japan.)

Dicranopteris glabra (Brack.).

Mertensia glabra Brack. Wilkes Expl. Exp. **16**: 292. 1854. (Type from Hawaii.)

Dicranopteris gigantea (Wall.).

Gleichenia gigantea Wall. Cat. n. 157. 1827 (*nomen nudum*); Hook. Sp. Fil. **1**: 5. *pl. 3 A.* 1844. (Type from Nepal.)

Dicranopteris longissima (Blume).

Gleichenia longissima Blume, Enum. Pl. Jav. 250. 1828. (Type from Java.)

Dicranopteris arachnoides (Hassk.).

Mertensia arachnoides Hassk. Jour. Bot. Hook. **7**: 322. 1855. (Type from Java.)

It is more than likely that other species of this section are confused in European herbaria, particularly with *D. gigantea* and *D. arachnoides* of the above list.

Sturm, who showed that the extension of range of *G. pubescens* at least was southward from its type locality rather than northward. Recently Dr. Christ has delimited a number of Costa Rican species, unfortunately with very poorly prepared material and probably without due reference to the species of South America. A number of his species have been re-collected in excellent specimens by Mr. Maxon, but much more field work in that prolific region will be necessary before we reach the end of our knowledge of the range of species. We have separated thirteen species in this section with three others still in the position of *species inquirendae.*

3. The section *Acropterygium* of Diels is characterized by bearing no segments on any of the internodes, the branches all terminating in a single pair of pinnae. To this section belongs *D. pectinata,* of wide distribution, one of the most graceful of the genus.*

4. The last section, *Heteropterygium* of Diels, is most peculiar of all in its branching. As in the last section there are no decurrent segments, but after the second forking and each succeeding one, a branch is deflected downwards on either side of the fork so as to make an angle of about the same degree of aperture as the fork itself. These deflected pinnae may be nearly as large as the regular pinnae of the plant or, in other species, may be reduced to a simple pinnule only slightly larger than the ordinary segments of the pinnae of the same plant. The type of this section as well as of the genus *Dicranopteris* is the plant described by Thunberg from Japan as *Polypodium dichotomum.* It is uncertain whether the Malayan plant which has a still earlier name is identical with this species or not.† In any case the American

* Commencing with Raddi, followed by Hooker (Sp. Fil. 1: 11,12. 1844), *Mertensia glaucescens* H. & B. has been reduced to synonymy with this species, without taking the trouble to examine Willdenow's type. The species proves to be a member of a distinct section (*Holopterygium*) from the present species and is to be compared with the glaucous species of that section more recently described from South America. The type locality of *M. glaucescens* is Santa Cruz, Venezuela.

† The Malayan plant has been called *Gleichenia linearis* and has the following synonymy:

Dicranopteris linearis (Burm.)

Polypodium lineare Burm. Fl. Ind. 235. *pl. 67. f. 2.* 1768. (type from Java); not *Polypodium lineare* Thunb. which belongs to a distinct family, but as a homonym will require a new name when placed in its proper genus.

Gleichenia linearis Clarke, Trans. Linn. Soc. II. 1: 428. 1880.

species, which has a relatively large range, is distinct from either the Japanese or Malayan species, and has already been twice named.

With this general account of the genus and its sections we present a preliminary synopsis of the North American species:

Primary branches bipinnate. (§ *Diplopterygium* Diels.)
  Pinnules contiguous, mostly alternate. 1. *D. Bancroftii.*
  Pinnules distant, mostly (?) opposite. 3. *D. Brunei.*
Primary branches simply pectinate or again (sometimes repeatedly) forking.
  Branches all naked up to the final pair of pectinate pinnae.
    With a pair of reflexed pinnae at each fork. (§ *Heteropterygium* Diels.) 7. *D. flexuosa.*
    Without reflexed pinnae at the forks. (§ *Acropterygium* Diels.)
      Ultimate pinnae sessile. 15. *D. pectinata.*
      Ultimate pinnae stalked (*i. e.*, the rachises naked at the base).
        Rachises zigzag, with reflexed segments. 17. *D retroflexa.*
        Rachises straight, with horizontal segments. 16. *D. pteridella.*
  Branches (some or all) pectinate; pinnae pinnatifid to the base. (§ *Holopterygium* Diels.)
    Once forked, the forks of the second and successive orders appearing like a bipinnatifid leaf; sinuses between the teeth broad. 13. *D. orthoclada.*
    Twice to four times forked.
      Primary internode (*i. e.*, stem between 1st and 2d fork) naked.
        Under surface more or less tomentose. 5. *D. cubensis.*
        Under surface smooth or at most faintly pubescent; rachises mostly scaly.
          Pinnae narrow (under 3 cm. wide); mostly 4-forked.
            Scales of axillary buds dark-fulvous; segments granular-glaucous beneath. 4. *D. costaricensis.*
            Scales of axillary buds pale-brown; segments faintly pubescent beneath, not glaucous. 11. *D. jamaicensis.*
          Pinnae wider (3.5–5 cm.).
            Under surfaces glaucescent; rachises densely-covered with pale spreading scales. 2. *D. bicolor.*
            Under surfaces faintly pubescent; rachises with scattered scales.
              Scales of axillary buds dark-fulvous; scales of ultimate rachises with dark centers. 12. *D. mellifera.*

Scales of axillary buds pallid; scales of ultimate rachises uniformly pale. 14. *D. palmata.*
Primary internode naked on the outside, at least below.
Pinnae narrow, 2 cm. or less wide.
Under surface thickly set with short erect reddish clavate bodies giving a granular appearance; primary internodes 2 cm. or less long. 6. *D. farinosa.*
Under surface smooth or glaucous-mealy, pale; primary internodes longer, 4–5 cm. long. 18. *D. strictissima.*
Pinnae wider, 2.5–6 cm.
Under surfaces slightly pubescent; ultimate rachises densely scaly. 9. *D. furcata.*
Under surfaces tomentose; ultimate rachises tomentose at first, becoming smooth. 8. *D. fulva.*
Primary internode (if any) fully pectinate; segments contiguous; primary axis prominent, producing (apparently) lateral branches. 10. *D. intermedia.*

LIST OF THE NORTH AMERICAN SPECIES

1. **Dicranopteris Bancroftii** (Hook.).

Gleichenia Bancroftii Hook. Sp. Fil. **1**: 5. *pl. 4 A.* 1844.

TYPE LOCALITY: Jamaica, *Bancroft.*

DISTRIBUTION: Mountains of Jamaica at altitudes of about 1200–1500 meters; also in Costa Rica, Colombia, Venezuela, Ecuador, and Bolivia.

ICON: Hooker, *loc. cit.*

This species was properly distinguished from the Old World representatives of the *longissima* group by Hooker, and this just opinion was abandoned when he cast all rational ideas of geographic distribution aside, and as well all rational conceptions of species limitations. The species is a most graceful plant in spite of its large size; it often forms sprays four or five meters long overhanging dry banks. Its allies are discussed in the footnote on page 249.

2. **Dicranopteris bicolor** (Christ).

Gleichenia bicolor Christ, Bull. Herb. Boiss. II. **6**: 279. 1906.

TYPE LOCALITY: Valle del Rio Navarro, Costa Rica, *Werckle.*

DISTRIBUTION: Known only from the mountains of Costa Rica, alt. about 1400 meters.

This very distinct species was first collected by J. J. Cooper and was referred by Mr. Baker to the all-embracing *Gleichenia pubescens*, as "a large glabrous form." From Cooper's fragment we had recognized a plant unique and distinct from any known species as early as 1898; the material then at hand was too meager for description.

3. **Dicranopteris Brunei** (Christ).

Gleichenia Brunei Christ, Bull. Herb. Boiss. II. **5**: 13. 1905.

TYPE LOCALITY: El Desengano, Costa Rica, *Brune*.

DISTRIBUTION: Known only from its type collection. Dr. Christ has kindly favored me with a part of spray which appears to be rather close to *D. Bancroftii*.

4. **Dicranopteris costaricensis** sp. nov.

A flabellate, 3–4-forked plant with narrow pinnae. Rootstock creeping; main stalk slender, 2 mm. in diameter, smoothish or with scattered scales; primary forks diverging at an angle of 100°, the primary internodes 4–8 cm. long, with 1 or 2 small obtuse lobes at the base; terminal bud large with dark-brown, ciliate-margined scales, sometimes forming a forking of the second order; secondary branching diverging at an angle of 80°–90°, the secondary internodes 4–6 cm. long, pinnate on one or both sides in the lower half; tertiary branching at an angle of 40°–60°, the internodes 5–6 cm. long, uniformly pinnate throughout, sometimes not forming a quaternary fork; pinnae 12–20 cm. long, 1.25–2 cm. wide, the segments short, glaucous underneath, with strongly revolute margins; veins once forked; rachises more or less densely covered underneath with delicate brown ciliated scales; sporangia in 3's or 4's.

Type from Costa Rica, Volcan Poas, alt. 2600 meters, *J. Donnell Smith 6859;* Volcan de Turrialba, alt. 2800 meters, *Pittier* (*J. D. S. 7486*).

This very distinct Costa Rican species has been confused by nearly every writer with *Gleichenia revoluta* H. & B., a species described from Ecuador, which differs materially in its narrower pinnae, different vestiture of the segments, and different bud-scales and decurrence of the segments on the internodes.

5. **Dicranopteris cubensis** sp. nov.

A straggling plant of wayside banks, with stems a meter or more high. Rootstocks wide-creeping, slender; 3-forked at the first branching, 2-forked at the second; primary internodes 3.5–4.5 cm. long, naked with more or less appressed pubescence, the buds rather large with small pallid finely ciliate scales; secondary internodes about equal length, sometimes nearly naked, but sometimes with segments decurrent from the tertiary forks one-half to two thirds the length; pinnae 25–30 cm. or more long, 5–7 cm. wide, the segments narrow, widening at the base, separated by 2–3 times their width, smooth above, covered beneath with a fine pure white appressed tomentum in which the sori are embedded; veins forked, mostly near the base, distinct; sporangia mostly in 3's and 4's.

On clay banks, slopes of El Yunque, near Baracoa, Cuba, *Underwood & Earle 1416* (type), *1196*; also collected by *Wright 921* (in part), *1810*.

6. **Dicranopteris farinosa** (Kaulf.).

Mertensia farinosa Kaulf. Wesen der Farrenkr. 37. 1827.

Mertensia subtrisperma Fée, Mém. Foug. **11**: 122. *pl. 32. f. 2.* 1866. (Type from Guadeloupe.)

TYPE LOCALITY: "Deren Vaterland ich nicht kenne" — *Kaulfuss.*

DISTRIBUTION: Known only from the island of Guadeloupe.

ILLUSTRATIONS: Kunze, Anal. Pterid. 6. *pl. 3.* 1837; Fée, *loc. cit.*

This is another characteristic species that has been strangely misunderstood in spite of the two excellent illustrations cited above, both of which call attention particularly to the very unique covering of the under side of the segments which we have seen in no other species of the family. Under the name *Gleichenia farinosa* or *Mertensia farinosa* it has been mistakenly reported from all the greater Antilles. It appears very rarely in collections and has probably a limited range on the islands of the Lesser Antilles. Although Kaulfuss was not aware of its original place of collection, his figure in Kunze's *Analecta* is unmistakable and it is more than probable that he found his specimen among some of the plants brought in by Sieber's collectors.

7. **Dicranopteris flexuosa** (Schrad.).

Mertensia flexuosa Schrad. Goett. Gel. Anz. 863. 1824.

Mertensia rigida Kunze, Linnaea **9**: 16. 1834. (Type from Chibangata, Peru, *Poeppig.*)

Gleichenia flexuosa Mett. Ann. Lug. Bat. **1**: 50. 1863.

Gleichenia rigida Bommer & Christ. Bull. Soc. Bot. Belg. **35**: 174. 1869. Not *Gleichenia rigida* J. Sm.

TYPE LOCALITY: Brazil, *Maximilian Prinz Neuwied.*

DISTRIBUTION: Lower elevations up to 800 m. alt., Porto Rico, Cuba, Jamaica, and southward from Colombia along the Andes to Peru and Brazil.

ILLUSTRATION: Mart. Icon. Crypt. Bras. *pl. 60. f. 1.*

This is the American representative of a rather complicated group of plants that have been unceremoniously massed under the name of *Gleichenia dichotoma*. This last species was described and figured from Japan by Thunberg as *Polypodium dichotomum* and may be distinct from the earlier Malayan representative of the group described by Burmann as *Polypodium lineare*. In any case the Malayan representative will bear the name *Dicranopteris linearis* (Burm.) as noted above. The fibro-vascular bundles of the last-named species are wiry and elastic and are used by the Malayans for weaving hats or hat frames and other articles. The Javan species is much larger than its low American representative and this accounts in part for the confusion which has placed several Old World species ranging from Hawaii and Japan to Java, Nepal, Madagascar and Fernando Po in one species, when there are certainly several as indicated by their mummied fragments preserved in European herbaria.

8. **Dicranopteris fulva** (Desv.).

Mertensia fulva Desv. Ann. Soc. Linn. Paris **6**: 200. 1827.

This commonest species of the island of Jamaica has been in recent years strangely confused with the *Mertensia pubescens* of Willdenow, which was originally described from South America. It was characterized in 1827 by Desvaux in the following terms which appear unmistakable:

"Stipite et rachi dichotomo glabris; frondibus pinnatis; pinnis per dichotomiam decurrentibus, pectinato-pinnatifidis: pinnulis linearibus, elongatis, subobtusis, subtus fulvo-tomentosis; sporangiis subquaternatis. Habitat in montibus ceruleis Jamaicae."

The Hookerian school, Grisebach, and Jenman all confused this species with *Mertensia pubescens*, notwithstanding the fact that Sturm as early as 1859 had definitely delimited that much smaller South American species which Willdenow himself had described as "*subtus albido villosis*," to say nothing of numerous other characters.

The present species forms immense thickets on banks and overgrows paths that are long neglected. Its general habit may be seen from a photograph taken last year in Porto Rico by Dr.

FIG. 2. Bank covered with *Dicranopteris fulva*, Porto Rico. (Courtesy of the *Journal of the New York Botanical Garden.*)

M. A. Howe which is here reproduced by the courtesy of the New York Botanical Garden (FIGURE 2). This is the species alluded to above (page 244) at the Tweedside plantation, Jamaica.

DISTRIBUTION: Cuba, Jamaica, Porto Rico, Hispaniola, and in

Mexico from Orizaba and Chiapas southward to Guatemala, Costa Rica and Panama. It is not always possible to cite specimens from the miserable fragmentary tips which even some of the recent collectors bring back to herbaria after a laborious and expensive journey to add to the knowledge of our tropical flora.

9. **Dicranopteris furcata** (L.).

Pteris dichotoma L. Sp. Pl. 1076. 1753. Not *Dicranopteris dichotoma* Bernh.

Acrostichum furcatum L. Syst. Nat. ed. 10. 2: 1321. 1759. (Based on Plumier *pl. 28*, the same as had previously served as the type of *Pteris dichotoma.*)

Polypodium furcatum Sw. Jour. Bot. Schrad. **1800**[2]: 28. 1801.

Gleichenia furcata Spreng. Syst. Nat. **4**: 25. 1827.

Mertensia furcata Willd. Vet. Ak. Nya Handl. 166. 1804.

Mertensia grandis Fée, Mém. Foug. **9**. 31. 1857 (nomen nudum); Mém. Foug. **11**: 120. 1866. (Type from La Soufrière, Guadeloupe.)

Rootstock unknown; upright stems stout, 5–6 mm. in diameter, covered above and when young with copious pale lanceolate scales; primary branches forming an angle of 80°, with one or two pinnae on either side at the base of the internode, which is 3 cm. long and scaly like the main stalk; occasionally forming a secondary branch with the second internode 6 cm. or more long, fully pinnate on both sides; pinnae 12–20 cm. long, 4.5–6.5 cm. wide in the middle, narrowed slightly toward each end, elliptic, the segments about 3 mm. wide, tapering mainly near the tips; under surfaces nearly smooth except the rachises which are densely scaly.

TYPE LOCALITY: Morne de la Calebasse, Martinique; based on Plumier, *pl. 28.*

DISTRIBUTION: Craters of extinct volcanoes [Martinique], Guadeloupe, and St. Kitts (Mt. Misery, *Britton & Cowell 526*).

ILLUSTRATION: Plumier, *loc. cit.*

This species has been strangely misunderstood and until the collection of fresh material by Britton and Cowell in 1900 it was impossible to correlate the species with other collections, especially of the *Mertensia grandis* Fée, which we have since seen in his collection and which was evidently based on plants with rather longer pinnae. The plants from St. Kitts exactly match the illustration from Plumier. The plant has not recently been collected in Martinique and is not likely ever to be collected there again. It should be sought at the summits of the higher volcanic islands of the Lesser Antilles. In St. Kitts it goes by the name of "stag-horn fern."

By strangely following somebody's error, Christensen * refers *Mertensia grandis* to *Gleichenia Bancroftii* (*Dicranopteris Bancroftii*), a member of a distinct section of the genus.

10. **Dicranopteris intermedia** (Baker).

Gleichenia intermedia Baker, Jour. Bot. 25: 24. 1887.

Gleichenia axialis Christ, Bull. Herb. Boiss. II. 5: 14. 1905. (Type from Rio Navarro, *Wercklé.*)

TYPE LOCALITY: Costa Rica, *J. J. Cooper.*

DISTRIBUTION: Costa Rica.

Dr. Christ in some way formed the impression that Baker's species was "une espèce évidemment alpine," whereas Cooper's collection was from near Cartago and not far from the type locality of *G. axialis*, which is without question a redescription of Baker's plant. It really does prevent errors to visit Kew, but it is hard to convince continental fern students of that fact.

11. **Dicranopteris jamaicensis** sp. nov.

A mountain species with narrow pinnae much forked, sometimes proliferous and forming low thickets. Rootstocks creeping, frequently branched with abundant brownish scales; stems erect, 25–60 cm. long, 2–4-forked; buds densely covered with pale-brown ciliate scales; primary internodes naked or with a very few small segments on the inner side at base, scaly at first, becoming smooth and shiny, 3–9 cm. long; secondary internodes nearly naked or more often with segments on both sides below or all the way up, densely scaly as are the rachises with narrow pale-brown ciliate scales; tertiary internodes fully pectinate; pinnae 16–22 cm. long, rarely more than 2 cm. wide, with numerous closely placed segments separated by less than their width; under surfaces smooth, veins distinct, once forked, a third above the base; sori pale, in 3's and 4's.

Blue Mountains of Jamaica, *Underwood 1511* (type), *508, 919, 2500, 2552, 3209*; *Maxon 2617*; also collected by *Jenman, Hart* and others.

* Index Filicum 423. 1906.

Confused by Jenman with *Gleichenia Matthewsii* Hook., a Peruvian species with a widely different vestiture throughout.

12. **Dicranopteris mellifera** (Christ).

Gleichenia mellifera Christ, Bull. Herb. Boiss. II. **6**: 28. 1906.

TYPE LOCALITY: Valle del Rio Navarro, Costa Rica, *Wercklé*.

DISTRIBUTION: Known only from Costa Rica.

13. **Dicranopteris orthoclada** (Christ).

Gleichenia orthoclada Christ, Bull. Herb. Boiss. II. **5**: 16. 1905; *ibid.* **6**: 282. 1906.

Gleichenia intermedia dissitifolia Baker, Jour. Bot. **25**: 24. 1887. (Type from Costa Rica, *J. J. Cooper.*)

TYPE LOCALITY: Costa Rica, *Wercklé 212*.

DISTRIBUTION: Known only from Costa Rica.

14. **Dicranopteris palmata** (Schaffner) sp. nov.

Mertensia palmata Schaffner; Fée, Mém. Foug. **9**: 32. 1857 (*nomen nudum*).

Gleichenia palmata Moore, Ind. Fil. 380. 1862 (*nomen nudum*).

A smoothish species with upright stems 3–4-forked, the primary and secondary internodes naked, the ultimate pinnae diverging at an angle of about 30°. Rootstock creeping, sending up strict branches (stems) 60 cm. or more high, the upper portion 4–6 mm. in diameter, smooth, olive-brown; primary branches diverging at an angle of 90°, 7–8 cm. long, naked except for a few scattering scales; secondary branches diverging at an angle of 60°, the internodes 3.5–4 cm. long, with a pair of bracts at the base and a line of linear scales along the inner side, otherwise naked; tertiary branches diverging at an angle of 30°–40°, the internodes 5–6 cm. long, pinnate on both sides throughout; quaternary and final branches forming an angle of 30°, the pinnae 20–25 cm. long, 3 cm. wide, tapering gradually to the point; segments 2.5 mm. wide, the margin often finely revolute, blunt, with a few scattered hairs beneath; sporangia in 3's or 4's; rachises pale reddish-brown with scattered ciliate scales.

Type from moist woods, Orizaba, Mexico, *Pringle 6129*; also collected by *Liebmann*, *Schaffner*, and *Bourgeau*; also common at 1500 m. in the Blue Mountains of Jamaica, occurring singly and not forming thickets like the allied species.

This species was first recognized by Schaffner as distinct and given a manuscript name which was published but not described by Fée under *Mertensia* and transferred by Moore to *Gleichenia;* although the plant has thus been known for nearly fifty years it has remained undescribed. The plant was distributed by Mr. Pringle as "a smooth form" of *Gleichenia pubescens*, but has nothing to do with the species distributed by him under that name in the collection of the same year (*no. 6130*). The Jamaica plants which we are unable to distinguish from the Mexican occur at points above Morce's Gap on the trail to John Crow Peak and above Cinchona on the road to New Haven Gap. Jamaica collections in the herbarium of the New York Botanical Garden are as follows: *Clute 184, Underwood 618, 965, 1245, 2033, 2097*, and *3138*. Mr. Jenman confused this species with *Gleichenia furcata*, to which species, as properly understood, it is not closely related.

15. **Dicranopteris pectinata** (Willd.).

Mertensia pectinata Willd. Vet. Ak. Nya Handl. 168. *pl. 4.* 1804.

Gleichenia pectinata Presl, Rel. Haenk. **1**: 71. 1825.

TYPE LOCALITY: Caracas, Venezuela.

DISTRIBUTION: Generally distributed through tropical America. Specimens are at hand from Jamaica, Hispaniola, Porto Rico, Dominica, St. Vincent, Martinique, Guadeloupe, Grenada, Trinidad, Guatemala, and Panama; also from Colombia, Guiana, Ecuador, Bolivia, and Brazil.

16. **Dicranopteris pteridella** (Christ).

Gleichenia pteridella Christ, Bull. Herb. Boiss. II. **6**: 284. 1906.

TYPE LOCALITY: Costa Rica, *Wercklé.*

DISTRIBUTION: Known only from its type collection.

17. **Dicranopteris retroflexa** (Bommer).

Gleichenia retroflexa Bommer, Bull. Soc. Bot. Belg. **35**: 175. 1896.

Gleichenia intermedia flexuosa Baker, Jour. Bot. **25**: 24. 1887. (Type from Costa Rica, *J. J. Cooper*).

TYPE LOCALITY: La Palma, Costa Rica, *Pittier 1471.*

DISTRIBUTION: Known only from the mountains of Costa Rica, alt. 1800 m.

ILLUSTRATIONS: Christ, Bull. Herb. Boiss. II. **5**: 15. 1905.

This remarkable species was first described by Mr. Baker, in

1887. Having already described a new species (*Gleichenia intermedia*) from the collections of J. J. Cooper, he evidently lost courage upon finding two others in the same collection undescribed and referred them both, as varieties, to his *G. intermedia*. One of these is *D. orthoclada*, described by Dr. Christ, and the other is the present species, which is the most peculiar of all the anomalies in a strange genus. We were at first inclined to regard the scrappy material collected by Cooper as a sport, but ample material collected by Mr. Maxon places us in the possession of a sufficient illustration of the species to doubt its normality no longer.

18. **Dicranopteris strictissima** (Christ).

Gleichenia strictissima Christ, Bull. Herb. Boiss. II. 5: 13. 1905.

Gleichenia glaucina Christ, Bull. Herb. Boiss. II. 6: 283. 1906. (Type from Navarro, Costa Rica.)

TYPE LOCALITY: Costa Rica, *Wercklé 215*.

DISTRIBUTION: Known only from Costa Rica, alt. 1450–1550 meters.

With specimens communicated from Dr. Christ before us, we are not able to separate these two species. Wercklé's specimens, unfortunately, do not give us good representatives of the species. More recently however Mr. Maxon has gathered some beautifully preserved specimens from La Palma (*no. 432*); these are of the *glaucina* type being strikingly glaucous beneath, a character on which too much reliance should not be placed in separating the members of this genus. The original *G. strictissima* has smooth but not glaucous under surfaces, but seems to differ in no other way.

SPECIES INQUIRENDAE

MERTENSIA GLEICHENIOIDES Liebm. Mex. Bregner 144. 1849. (Type from Cuapa, Dept. Vera Cruz, Mexico, *Liebmann*.)

Gleichenia Leibmanni Moore, Ind. Fil. 379. 1862.

This species we have never seen. A tracing of a single fork appears in the collection of Mettenius at Berlin, and shows a narrow elongate pinna with crenately lobed segments wholly unique in the genus. It is only known from its type collection, and Mr. Christensen, who is at the Copenhagen museum where

Liebmann's types should be, places it among the little-known species.

GLEICHENIA TRACHYRHIZOMA Christ, Bull. Herb. Boiss. II. **6**: 280. 1906. (Type from Valle del Rio Navarro, 1,400 meters, *Wercklé.*).

GLEICHENIA BREVIPUBIS Christ, Bull. Herb. Boiss. II. **6**: 280. 1906. (Type from Valle del Rio Navarro, Costa Rica, alt. 1,400 meters, *Wercklé.*)

Although Dr. Christ has sent fragments of these two Costa Rican species we are unable to differentiate them satisfactorily in our synopsis, as they do not show distinctive characters; Wercklé's specimens are poorly preserved and do not show essential parts of the plants.

COLUMBIA UNIVERSITY.

Studies on the flora of Southern California — II.

LE ROY ABRAMS

Xylothermia montana tomentosa subsp. nov.

Distinguished from the typical form by the broader and larger leaves which, together with the twigs and legumes, are densely hoary-tomentose.

This subspecies is confined to the chaparral region of Southern California, extending from the vicinity of Los Angeles to the Mexican boundary. The typical form extends from Santa Barbara northward both in the Coast Ranges and the Sierra Nevada.

Type collected by the author (*3530*) near El Nido, San Diego County, May 20, 1903.

Chamaebatia australis sp. nov.

Chamaebatia foliosa var. *australis* Brandegee, Bot. Gaz. **27**: 447. 1899.

"Much less glandular-pubescent than the type; leaves narrower in outline, three times as long as wide and barely more than twice pinnate, calyx-lobes shorter: ovary smooth." These are characters that hold well and since no intermediate forms have been found it seems only logical that a plant so isolated geographically should be considered as a distinct species. The range and habitat of the two species, as pointed out by Brandegee, are quite different. In addition to the localities cited by Brandegee may be added San Ysidro Ranch, Lower California, *Mearns 3861*, July 2, 1894.

ADENOSTOMA FASCICULATUM DENSIFOLIUM Eastwood, Bull. Torrey Club **32**: 199. 1905

This variety was based upon specimens collected by Mr. Fordyce Grinnell Jr. on Mt. Wilson, near Pasadena. During a short stay in Southern California the past summer I had an opportunity to study somewhat closely the chamiso in the mountains about Pasadena, and from these observations I am convinced that Grinnell's specimens were from merely abnormal stunted shrubs. The chamiso is fairly common there, and is normally quite typical *A. fasciculatum.*

Xanthoxalis californica sp. nov.

Perennial from a stout woody root, bearing many rather stout branching woody rootstocks at the crown; stems decumbent, tufted at the ends of the rootstocks, 1–3 dm. long, very sparingly and loosely villous; leaflets pale-green, villous; cyme only 1–flowered or mostly 2–flowered, scarcely exceeding the leaves; pedicels 1–2 cm. long, somewhat sparsely appressed-pubescent; sepals obovate-oblong, ciliate on the margin above, 5 mm. long; petals yellow, 8–10 mm. long, glabrous; longer stamens glabrous; styles persistent, very slender, 3–4 mm. long; capsule columnar, 10–15 mm. long, on more or less reflexed pedicels; seeds strongly rugose.

Related to *X. Wrightii** of New Mexico and Arizona, with which it has been confused, but that species is densely villous-pubescent, decidedly glaucous, and has very short, stout styles.

Dry hillsides in the chaparral region of Southern California. Type collected by the author (*3274*) in the Onofre Mountains, San Diego County, April 19, 1903.

Malvastrum viscidum sp. nov.

Annual or possibly sometimes more persistent, 5–10 dm. high; herbage short-stellate-pubescent throughout, somewhat ferruginous, viscid-glandular and heavy-scented; leaves on petioles 15–20 mm. long, nearly orbicular, deeply cordate, 2–4 cm. broad, coarsely crenate; veins prominent beneath; upper surface rugose, appearing almost glabrous; flowers in interrupted spicate clusters; calyx campanulate, 5–7 mm. broad, its lobes broadly lanceolate, slightly acuminate, about equaling the tube; petals reddish, turning purple with age, 15 mm. long; styles pubescent at base, 9 mm. long, equaled by the stamens; immature carpels pubescent at apex, not reticulate on the sides.

A close relative of *M. densiflorum* S. Wats., but much less villous and more glandular; leaves less deeply lobed, and calyx-lobes much shorter. Type collected by the author (*3528*) on dry hill-

* **Xanthoxalis Wrightii** (A. Gray). *Oxalis Wrightii* A. Gray, Pl. Wright. 1: 27. 1852.

sides near El Nido, San Diego County, May 19, 1903. Nevin's specimen from San Juan Capistrano, which Watson referred to *M. densiflorum*, belongs here.

TRICHOSTEMA PARISHII Vasey, Bot. Gaz. 8: 173. 1880

T. lanatum var. *denudatum* A. Gray, Syn. Fl. 2: 459. 1886.

According to Vasey this "differs from *T. lanatum* in the shorter and broader leaves, longer and more slender thyrsus, with cymules more open and much less woolly; flowers smaller and filaments shorter." Dr. Gray simply states "with the wool remarkably short." In all the specimens examined the flowers were scarcely half the size of *T. lanatum*, and the wool much less conspicuous.

T. lanatum ranges from Monterey County to Orange County. In the southern portion of its range it is confined to the foothills toward the coast. *T. Parishii*, according to specimens at hand, is confined to the dry interior foothills, extending over to the desert slopes. It ranges from Acton, Los Angeles County, to the Mexican boundary, and probably southward into northern Lower California.

Gutierrhezia bracteata sp. nov.

Suffrutescent, much-branched above, about 6 dm. high; branches slender, strongly striate, granular-scabrous; leaves at flowering time few, becoming reflexed, 1 mm. wide, 15–40 mm. long, very sparsely short scabrous, obscurely punctate, those of the strictly divaricate branchlets rather numerous, short and bract-like; heads solitary, terminating the ultimate branchlets; involucres turbinate-campanulate, 5 mm. high; involucral bracts in 3–4 series, obovate, very obtuse, with greenish tips; rays usually 8, nearly 2 mm. broad; disk-flowers 7, 4 mm. high, including the achene; pappus-scales obtuse, finely striate, ciliate on the margin.

This species is easily separated from all other members of the genus by its decidedly divaricate, bracted branchlets. Its affinities are perhaps with *G. divergens* Greene, from which it is distinguished not only by the character of its branchlets but by its larger and broader heads.

Desert slopes of San Bernardino County, between Banning and Seven Palms, *C. R. Orcutt*, Nov. 1889. Type in the Gray Herbarium of Harvard University.

STANFORD UNIVERSITY, CALIFORNIA.

INDEX TO AMERICAN BOTANICAL LITERATURE
(1906)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions their kindness will be appreciated.

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Allison, A. Notes on the winter birds of Hancock County, Mississippi. The Auk **23**: 44–47. Ja 1906.

The vegetation of the county is discussed briefly on pages 44 and 45.

Baillie, A. G. Bog plants. Bull. Pictou Acad. Sci. Assoc. **1**: 23, 24. N 1906.

Baker, C. F. Informe del Departamento de Botánica. Inf. An. Estac. Cent. Agron. Cuba **1**: 131–145. 1 Je 1906.

Baker, C. F. José Blain. Inf. An. Estac. Cent. Agron. Cuba **1**: 217–223. *pl. 30.* 1 Je 1906.

Borge, O. Algen aus Argentina und Bolivia. Ark. Bot. **6^4**: 1–13. *f. 1–5.* 16 Jl 1906.

Cermenati, M. Ulisse Aldrovandi e l'America. Ann. di Bot. **4**: 313–366. 20 S 1906.

Christ, H. Die *Botrychium*-Arten des Australen Amerika. Ark. Bot. **6^3**: 1–6. *f. 1–9.* 9 Je 1906.

Includes *B. Negeri* sp. nov.

Cockerell, T. D. A. The alpine flora of Colorado. Am. Nat. **40**: 861–873. 19 D 1906.

Cockerell, T. D. A. The bees of Florissant, Colorado. Bull. Am. Mus. Nat. Hist. **22**: 419–455. 17 D 1906.

Includes a flower-visiting record, in which (!) is published the new combination *Hymenoxys ligulaeflora.*

Cook, M. T. Informe del Departamento de Patología Vegetal. Inf. An. Estac. Cent. Agron. Cuba **1**: 147–207. *pl. 24–29.* 1 Je 1906.

Cook, M. T. Teratología de la piña. Inf. An. Estac. Cent. Agron. Cuba **1**: 242–246. *pl. 43–46.* 1 Je 1906.

Davidson, A. A revision of the western mentzelias. Bull. So. Calif. Acad. Sci. **5**: 13–18. 30 Ap 1906.

Dietel, P. Monographie der Gattung *Ravenelia* Berk. Beih. Bot. Centralb. **20**^{2}: 343–413. *pl. 5, 6.* 1906.

Recognizes 81 species, including 6 North American ones.

Dusén, P. Beiträge sur Bryologie der Magellansländer, von Westpatagonia und Südchile. IV. Ark. Bot. **6**^{8}: 1–40. *pl. 1–12.* 4 S 1906.

Includes 23 new species in 8 genera.

Earle, F. S. Algunos hongos cubanos. Inf. An. Estac. Cent. Agron. Cuba **1**: 225–242. *pl. 31–42.* 1 Je 1906.

Includes new species in *Pocillaria* (5), *Phyllotus* (2), *Geopetalum* (2), *Crepidotus, Galera* (3), *Gymnochilus* (5), *Stropharia,* (2), *Pholiotina,* and *Pholiota.*

Foslie, M. Algologiske notiser, II. Kgl. Norske Vid. Selsk. Skr. **1906**^{2}: 1–28. [D] 1906.

Includes new American species in *Lithothamnion* (7), *Archaeolithothamnion, Litholepis, Lithophyllum* (2), and *Mastophora.*

Fries, R. E. Zur Kenntnis der Phanerogamenflora der Grenzgebiete zwischen Bolivia und Argentinien. II. *Malvales.* Ark. Bot. **6**^{2}: 1–16. *pl. 1, 2.* 9 Ap 1906.

Includes new species in *Bombax, Malvastrum, Sida, Gaya,* and *Wissadula.*

Fussell, L. List of Delaware County plants. Proc. Delaware Co. Inst. Sci. **2**: 34–46. O 1906.

Delaware County, Pennsylvania.

Grant, G. B. *Wheelerella.* Bull. So. Calif. Acad. Sci. **5**: 28. 30 Ap 1906.

Hackel, E. Gramina cubensia nova. Inf. An. Estac. Cent. Agron. Cuba **1**: 409–412. 1 Je 1906.

New species in *Paspalum* (2) and *Leptochloa.*

Hasse, H. E. Contributions to the lichen-flora of Southern California. Bull. So. Calif. Acad. Sci. **5**: 38–45. 11 S 1906.

Hasse, H. E. A few lichens picked up on San Jacinto Mountain. Bull. So. Calif. Acad. Sci. **4**: 123–125. 5 F 1906.

Hemsley, W. B. On the *Julianiaceae,* a new natural order. Jour. Bot. **44**: 379–384. N 1906.

Holm, T. *Ceanothus americanus* L. and *ovatus* Desf.; a morphological and anatomical study. Am. Jour. Sci. IV. **22**: 523–530. *f. 1–5.* D 1906.

Holm, T. The root-structure of *Spigelia marilandica* L., *Phlox ovata* L., and *Ruellia ciliosa* Pursh. Am. Jour. Pharm. **78**: 553–559. *f. 1–5.* D 1906.

Jennings, O. E. A new species of *Lonicera* from Pennsylvania. Ann. Carnegie Mus. **4**: 73–77. *pl. 20.* D 1906.

L. altissima sp. nov.

Kneucker, A. Bemerkungen zu den "*Gramineae* exsiccatae" XXI und XXII Lieferung 1906/07. Allgem. Bot. Zeits. **12**: 178–182. N 1906; 202–205. D 1906.

Landreth, B. A case of persistent vitality in seeds. Proc. Am. Phil. Soc. **45**: 5–8. Je 1906.

Lloyd, C. G. Mycological notes. 21: 245–260. *pl. 70–73 + f. 88–97.* Ap 1906; 22: 261–276. *f. 98–123.* Jl 1906; 23: 277–292. *pl. 86–90 + f. 124–130.* Au 1906; 24: 283–308. *pl. 91–93 + f. 131–143.* D 1906.

Lloyd, C. G. The *Tylostomeae.* 1–28. *pl. 74–85 + f. 1–6.* Cincinnati, Ohio. F 1906.

Moore, C. L. "Rusts," — with notes on some Nova Scotian species. Bull. Pictou Acad. Sci. Assoc. **1**: 20–22. N 1906.

Palmer, T. C. Rare local ferns. Proc. Delaware Co. Inst. Sci. **2**: 34–46. O 1906.

Parish, S. B. *Cereus giganteus* in California. Bull. So. Calif. Acad. Sci. **4**: 122. 5 F 1906.

Parish, S. B. A preliminary synopsis of the Southern California *Cyperaceae.* Bull. So. Calif. Acad. Sci. **4**: 126–133. 5 F 1906; **5**: 20–28. 30 Ap 1906; [35–37,] 47–54. 11 S 1906.

Pearl, R. Variation in the number of seeds of the lotus. Am. Nat. **40**: 757–768. *f. 1–4.* 26 N 1906.

Perrédès, E. F. London botanic gardens. Am. Jour. Pharm. **78**: 317–325. Jl 1906; 353–365. *pl. 26–30.* Au 1906.

Robinson, B. L. *Oxalis corniculata* and its allies. Jour. Bot. **44**: 386–391. N 1906.

Simmons, H. G. The vascular plants in the flora of Ellesmere-land. 1–198. *pl. 1–10.* Kristiania, 14 My 1906.

Includes a description of *Poa evagans* sp. nov.

Slade, H. B. Studies in plant mutation. Am. Jour. Pharm. **78**: 311–317. Jl 1906.

Van Tieghem, P. Sur les Héliotropiacées. Ann. Sci. Nat. Bot. IX. **4**: 261–271. D 1906.

Viguier, R. Recherches anatomiques sur la classification des Araliacées. Ann. Sci. Nat. Bot. IX. **4**: 1–208. Jl 1906; 209, 210. D 1906.

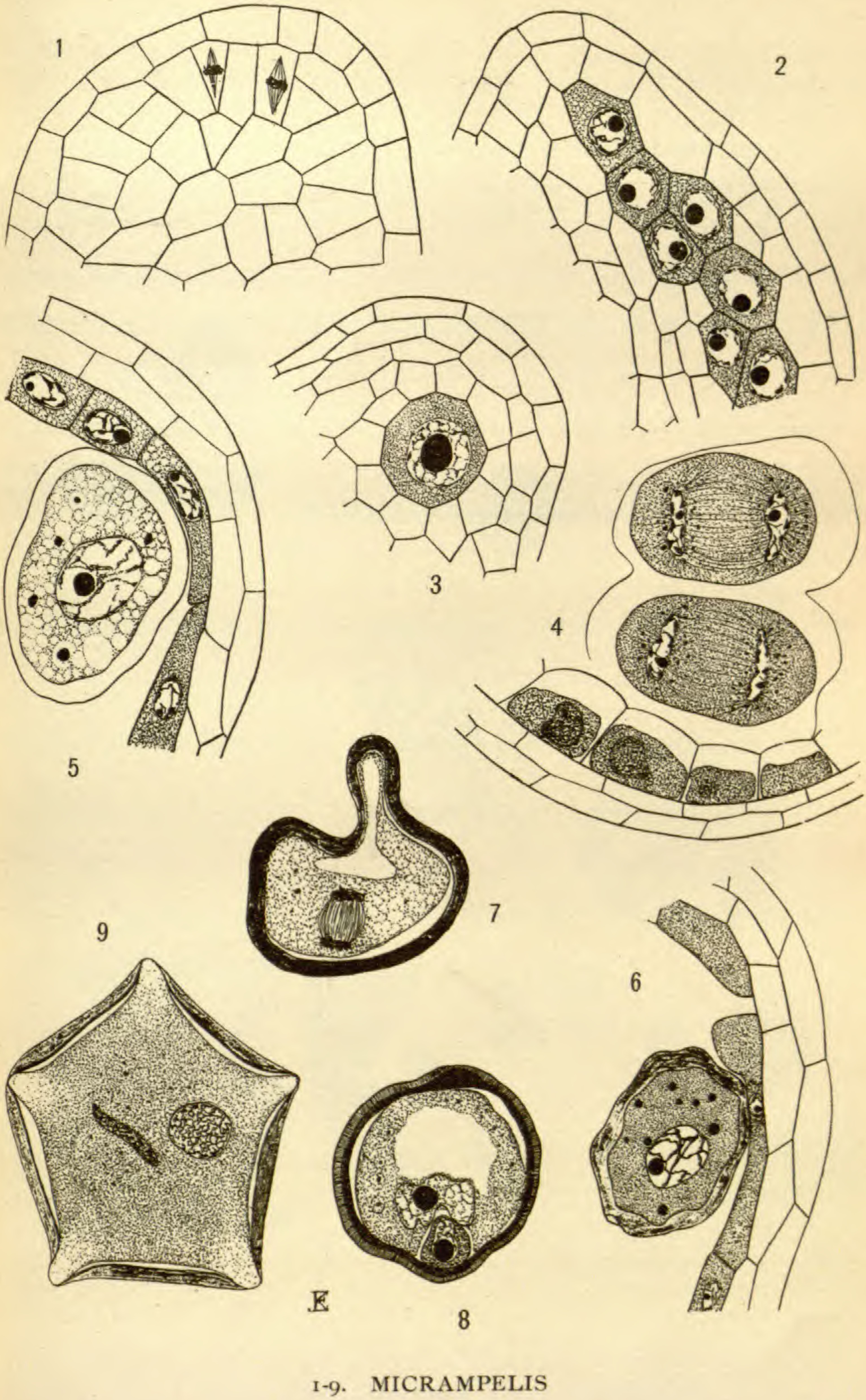
Warnstorf, O. Neue *Sphagna* aus Brasilien. Beih. Bot. Centralb. **20**^{2}: 128–130. 1906. [Illust.]

Description of 7 new species and 1 new variety.

Wheeler, W. M. An ethological study of certain maladjustments in the relations of ants to plants. Bull. Am. Mus. Nat. Hist. **22**: 403–418. *pl. 63–68.* 17 D 1906.

Whitfield, R. P. Notes on some Jurassic fossils from Franz Josef land, brought by a member of the Ziegler Exploring Expedition. Bull. Am. Mus. Nat. Hist. **22**: 131–134. *pl. 18, 19.* 26 My 1906.

Mentions a few fossil plants.



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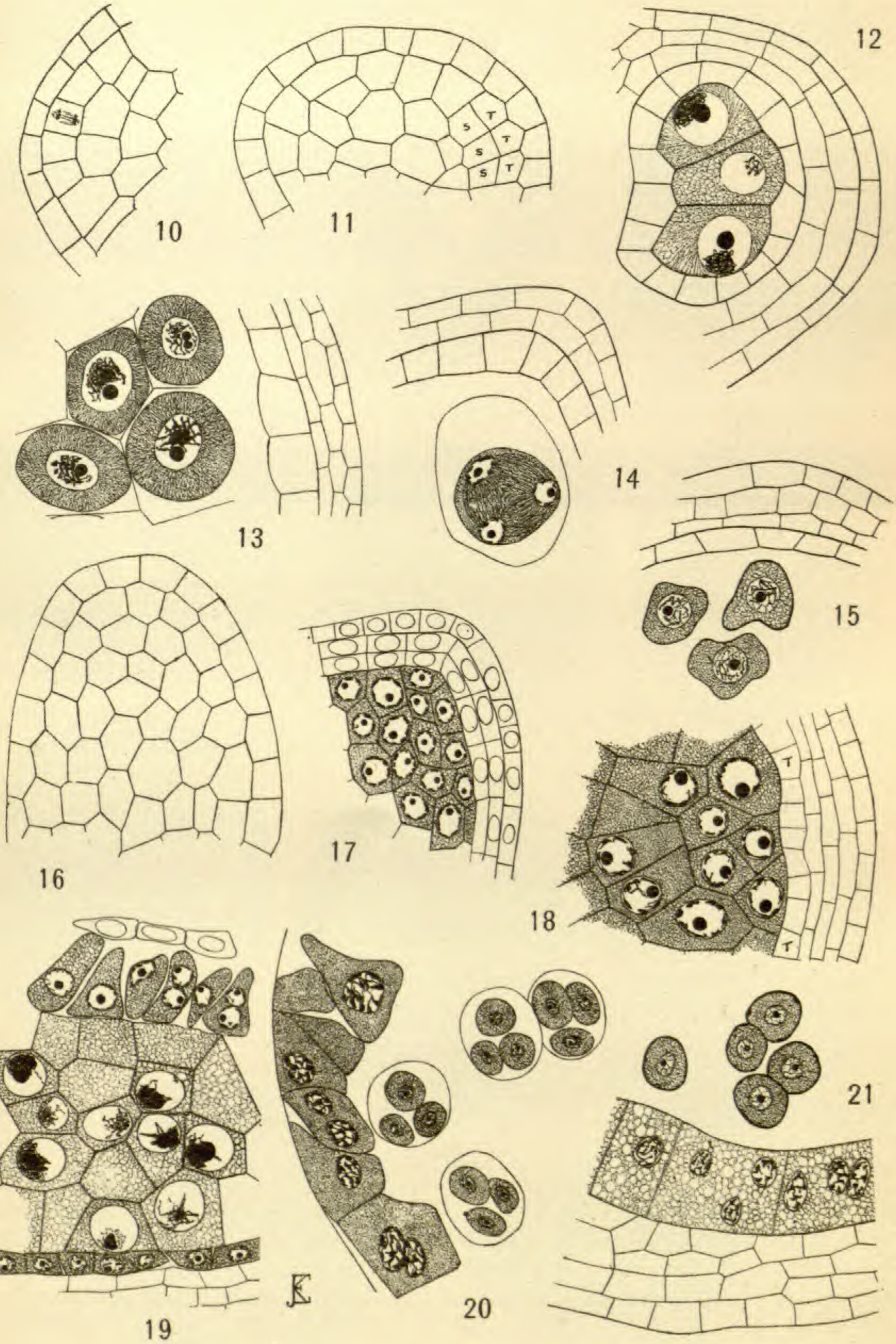

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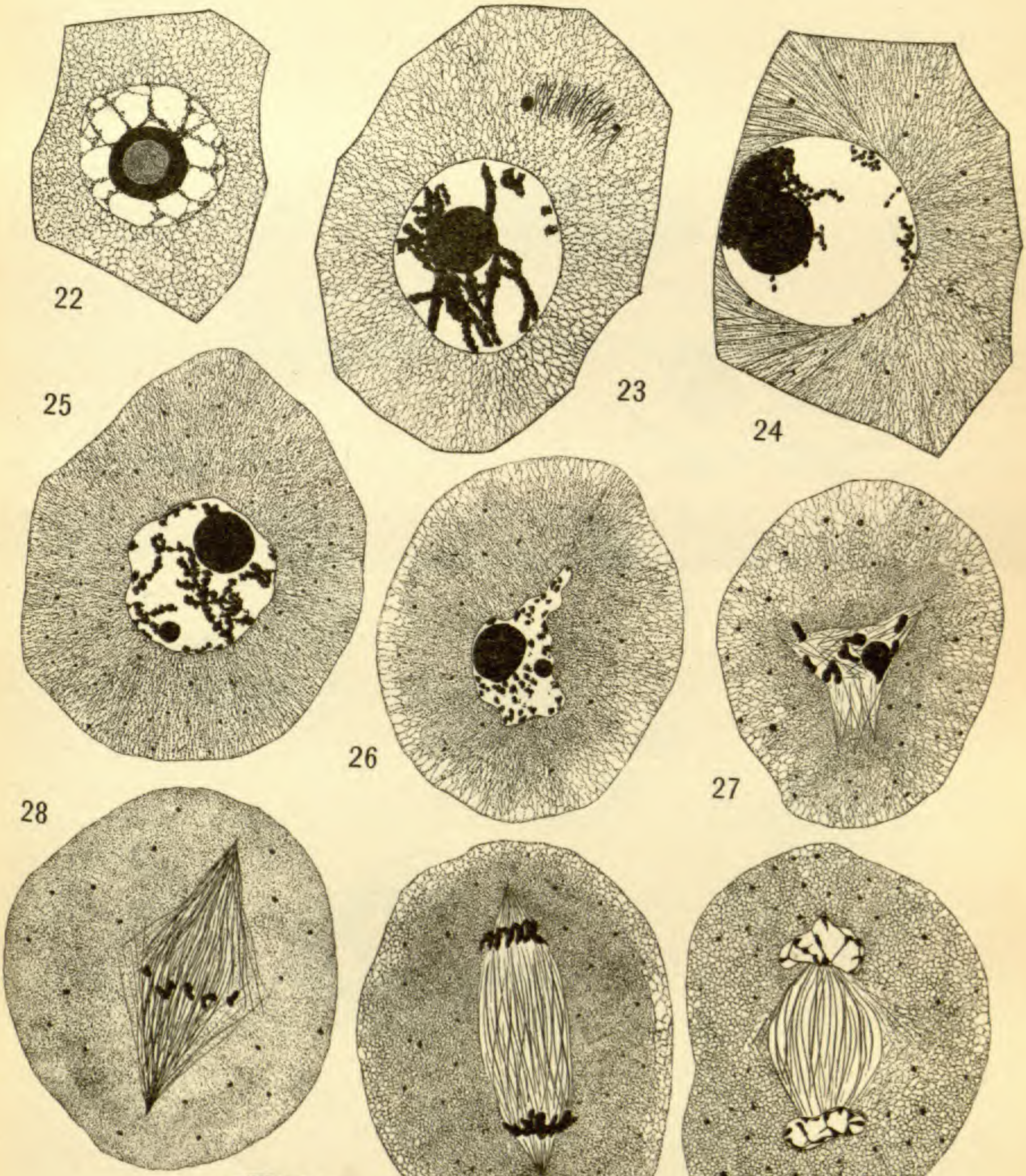

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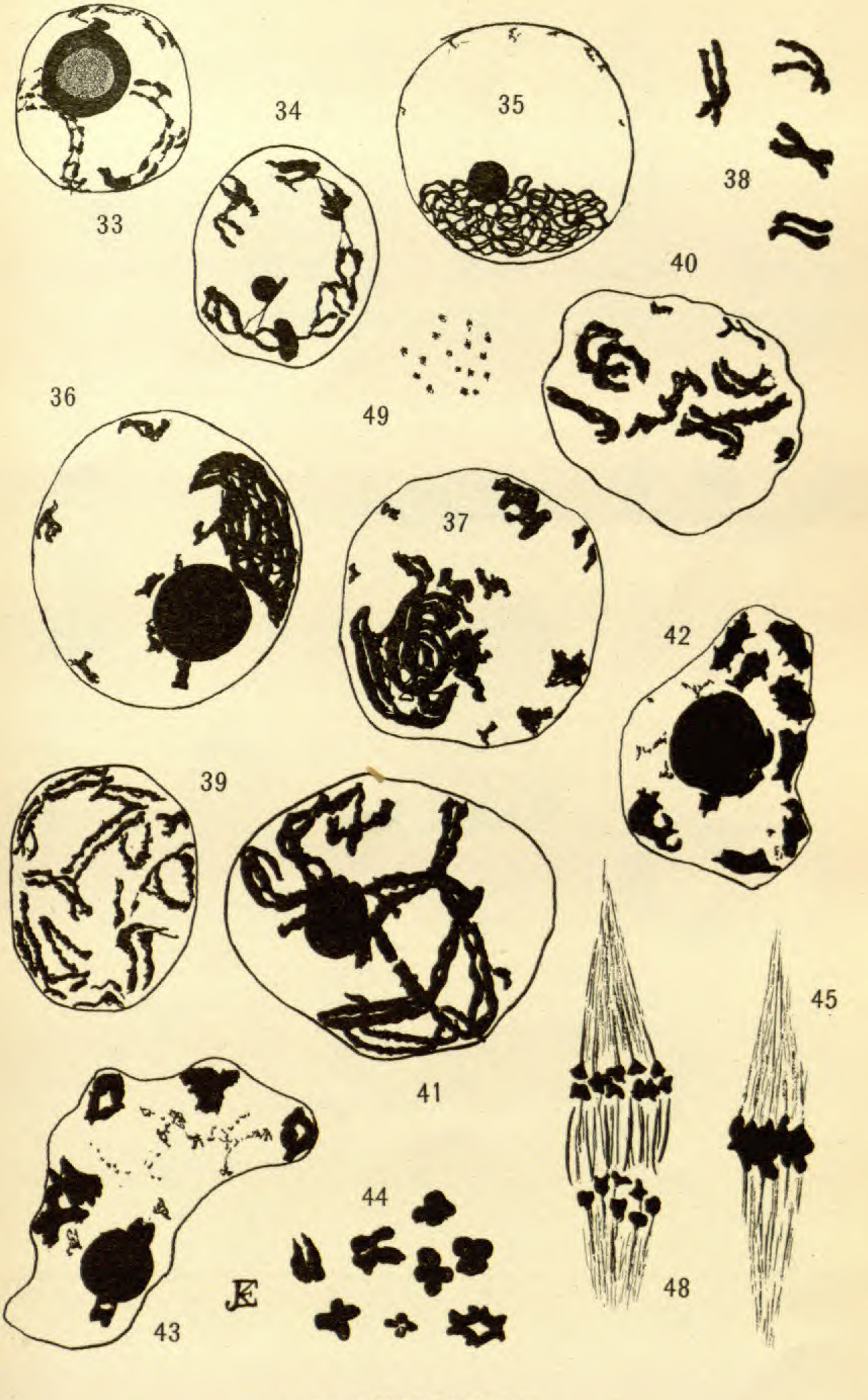

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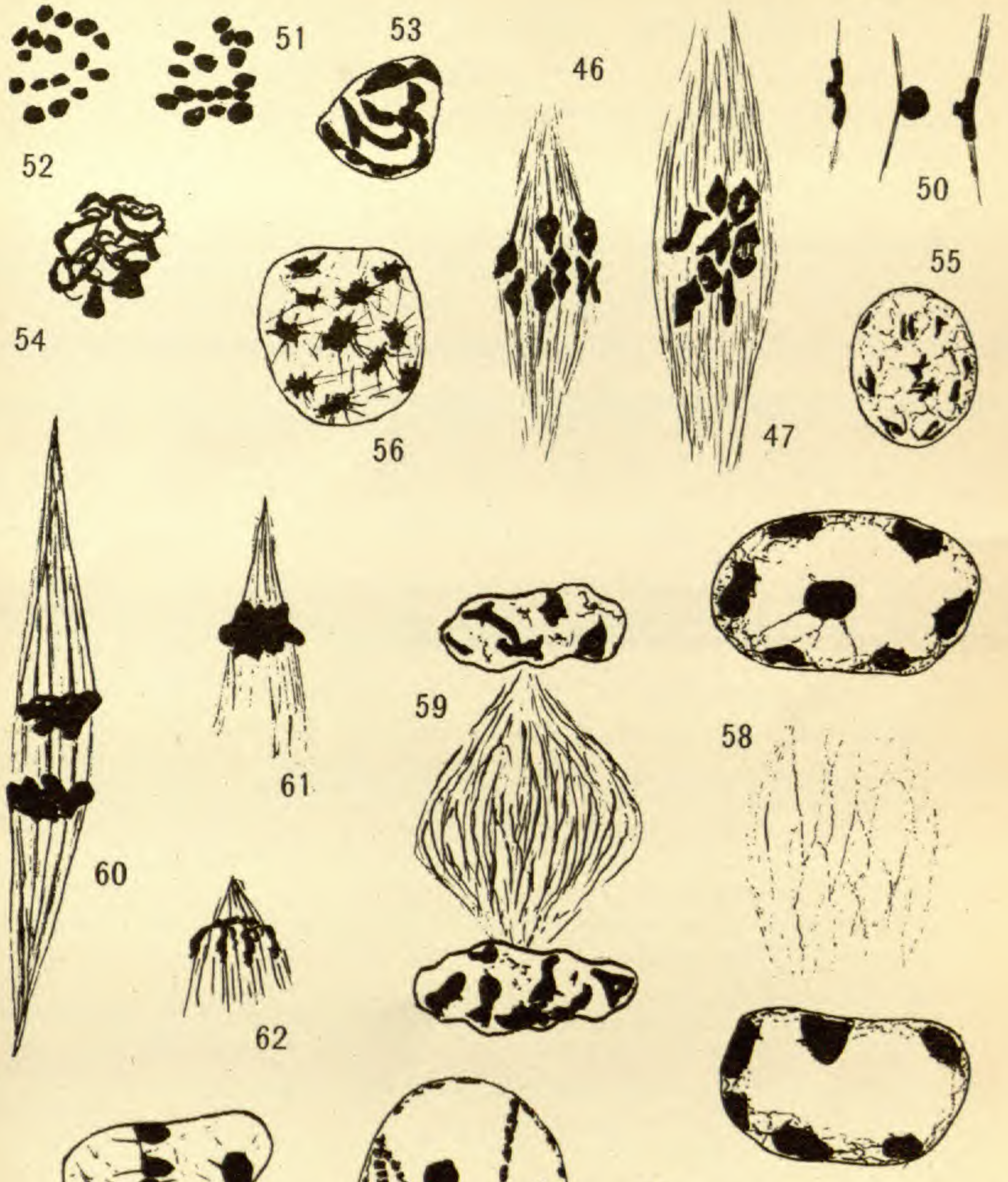

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Vol. 1, No. 4; price, 75 cents:

Sturtevant, Edward Lewis. On seedless fruits. Pages 141–187. 30 My 1890.

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Holm, Herman Theodor. Contributions to the knowledge of the germination of some North American plants. Pages 57–108, *plates 5–19*. 15 Ap 1891.

Vol. 2, No. 4; price, 75 cents:

Wheelock, William Efner. The genus *Polygala* in North America. Pages 109–152. 30 D 1891.

Vol. 3, No 1; not furnished separately:

Small, John Kunkel & Heller, Amos Arthur. Flora of western North Carolina and contiguous territory. Pages 1–39. 20 F 1892.

Vol 3, No. 2; price, $2.00:

Morong, Thomas. The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74*. 15 Mr 1893.

Vol. 3, No. 3; not furnished separately:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. [Part 1.] Pages 1–67. 28 Ap 1893.

Vol. 4, No. 1; not furnished separately:

Underwood, Lucien Marcus. Index *Hepaticarum*. Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

Small, John Kunkel & Vail, Anna Murray. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 93–201, *plates 75–82*. 18 N 1893–17 Ap 1894.

Vol. 4, No. 3; price, 50 cents:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

Vol. 4, No. 4; price, 50 cents:

Pettit, Anna Stockton. *Arachis hypogaea* L. Pages 275–296, *plates 83–85* 5 Je 1895.

Vol. 4, No. 5; price, 75 cents:

Rydberg, Per Axel. The North American species of *Physalis* and related genera. Pages 297–374. 15 S 1896.

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BULLETIN

OF THE

TORREY BOTANICAL CLUB

CONTENTS

The embryology of Rhizophora Mangle. (Plates 21, 22.) MELVILLE THURSTON COOK 271

The production of deleterious excretions by roots. OSWALD SCHREINER and HOWARD SPRAGUE REED 279

New species of fungi. . . . . CORNELIUS LOTT SHEAR 305

INDEX TO AMERICAN BOTANICAL LITERATURE 319

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BULLETIN

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JUNE, 1907

The embryology of Rhizophora Mangle

MELVILLE THURSTON COOK

(WITH PLATES 22 AND 23)

The peculiar habit of the mangrove (*Rhizophora Mangle* L.), of germinating the seed while yet on the tree, has attracted considerable attention, and it has been the subject for observation and investigation by a number of persons. The most important investigations on the embryology were made by Karsten * on this and related species and genera, and on species which have similar habit but are classed in entirely different families; but the results of his work on this particular species were very meager.

The study of this species presents many difficulties, and it was only after repeated efforts that the author succeeded in getting the preparations on which this paper is based. A few stages are missing, but since it is impossible for the author to secure more material at this time it was thought best to publish the results of the investigations.

In general it may be said that the picric acid killing and fixing agents were most successful, but the preparation which gave the best results was a mixture of 98 c.c. saturated aqueous solution of picric acid with 2 c.c. sulphuric acid.

Only one of the four ovules is fertilized (FIGURE 1), and this grows while the other three atrophy (FIGURE 13). The ovaries and ovules did not always increase in size with the same rapidity, so that it was not always possible to judge the age and condition of the internal structures by the size of the ovary or ovule, as will

* KARSTEN, G. Ueber die Mangrove-Vegetation im Malayischen Archipel. Eine morphologisch-biologische Studie. Bibliotheca Botanica, Heft 22 (5 : 1–71). 1891.

[The BULLETIN for May 1907 (34: 221–270, *pl. 17–21*) was issued 10 Jl 1907.]

be seen by a comparison of FIGURES 4 and 5, in which the smaller is the more advanced, or by comparison of FIGURES 21 and 22, in which the two structures are of about the same age. It was impossible to determine positively the origin of the archesporium, but it was apparently sub-epidermal (FIGURE 18). One or two tapetal cells are cut off, but whether they ever exceed this number or not the author is unable to say. Karsten figures two each in *R. mucronata* and *Bruguiera eriopetala* and one each in *B. caryophylloides* and *Ceriops Candolleana*. At this time the two integuments were just appearing (FIGURE 2). The archesporial cell enlarges with the enlargement of the nucellus, but the integument undergoes the most rapid growth (FIGURES 3, 19). The ovule continues to increase in size and the archesporial cell divides into megaspores. My only satisfactory preparation of this stage showed three megaspore-cells (FIGURE 20), but it is impossible to say whether this is or is not the regular number. Karsten figures four for both *R. mucronata* and *C. Candolleana*. The nucellus is always small as compared with the size of the ovule. My material was unsatisfactory for following the development of the embryo-sac; however, its formation results in the complete destruction of the nucellus (FIGURES 5, 21). Karsten figures the same condition in this species and in *Carallia integerrima*. In the eight-nucleate stage it was impossible to do more than work the details of the egg-apparatus (FIGURES 21, 22), which were in every way like the normal egg-apparatus. The author did not succeed in finding the polar nuclei or antipodal cells, but found what was apparently the primary endosperm-nucleus (FIGURE 23) lying in the micropylar end of the sac. It was impossible to follow the early divisions of the endosperm, but from this point the preparations were quite satisfactory.

EMBRYO AND ENDOSPERM

The growth of the ovule and ovary is now quite rapid. The embryo-sac increases in size both as a result of growth of the ovule and by destruction of the inner integument, so that we now have a sac enclosed only by the outer integument, filled with an enormous amount of endosperm, in the micropylar end of which is a small embryo (FIGURE 6). At this stage the other three ovules are in an advanced stage of degeneracy (FIGURE 7). The cells of the endosperm appear to radiate rather indefinitely from a central point in the sac (FIGURE 6). The growth of the embryo may be divided into three periods: (1) first growth of the cotyledons, (2) growth of the hypocotyl, (3) second growth of the cotyledons. The youngest embryo secured was pear-shaped with well-developed suspensor, but was not attached to the wall of the sac (FIGURES 6, 8). The suspensor persists until late in the development of the embryo (FIGURES 8, 9, 14). Apparently the embryo had originated as a series of cells in linear arrangement and developed in accordance with the capsella type. The only embryo of this species figured by Karsten is somewhat younger than this one but does not show a suspensor. The cotyledonary end of the embryo grows quite rapidly and is sometimes quite regular in outline (FIGURES 9, 11, 12) but more frequently is very irregular (FIGURE 10) and apparently very much crowded by the surrounding structures. At a point in the longitudinal axis of the embryo and not far from the suspensor, the cells are very small and very numerous (FIGURE 9, *x*). In a short time the separation of certain cells at this point gives rise to the plumule (FIGURES 10, 12, 24); this is only discernible in section. The cells on the side next to the root-tip are smaller, contain more protoplasm, and are apparently more active than those on the cotyledonary side (FIGURE 24). The endosperm is very thin but the cells of the integument which come in contact with it are very protoplasmic (FIGURE 25). This union between the endosperm cells and the integument is very close; frequently through shrinkage of the internal structures there would be a separation of cells, but this was usually within the integument and not between the cells of the endosperm and the wall of the sac (FIGURE 25). The growth of the cotyledonary part of the embryo results in the pushing of the opposite end of the embryo and part of the endosperm out through the micropyle, and they now lie within the cavity of the ovary (FIGURE 12). The endosperm over the surface of the cotyledons is now very thin, thus bringing them into close contact with the walls of the sac (integument) (FIGURE 12). The cells of that part of the endosperm which has been forced from the sac show a rather indefinite arrangement in rows extending obliquely from the surface of the embryo outward and upward towards the integument (sac), indicating that the growth of the embryo has exerted great pressure on them (FIGURE 12). Up to this time there has been very little modification in the surface cells of the cotyledons; they are more protoplasmic than the inner cells but otherwise not materially different (FIGURE 26). The growth of the cotyledons now almost entirely ceases and the second period of growth, or growth of the hypocotyl, begins. The hypocotyl grows very rapidly, pierces the apex of the ovary and forms the long pendulous structure, which is frequently eight or ten inches in length (FIGURES 14, 17). The plumule (FIGURE 15) and the vascular tissues of the cotyledonary structure which originated considerably earlier (FIGURE 10, *v.s.*) become more prominent and important. The entire cotyledonary structure undergoes considerable change; the cells appear to contain more protoplasm and stain more deeply. The surface cells and those near the surface become very much elongated with their long axis at right angles to the surface (FIGURE 27). All these modifications are probably for the increased activity of these cotyledonary structures, which undoubtedly absorb great quantities of food for the development of the long hypocotyl. At about this same time numerous masses or strands of very much elongated cells are formed, which lead from the surface cells to the vascular system of the cotyledons (FIGURE 16). A more careful examination of these strands of cells shows them to be of the same character as the vascular system (FIGURES 29, 30), and the author suspected that this system contained more or less sieve tissue but was unable to decide positively on that point. Just before the separation of the hypocotyl from the cotyledonary structure, traces of tracheary tissue (FIGURES 29, 30) appear but it is never very abundant. The endosperm over the surface of the cotyledonary structure becomes very thin with the corresponding slow growth of these organs during this period, and the cells of the integument (wall of sac) are very rich in protoplasm (FIGURE 28).

When the hypocotyl is about three inches in length, about two-thirds of the cotyledons are imbedded in the embryo-sac, and the remaining part in the ovary-chamber, surrounded by a thin layer of endosperm, while the hypocotyl projects through the apex of the ovary (FIGURE 17). As the embryo approaches maturity, the cotyledonary structure sets up a second growth which pushes the point of union between the cotyledons and the hypocotyl beyond the apex of the ovary. The cotyledons and the hypocotyl then separate and the hypocotyl drops, carrying with it the plumule; while the ovary, containing the outer integument (sac) and cotyledons, remains hanging on the tree.

It is very evident that the cotyledons perform an important function in supplying food to the growing hypocotyl. The disintegration of the nucellus and inner integument and the formation of the enormous endosperm are all important in the nourishment of the embryo during the early part of its development. This may be readily traced by comparing FIGURES 2, 3, 4, 5, 6, 12, and 17; first we have the beginning of the nucellus and both integuments (FIGURE 2) followed by an increase in size of the ovule in which the nucellus is very small (FIGURES 3, 4), then the disintegration of the nucellus to form the embryo-sac (FIGURE 5), the enlargement of the ovule and disintegration of the inner integument (FIGURE 6), a further enlargement in which about one-third of the embryo and a considerable part of the endosperm are forced out of the embryo-sac (inner integument) and lie in the chamber of the ovary (FIGURE 12), and lastly an elongation of the hypocotyl and diminution of the endosperm (FIGURE 17).

SUMMARY

1. Four ovules, but only one fertilized.

2. Archesporium probably subepidermal and cutting off two tapetal cells.

3. Megaspores probably four in number.

4. Completion of embryo-sac results in complete disintegration of the nucellus.

5. Further growth of embryo-sac results in complete disintegration of the inner integument and formation of a large amount of endosperm.

6. Embryo has easily recognized suspensor and is probably of the capsella type.

7. The growth of the embryo may be divided into three periods: (1) first growth of the cotyledons, (2) growth of the hypocotyl, (3) second growth of cotyledons.

8. During first period of growth about one third of the embryo and the greater part of the endosperm are forced out of the embryo-sac and lie in the chamber of the ovary.

9. The second period of growth is confined largely to the hypocotyl, but during this time the structure of the cotyledons undergoes great modification.

10. This modification of the cotyledons is undoubtedly for the purpose of absorption.

11. During the third period of growth, the cotyledons elongate and the point of union between them and the hypocotyl is forced beyond the apex of the ovary.

The greater part of this work was done in Cuba, but it was finished in the laboratory of the New York Botanical Garden. The material was collected at Mariel, Cuba, and herbarium specimens have been deposited in the herbarium of the said garden.

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Explanation of plates 22 and 23

Figures 1 and 17 are purely diagrammatic, made with the aid of a hand lens. Figures 6, 7, and 12–16 are semi-diagrammatic, made with the aid of a very low power lens in a compound microscope. Figures 2–5 and 8–11 were made with Spencer's 4/ ocular and 2 mm. objective. Figures 24–29 were made with Spencer's 8/ ocular and 4 mm. objective. Figures 18–23 and 30 were made with Spencer's 8/ ocular and 16 mm. oil immersion.

Fig. 1. Cross-section of ovary showing four ovules.

Fig. 2. Young ovule showing archesporium and origin of integument. (See Fig. 18.)

Fig. 3. Young ovule showing archesporium and integuments. (See Fig. 19.)

Fig. 4. Young ovule showing megaspore and integuments. (See Fig. 20.)

Fig. 5. Ovule showing disintegration of nucellus in the formation of the embryo-sac; also the integuments. (See Fig. 21.)

Fig. 6. Embryo-sac containing embryo (*e*), endosperm (*end*), somewhat shrunken and enclosed in the outer integument (*o. i.*), the inner integument having undergone disintegration. (See Fig. 8.)

Fig. 7. Atrophied ovule. Same age as figure 6.

Fig. 8, *a–f.* Embryo in serial sections showing suspensor (*su*). Same preparation as figure 6.

Fig. 9. Embryo showing suspensor (*su*), prominent cotyledonary structures and point of origin of the plumule (*x*).

Fig. 10. Embryo showing irregular cotyledonary structures (*cot*), plumule (*x*), and vascular system (*v. s.*).

Fig. 11. Tip of cotyledonary structure. About the same age as figure 10.

Fig. 12. Embryo (*emb*), surrounded by endosperm (*end*), and partially enclosed in the sac which is composed of the outer integument (*o. i.*).

Fig. 13. Cross-section of ovary showing the one fertile and the three sterile, degenerating ovules; embryo (*emb*), endosperm (*end*), and sac (*o. i.*). About the same age as figure 9.

Fig. 14. Part of embryo showing plumule (x), vascular system (*v. s.*), and suspensor (*su*).

Fig. 15. Part of embryo showing plumule (x) and vascular system (*v. s.*).

Fig. 16. Tip of cotyledon showing vascular system and connections with the surface.

Fig. 17. Diagrammatic drawing showing relation of parts; embryo (*emb*), endosperm (*end*), sac or outer integument (*o. i.*), and ovary (*o*).

Fig. 18. Archesporium and two tapetal cells. From same preparation as figure 2.

Fig. 19. Archesporium. From same preparation as figure 3.

Fig. 20. Nucellus and megaspores. From same preparation as figure 4.

Fig. 21. Embryo-sac showing egg-apparatus. From same preparation as figure 5.

Fig. 22. Egg and one synergid.

Fig. 23. Part of embryo-sac showing endosperm-nucleus and pollen-tube (*p. t.*).

Fig. 24. Plumule. From same preparation as figure 10.

Fig. 25. Endosperm (*end*), and part of the wall of the sac or outer intgument (*o. i.*). From the same preparation as figures 10 and 24.

Fig. 26. Surface of cotyledon. From same preparation as figure 12.

Fig. 27. Surface of cotyledon showing modified columnar cells. From same preparation as figure 16.

Fig. 28. Endosperm (*end*) and integument or wall of sac (*o. i.*). From same preparation as figure 16.

Fig. 29. Vascular system. Same age as figure 16.

Fig. 30. Vascular system showing formation of tracheary tissue. Same age as figure 29.

The production of deleterious excretions by roots*

OSWALD SCHREINER AND HOWARD SPRAGUE REED

It is our purpose to show in the following paper that the roots of certain higher plants may produce substances which have a deleterious effect. The undue accumulation of these substances is unfavorable for the growth of plants, and hence this study throws some light upon problems of soil conditions and ecological relations.

A number of typically unproductive soils from different parts of the United States have been under study in the laboratories of the Bureau of Soils of the United States Department of Agriculture for several years, and some of their properties are now understood. It has been demonstrated that many soils are unproductive, not because proper nutrients are lacking, but because they contain substances actually deleterious to plant growth.†

An aqueous extract of an unproductive soil, though containing nutrient materials, is often a poorer medium for the growth of plants than distilled water. Wheat seedlings will grow for about three weeks in good distilled water, but various experiments described in the publications just cited show that seedlings grown in the extract of an unproductive soil give a much poorer growth in both top and root, and the plants often die within two weeks.

When such an extract of a poor soil is treated with an insoluble, finely divided solid it loses its toxicity for plant development and gives (as might be expected) a better growth of plants than distilled water. The method usually followed is to add carbon black to the soil extract. The carbon black is stirred or shaken with the soil extract for a few minutes and, at the expiration of a half hour, filtered out. The carbon black contains no nutritive substances. It is practically pure carbon obtained by burning

* Published by permission of the Secretary of Agriculture.

† A great deal of evidence on this point has already been presented in Bulletins 28 and 36 of the Bureau of Soils, and a general presentation is given in Farmers' Bulletin 257 of the United States Department of Agriculture.

natural gas and collecting the separated carbon on cool surfaces. It acts by absorbing part of the soluble matter from the soil extract, a power which it possesses to a remarkable extent, by virtue of its enormous surface. The growth of plants in the extract after treatment with carbon black, ferric hydrate or other absorbing agents, is usually greatly increased. The conclusion logically follows that the retarded growth in the original soil extract is due to the presence of some substance or substances actually detrimental to plant development and not to the absence of beneficial nutritive substances.

This experiment is typical of a great number of experiments, employing various unproductive soils. In many cases the growth of plants was greatly improved by diluting the extract with distilled water; in other cases by brief boiling, or by distillation, the toxic properties being found in the distillate. Without dwelling here at length upon the exact data derived from such experiments, it may be said that they agree in showing that the unproductiveness of those soils was due to the presence of substances which exerted a toxic action upon plants. It was also shown that the toxic effect in the soil extracts could be overcome in various ways.

Experiments upon the diminished yields of succeeding crops have given results which indicate that the harmful effect of continuous planting of the same crop may be due to the production of deleterious substances. Many, perhaps a majority, of investigators have assumed that the diminished yield of a second crop is the result of the depletion of the plant nutrients by the first crop. There is now evidence from a number of sources that an important factor in causing diminished yield is the presence of substances detrimental to plant growth. An experiment giving evidence on this point has been described by Livingston ('05) in which wheat was planted in a series of five pot cultures of clean glass sand, simultaneously with five other pot cultures planted in glass sand which had previously grown wheat for twenty-one days. The two series were subjected to the same conditions and growth was measured by the amount of water which the plants transpired. The growth of the plants in the "exhausted" sand was about 45 per cent. of that in fresh sand. In the same experiment the effect of a good absorbing agent was tried. Ferric hydrate was added to five pots of "exhausted" sand in which wheat was planted. This good absorbing agent renovated the sand to such an extent that the growth of wheat in it was only 6 per cent. less than that in the fresh sand. It would be obviously incorrect to assume that the decreased growth of wheat in the sand was due to the depletion of nutrients. Neither can one maintain that the beneficial action of ferric hydrate consisted in supplying nutrients. The only explanation is that the ferric hydrate had a strong absorbent action upon some substance, or substances, which were toxic to the second growth of wheat and which had resulted from the growth of the first crop.

Facts like those cited above give indications that the toxic condition of unproductive and "exhausted" soils may be caused by some substances excreted from the roots of plants. These indications are further supported by the results of all experiments upon the nature of the toxic substances. Up to the present time they all indicate that the toxic substances are organic, and not inorganic, bodies. It has been shown, for example, that the extract from a poor soil may often be benefited by incineration or mere charring of the organic matter present in the residue obtained by evaporating the soil extract, and redissolving it in pure water. When plants are grown in such solutions they show marked improvement over those grown in the original extract. In an experiment described in Bulletin 28 of the Bureau of Soils (p. 29 ff.), 24 wheat plants grown in such a solution showed an increase of 25 per cent. in growth over a control in the original extract. Here there has apparently been a destruction or an alteration of the substances which were previously detrimental to the growth of plants.

Turning to the literature, it will be seen that there are numerous instances in which deleterious excretions have been demonstrated in the lower plants, but in the higher plants there appear to be no definite proofs that such excretions are produced.

Among the earlier botanists there prevailed an idea that roots excreted waste matters. Such ideas were a logical outgrowth of the efforts of their time to correlate the structures and functions of plants with those of animals. Brugmans ('89) alleged that he had observed small drops to exude during the night from roots of *Viola arvensis* growing in pure sand in a transparent dish. He even stated that he had observed small fragments of material at the extremities of the roots of certain other plants, which he believed to have been exuded from the roots. His observations rest upon what must now be regarded as insufficient evidence and appear to have been made without any of the precautions necessary for a scientific experiment.

The idea that roots excrete waste matters was promulgated by von Humboldt and by de Candolle and by them given prominence in explaining natural plant associations and crop rotations. It is interesting to note that de Candolle ('32, 3: 1480) stated his belief that the cockscomb and other noxious weeds injured the neighboring plants by some excretion from the roots. It is a matter of common knowledge that de Candolle used his theory of root excretions as a basis for explaining the benefits of crop rotations. He reasoned that the excreta from the roots remaining in the soil would be harmful if the soil were again planted to the same crop; but that, if a different species were planted, it would receive very little harm from the excreta of the previous crop, and even possibly might be benefited by them. Plenck ('94) and Macaire-Prinsep ('32) also endorsed the idea of root excretion. Macaire-Prinsep made an experiment from which he and others drew incorrect conclusions. By separating the roots of a plant into two groups, one of which was placed in a flask containing pure water and the other in a flask containing a solution of sodium chloride or lead acetate, he found that traces of the solute could be detected in the flask originally containing pure water. He believed that the roots in the solution had taken up dissolved matter which had been again actively exuded by the roots. His work was criticised by Braconnot ('39) and Unger ('36), who showed that his results were due to the capillary action of the roots, aided, no doubt, by the siphon which they formed. Walser ('38) and Braconnot ('39) attempted to detect excretions by examining the medium in which plants of the *Papaveraceae* had grown. They believed that it would be possible to demonstrate the presence of opium-like bodies in the medium if the roots produced excretions. Without recognizing the fundamental error of such an attempt they interpreted the failure of their analysis to mean that no excretions were produced by roots. They deserve credit, however, for showing that Brugmans had entirely misinterpreted the death of the root hairs and the peeling off of the outer layers of the root by assuming that this material was solid excretion from the living root. Nevertheless, several years later Gasparrini ('57) made the absurd statement that he had observed that the root hairs had small lids which opened and emitted secretions.

After the earlier work had been shown to be ill-founded by the investigations of Walser and Braconnot, that line of investigation was given up, and it is only within recent years that any data have been presented on deleterious root excretions.

Newcombe ('02), in describing the growth of roots in closed glass tubes containing water, says that the roots suffered distortion after 12 to 15 hours when the temperature was 23° C. or over. He referred the distortion to a possible lack of oxygen or to the accumulation of root excretions.

Livingston ('05) described an experiment which indicated quite distinctly that toxic substances may arise during growth. The experiment consisted in placing an absorbent agent (carbon black) in a synthetic nutrient solution and measuring the growth of wheat plants in it. The plants from the nutrient solutions containing carbon-black grew 27 per cent. more than the control plants in a solution in which carbon-black was lacking. In the solutions containing ferric hydrate the growth was increased 33 per cent. In another experiment, water redistilled from potassium dichromate and sulphuric acid and from alkaline potassium permanganate was used, the distillates being condensed in a platinum tube. The addition of ferric hydrate to part of the cultures produced an increase of growth (measured by transpiration) amounting to 34 per cent. The conclusion was there drawn that the roots of seedling wheat plants do give off substances which are poisonous to themselves, and that these substances can be removed or corrected by carbon-black or ferric hydrate.

Indirectly there has been gathered some very good evidence upon this point by investigators who have studied the antagonism between different species.

The Woburn Experiment Station ('03) has reported a detailed study of the antagonism existing between the roots of grass and those of fruit trees. They found that the grass roots had an actively malignant action upon the tree roots which could only be due to some action similar to that of direct poisoning.

Jones and Morse ('03) reported a remarkable case of antagonism between the butternut, *Juglans cinerea*, and cinquefoil, *Potentilla fruticosa*. The *Potentilla* was often killed under and around the butternut trees on a circle of fully twice the diameter of the tree top. *Potentilla* grew vigorously beneath other species of trees without any injury. They found that wherever the *Potentilla* was killed or dying its roots were intertwined and in close relation to those of the butternut trees. The death of the *Potentilla* seemed to be caused by some relation to, or effect from, the roots of the trees.

Another illustration of the antagonistic action of one plant upon another has been given by Jensen ('07), who studied the effect of tree roots upon wheat under experimental conditions. He found that the action of the tree roots had a remarkably depressing effect upon the growth of wheat. The harmful effect was especially marked with certain trees like *Pinus* and *Acer*, while others like *Prunus* were less harmful. The growth of the wheat was most retarded during the summer season when the trees were physiologically active. When, in the autumn, the trees became dormant, the growth of wheat was much improved.

An examination of the literature dealing with the growth of the lower plants shows that different workers have found that the growth of these plants often gives rise to unfavorable conditions in the surrounding medium. Some typical and instructive examples are described by Pfeffer in his *Physiology of plants* (1 : 512; English translation by Ewart).

Bacteriology has demonstrated quite clearly that deleterious substances are formed during the growth of cultures. Eijkman ('04) has studied the reaction of the waste products of a number of bacteria upon the same and other species. He found that the organisms produced without exception thermolabile substances which inhibited growth. The inhibiting substances were diffusible but could not be filtered through a porcelain filter; they were destroyed when heated to a temperature at which the organisms were killed. The waste products of a given species were usually more toxic to that and closely related species than to those species more distantly related.

Eijkman's results are confirmed by the recent work of Rahn ('06) on other bacteria. Rahn finds a thermolabile toxic substance which is absorbed by freshly heated clay filters so that a piece of recently heated clay saturated with old bouillon was quickly covered by a growth of organisms. The toxic substance was also destroyed by diffuse light.

The work of Emmerlich and Loew ('99) and other investigators on the action of bacteriolytic ferments and their toxic action on the bacteria of many infectious diseases, involving the preparation of antitoxins and their use in medicine, is of the greatest interest in this connection as showing that the products of bacterial life are poisonous to the living forms of a similar or related species.

Experimenters upon chemotropism have found that the growth of fungus hyphae is not always in the direction of nutrient materials, but they will sometimes grow into toxic substances. Clark ('02) found that the hyphae of *Rhizopus* would grow from a layer of rich nutrient agar into a layer of non-nutrient agar containing 0.005*N* copper sulphate. Fulton ('06) working on the same subject has clearly demonstrated that the hyphae grow in any direction that will carry them out of a region already occupied by numbers of hyphae. He showed that the repelling substance remains in the solution in which the fungi have grown, and that it is not carbon dioxide. The results of the two last-named authors agree in indicating that the fungus hyphae are negatively chemotropic to some substances which they secrete and this negative chemotropism is much greater than any positive chemotropism they may have for nutrients or oxygen.

According to Ferguson ('02) the germination of certain mushroom spores is greatly facilitated when a small bit of living mushroom tissue is included in the culture, but the further development of hyphae from these spores is almost completely inhibited. When the spores which have been germinated are transferred to cultures in which there are no pieces of tissue a continuous development of hyphae takes place. This observation would seem to indicate that the pieces ot living tissue exerted some influence which inhibited further growth and that its inhibitory effect was first felt by the delicate germ-tubes.

Wehmer ('91, '06) has demonstrated that certain of the fungi do produce a very toxic substance, namely, oxalic acid.

PLAN OF THE EXPERIMENTS

One general feature of the foregoing work upon excretions has been the indication that the amount of substance excreted is very small. The removal of toxic substances by the use of a small amount of absorbing material or by momentary boiling are evidence that refined methods are necessary in their investigation. The amount of toxic substances present is so small that an ordinary chemical analysis of the soil does not give evidence of them.

The assumption on the part of Braconnot ('39), Walser ('38), Boussingault ('41), and others that these substances existed in sufficient amounts to be detected by ordinary analysis was a fundamental error, which kept other workers from investigating their nature and action. At the same time there is evidence which cannot be overlooked that the plant is sensitive and does respond to the presence of deleterious substances. The following experiments were therefore so planned that the plant itself could be used as an indicator of the excretion of deleterious substances from its roots.

For indicating the presence of a small amount of deleterious material, the rate at which the root of a plant elongates is not entirely satisfactory. Experiments like those of Lilienfeldt ('05) and especially those of Fulton ('06) show that the chemotropic behavior of an organism can be depended upon to indicate the presence of small amounts of deleterious substances. Seedlings of wheat and oats (*Triticum vulgare* and *Avena sativa*) were used as indicators in most of the experiments, since it was found that their roots were chemotropically sensitive to the deleterious substances studied. The wheat seedlings used were germinated in water by a method devised in the laboratory of the Bureau of Soils, and described by Livingston ('06). The seedlings germinated by this method were remarkably uniform, and their roots were straight and free from any adhering particles. The design of the experiments included a study of the behavior of the roots of wheat seedlings in the presence of excreta from plants of the same and other species. The latter experiments employed seedlings of corn (*Zea Mays*), cowpeas (*Vigna Catjang*) and oats (*Avena sativa*).

For the purpose of making investigations upon the chemotropic behavior of roots it was necessary to employ a medium which was as nearly non-nutrient as possible. In the first experiments clean quartz sand was used as a medium in which to grow the plants. Owing to the difficulty of filling the tubes of small diameter and the necessity (described below) of rotating the cultures, the sand was not suited to the purpose of experimentation. After some preliminary tests, agar agar proved to be a very satisfactory medium to serve as a substratum. The fibers of agar agar were soaked in one or two changes of distilled water at room temperature to remove the slight amount of soluble matter present. The agar agar was then melted by boiling it in distilled water in the ratio of 2 parts of agar to 100 of water. The melted agar was filtered through absorbent cotton and gave a preparation which remained clear when reheated. The agar was poured out and allowed to cool to 30°–35° C. at which temperature it was just beginning to harden. The roots of the seedlings were put in at this time and were firmly held when the agar became set. In agar prepared in this manner the root system developed in a perfectly normal manner. The roots were clean and white, and showed no distortion nor swellings as they do in unfavorable media. The behavior of the roots could be noted at any time through the transparent agar jelly. The glass receptacles in which the seedlings grew were always covered with black paper to exclude light. Since the agar jelly contained about 98 per cent. of water, the plants were able to obtain an ample supply for growth. Small quantities of distilled water were added daily to keep the surface of the agar moist and to prevent the formation of fissures.

The remarkable freedom of the agar from growth of moulds and bacteria showed how free it was from substances which might serve as nutrients. Although the jars containing the agar cultures stood open from 4 to 10 days they were very rarely infested with moulds or bacteria and the few plants that were thus infested were discarded * from the results.

* *Vide infra* for experiments eliminating bacteria.

PRELIMINARY EXPERIMENTS

The first experiments were designed to perfect a method of using the plant so that it would serve as an indicator of the deleterious root excretions, if such substances were produced.

FIG. 1.

Several sorts of perforated tubes of glass and mica were tried; in the end it was found that more satisfactory results were obtained from the use of glass tubes having an internal diameter not greater than 1 cm. The best results were obtained from the use of segmented glass tubes, having small openings between the segments (FIGURE 1). The tubes were made from glass tubing having an internal diameter of 6 or 8 mm. Pieces of tubing 10 cm. long were closed at one end by fusion. Each of these pieces was then cut into three nearly equal lengths. These three segments were then bound to a glass rod, leaving a space of two or three mm. between adjoining segments. They thus formed a straight segmented tube with narrow openings about one-third of the distance from the top and bottom respectively.

The segmented tubes were placed in a vertical position in small glass jars, the fused ends of the tubes resting on the bottom of the jar. Pure non-nutrient agar, which had been washed in three changes of distilled water and melted in distilled water, was poured into the jars until its level reached the tops of the tubes. When the agar had cooled to a temperature between 35° and 38° C., the roots of a wheat seedling three days old were inserted in the open, upper end of each segmented tube.

The design of such an arrangement was to enclose the growing roots in a small space in which the toxic excretions would be confined. At the same time, it provided at intervals small openings through which there would be some diffusion of the toxic products to the exterior. When the growing roots reached one of these regions from which diffusion was taking place, they would have a chance to respond to this unequal distribution of the deleterious substances. Such response would be plainly manifested by the growth of the roots toward regions where deleterious substances were less abundant. In other words, the roots might curve and grow out of the narrow openings between adjoining segments of the tube.

The first experiment employed a total of 26 roots. The jars containing the tubes and seedlings were wrapped in black paper and stood in a well lighted portion of the laboratory. At the expiration of 6 days, it was found that 14 of the roots had turned from their normal downward course and grown out through the narrow openings into the surrounding agar. The experiment was repeated three times, using a total of 90 roots, 48 of which grew out of the tubes through the narrow openings. It will be noted that this is a response of 53 per cent. of the roots employed.

Since the wheat roots are positively geotropic and possess thereby a natural tendency to grow vertically downward, it must be assumed that there was some definite stimulus acting at the narrow openings of the segmented tubes which caused them to curve and grow out. The roots in these and later experiments showed no distortion nor traumatic curvatures. They always grew straight until reaching the openings through which they passed out into the surrounding medium.

It seems justifiable, therefore, to conclude that their curvature was a response to the presence of some substance or substances to which they were negatively chemotropic. Inside the narrow tube these substances were comparatively concentrated, but at the narrow openings the deleterious substances had partially diffused toward the exterior. When the roots reached the regions from which diffusion had taken place they responded by curving and growing out of the tubes. The same phenomenon of diffusion will explain why the roots did not find the agar in the lower part of the tubes as favorable for growth as that outside the tube.

The following experiment may be cited in further support for the above statements:

Several jars containing melted agar, which had cooled to 36°–38° C., were thickly planted with wheat seedlings. In a few days the roots of the seedlings completely permeated the masses of agar, they were allowed to grow for a week longer and then carefully pulled out, removing as little agar as possible. The agar was melted over a steam bath at a temperature of 70°–80° C., filtered through absorbent cotton and poured into clean jars.

Controls were set up simultaneously which contained freshly prepared agar. Each lot of jars received a set of segmented glass tubes and when the agar had cooled to the proper temperature, wheat seedlings were inserted in the open ends of the segmented tubes. If the foregoing hypothesis regarding the presence and diffusion of toxic waste products be true, one would expect fewer roots to leave the segmented tubes when they were surrounded by a medium which already contained the waste products, because there would be a more equal concentration of them throughout the entire medium. This is precisely what was observed. Of 23 roots which grew in the used agar, only 8 curved and grew out of the tubes. Of 13 control roots, 7 turned and grew out of the tubes.

Do the roots in the tubes curve because of an insufficient supply of oxygen? There might be some doubt as to whether part of the response might arise from a deficient supply of oxygen in the small tubes, and the question "Do the roots in the tubes curve because of a possibly insufficient supply of oxygen?" naturally presents itself. The evidence obtained by Bennett ('04) is entirely against such behavior. The author just mentioned made very careful and exhaustive experiments with the roots of land plants, but was unable to find any evidence whatever that direction curvatures could be induced by the one-sided application of such gases as oxygen or carbon dioxide. It was deemed desirable, however, to test the roots of wheat seedlings in the experiments under consideration. A number of segmented glass tubes were set up in jars of freshly prepared agar and a wheat seedling placed in the upper end of each tube. When the agar had become partially solidified, air bubbles were produced by manipulating a glass tube in it. The bubbles were formed at the surface of the segmented tubes and at the level of the narrow openings. When the roots grew downward, they showed the usual curvature at the openings. They did not, however, show any tendency to grow toward the air bubbles, nor to the agar in the vicinity of the air bubbles. Many roots grew directly through air bubbles and passed on without being deflected from their course by the presence of air bubbles. It would be manifestly wrong to base judgment on this question if the roots passed from the agar in the air bubble and remained there, since the environment would be changed in respects other than air content. One might expect, however, that if an aerotropic tendency were manifested it might be shown by roots turning toward the agar in the vicinity of the air bubbles. Such a tendency was not manifested by roots in this or other experiments where air bubbles were present, hence it follows, that the results reported are really due to a stimulation of the roots by some deleterious substance and not to a deficiency of oxygen.

The behavior of the roots of oat seedlings in the presence of their own excreta. — For comparison with the behavior of the roots of wheat seedlings a series of tubes was prepared which held oat plants. The segmented tubes contained and were surrounded by freshly prepared agar. The experiment lasted 6 days. The agar in the tubes became so toxic that 13 of the 39 roots employed were killed. Of the remaining roots, 19 curved and grew out of the tubes. This is a response of 73 per cent. (the roots killed not being considered), and shows that the roots of oat seedlings produced a toxic condition which was quite repellent to themselves. In all cases it was the later roots which were killed. The roots which grew out into the surrounding fresh agar showed no signs of injury.

Experiments in which malic acid was added to the culture medium. — Continuous observation of the agar in which plants were grown spoke against the action of the bacteria as a partial factor in producing the results. Nevertheless it was thought profitable to make an experiment in which bacteria were excluded.

After some preliminary experiments which showed that wheat seedlings could tolerate malic acid, a quantity of wheat seedlings were grown in agar which contained 125 parts per million of malic acid. While this amount of acid was not sufficient to inhibit the growth of wheat roots, it reddened litmus paper instantly, and it is safe to assume that bacteria did not develop in such preparations. Part of the segmented tubes contained this agar in which plants had been grown and the others were surrounded by it.

Fifteen roots grew in segmented tubes containing fresh agar and surrounded by used agar. Of this number only four roots grew out into the used agar. Thirty-three roots grew in segmented tubes containing used agar and surrounded by freshly prepared agar. Sixteen of these roots curved and grew out of the tubes into the freshly prepared agar. The proportion of the response is 56 : 100, which is almost precisely the proportion obtained where no precautions were taken to exclude bacteria. Hence it is believed that the results related in this paper are not induced (although they may be modified) by the action of bacteria.

Experiments in which the attractive effect of gravity on the roots was neutralized. — It is evident to anyone familiar with the growth of roots that the positive geotropism, inherent in the wheat roots would hinder their lateral curvature and growth out of the tubes. The responses which have been thus far obtained are therefore the resultant responses to these two stimuli. One might expect that a root which was only feebly stimulated by the presence of the deleterious substances might be more strongly stimulated to grow downward by the attractive force of gravity and hence show no response. The action of gravity cannot be eliminated but it can be neutralized by revolving the plants so that all sides are equally stimulated. Accordingly in the subsequent experiments the preparations containing the seedlings were rotated by attaching them to the arms of a klinostat driven by a small electric motor. The dial which supported the arms was 25 cm. in diameter and revolved once in two minutes. The construction of klinostat and general method of use were similar to the type previously described by Reed ('03).

In all the following experiments the segmented tubes were contained in glass vials 10 cm. long and 2.5 cm. in diameter. The vials were attached to the arms of the klinostat in such a way that they revolved in a plane perpendicular to their long axis. One wheat seedling was placed in each segmented tube and each experiment lasted several days.

Three experiments were performed using freshly prepared agar. Out of a total of 47 roots, 31 curved and grew out of the segmented tubes, a response of 66 per cent. The response in similar tubes which had not been rotated had been 53 per cent.

Summing up the results of these experiments, it appears that the roots of wheat seedlings are repelled by some deleterious substance or substances produced during growth and that a satisfactory means of demonstrating the same is by the use of segmented glass tubes. Evidence is displayed to show that the curvature of the roots is not due to the action of light, of gravity, of water, nor to a lack of oxygen. Since the medium employed as a soil is as nearly as possible non-nutritive, the question of plant nutrients does not complicate the study. When the effect of gravity is neutralized, a larger proportion of the roots respond to the stimulus produced by the presence of toxic excreta.

EXPERIMENTS SHOWING THE BEHAVIOR OF WHEAT PLANTS GROWING IN A MEDIUM CONTAINING THE EXCRETA FROM THE ROOTS OF WHEAT OR OTHER PLANTS

With the foregoing results in hand, the next problem was to study the behavior of one plant in the presence of excreta from various other plants. Wheat was selected as the plant to be employed as an indicator, since the roots which it puts out after the short life of the primary root are positively geotropic and sufficiently sensitive for chemotropic reactions.

It was shown in the preliminary experiments that the toxic effects remained in the agar in which the plants had grown. It was also shown that the toxic effects persisted when such agar was melted and used again. In the experiments which are next to be described the effects of root excretions from wheat, corn, cowpeas, and oats were studied. The agar containing their excretions was obtained in each case by planting a large number of seedlings in a dish of soft agar and allowing them to grow for 8 to 15 days, according to the plant employed. In a few days the agar was completely permeated by the roots of the plants, the plants being nourished in the meantime by the reserve materials of the seed. When the agar was to be used for experiment the plants were pulled out, removing as little agar as possible. The agar was then placed in a shallow, covered dish on the steam-bath, stirred and heated to 75–80° C. Continued heating at a high temperature changes or destroys the toxic substance; even at this temperature some of the toxic effect was probably lost. As soon as the agar was completely melted it was filtered through absorbent cotton into the desired receptacles and cooled to room temperature. Distilled water was added to restore that lost by evaporation.

The following series of experiments were so designed that the used agar was tested against freshly prepared agar, the segmented glass tubes being filled with one and surrounded by the other. The mode of procedure was as follows: Clean segmented tubes were placed in a jar of liquid agar and when it had cooled to the proper temperature a seedling was placed in the mouth of each tube. When the agar had hardened throughout the entire jar, the tubes could be removed without disturbing the seedling or losing any agar from the tubes. The tubes were transferred to vials containing the other sort of agar which had cooled to a temperature between 30° and 35° C. When this agar was completely hardened, the vials were wrapped in black paper and put upon the klinostat. The quantity of agar in which plants had grown was always separated into two portions, one of which was used within a set of tubes and the other portion without another set of tubes. This procedure made each set of results a control on the accompanying results. Thus, the experiments designated under each heading as "a" constitute a check against those designated as "b" and *vice versa*.

WHEAT SUCCEEDING WHEAT.

(*a*) *Wheat plants in tubes containing fresh agar and surrounded by agar in which wheat had been grown.* The used agar was obtained and prepared in the manner outlined above. Five experiments were conducted comprising 89 roots. The details are given in the accompanying table.

Experiment No.	Roots Capable of Responding.	Roots Which Grew Out of Tubes.	Per Cent. Response.
1	8	0	0
2	22	12	55
3	12	2	16
4	32	13	40
5	15	4	26

Average for the five samples of agar, 27 per cent.

It will be noted that an average of only 27 per cent. of the roots which grew as far as to the first opening in the tube, turned and grew out into the surrounding agar, in which wheat plants had previously grown, as against 66 per cent. when fresh agar was also used on the outside, as in the experiment already described.

(*b*) *Wheat plants in tubes containing agar in which wheat had* *been grown and surrounded by fresh agar.* The results of six experiments are presented showing that 62 per cent. of the roots capable of responding grew out of the tubes containing the agar in which a previous wheat crop had grown into the fresh agar surrounding the segmented tube.

Experiment No.	Roots Capable of Responding.	Roots Which Grew Out of Tubes.	Per Cent. Response.
1	8	7	87
2	13	4	31
3	11	6	55
4	8	6	75
5	33	16	48
6*	41	30	73

Average response for the six samples of agar, 62 per cent.

It will be noted that the percentage of diverted roots in the several experiments varies somewhat. This is due to the varying toxicity of the agar derived at different times and from different crops, as shown by the fact that the differences are consistent in the two series, namely, that a high result in series "*a*" is always accompanied by a low result in series "*b*" and *vice versa* for the same sample of used agar.

In the development of roots and tops the plants in series "*b*" excelled. This is probably due to the greater total quantity of fresh agar in that set. As soon as the roots passed out of the segmented tubes the sensitive and absorbing portions were in a medium containing a relatively small amount of toxic excreta. It is obvious from these data that toxic substances remain in the used agar and exert an influence on the succeeding crop. When the roots growing in freshly prepared agar reached the openings in the segmented tubes 27 per cent. of them grew out into the used agar, whereas under the opposite set of conditions 62 per cent. of the roots grew out of the tubes, the proportion of the responses being 44 : 100. This plainly indicates that in the agar which had grown a crop there is some toxic substance, the only source of which could be the excreta from the roots of the previous crop.

WHEAT SUCCEEDING CORN.

The corn used in these experiments was a variety of pop-corn.

* Experiment 6 has no corresponding experiment in table "a" of this series.

When the seedlings had attained a length of 5 cm. they were planted thickly in dishes of soft agar. At the expiration of 10 to 15 days the seedling plants were removed and the agar melted for experiments in the manner previously described.

(*a*) *Wheat plants in tubes containing fresh agar and surrounded by agar in which corn had grown.*— The accompanying table summarizes the results of four experiments. As much as 59 per cent. of the wheat roots capable of response curved out and grew out of the tubes away from their own excreta into the agar containing the excreta of the previous corn crop.

Experiment No.	Roots Capable of Responding.	Roots Which Grew Out of Tubes.	Per Cent. Response.
1	13	7	54
2	20	10	50
3	13	9	69
4	28	17	61

Average response for the four samples of agar, 59 per cent.

(*b*) *Wheat plants in tubes containing agar in which corn had been grown and surrounded by fresh agar.* — Four experiments were likewise performed in this series. Here 62 per cent. of the roots curved and grew out of the tubes. The details are shown in tabular form.

Experiment No.	Roots Capable of Responding.	Roots Which Grew Out of Tubes.	Per Cent. Response.
1	24	16	67
2	32	18	56
3	39	27	69
4	9	5	56

Average response of the four samples of agar, 62 per cent.

These results obtained from the use of agar in which pop-corn had previously grown showed that such agar is decidedly less toxic to wheat than the agar in which wheat had grown. In all cases where pop-corn agar was used a high per cent. of roots curved and grew out of the tubes. The figures obtained, 59 and 62 per cent., stand notably near that obtained when only freshly prepared agar was employed, namely 66 per cent. The percentages obtained in series "*a*" and "*b*" are the proportion of 95:100, the difference lying within the limit of experimental error. This means that the roots behave nearly the same whether the tubes are surrounded by fresh or used agar, and that the toxic effect of the agar in which corn has grown is small, the used agar being, in fact, practically as good as if freshly prepared agar had been used.

WHEAT SUCCEEDING COWPEAS.

The same method of procedure was followed as in the previous experiments.

(*a*) *Wheat plants in tubes containing fresh agar and surrounded by agar in which cowpeas had grown.* — The results of four experiments employing 82 roots are tabulated.

Experiment No.	Roots Capable of Responding.	Roots Which Grew Out of Tubes.	Per Cent. Response.
1	12	8	67
2	38	21	55
3	23	9	39
4	9	6	67

Average response for the four samples of agar, 57 per cent.

(*b*) *Wheat plants in tubes containing agar in which cowpeas had grown and surrounded by fresh agar.* — The four experiments corresponding to the above employed a total of 96 roots; the details are here given in tabular form.

Experiment No.	Roots Capable of Responding.	Roots Which Grew Out of Tubes.	Per Cent. Response.
1	20	11	55
2	31	23	74
3	26	17	65
4	19	11	58

Average response for the four samples of agar, 63 per cent.

The results of these two sets of experiments are closely similar to the preceding experiments, which employed agar in which corn had grown. That is to say, it makes little difference so far as this response is concerned, whether the used agar is outside or inside of the segmented tubes. The results in the experiments with cowpeas are in the proportion of 90:100.

This is interpreted to mean that the excreta of the cowpea roots are very slightly toxic to roots of wheat seedlings.

WHEAT SUCCEEDING OATS.

The results of the preceding experiments point quite distinctly to the conclusion that the waste products of some plants are only slightly toxic to wheat seedlings. It seemed desirable to test oats, a more closely related species to wheat than either of the other two tested, and one which in agricultural rotation is a bad crop to precede wheat.

Oat seedlings were allowed to grow for 8 to 10 days in non-nutrient agar, which was then melted for use as in preceding experiments.

(*a*) *Wheat plants in tubes containing fresh agar and surrounded by agar in which oats had grown.* — The accompanying table shows the results of four experiments comprising 87 roots.

Experiment No.	Roots Capable of Responding.	Roots Which Grew Out of Tubes.	Per Cent. Response.
1	21	11	52
2	34	19	56
3	15	6	40
4	17	8	47

Average for the four samples of agar, 49 per cent.

It will be noticed that only 49 per cent. of the roots grew out of the tubes into the agar in which oats had grown as against 66 per cent. in the case of the fresh agar in the experiments already given.

(*b*) *Wheat plants in tubes containing agar in which oats had grown and surrounded by fresh agar.* The following table gives the results of four experiments which are complements of those given under "*a*."

Experiment No.	Roots Capable of Responding.	Roots Which Grew Out of Tubes.	Per Cent. Response.
1	24	16	67
2	21	13	62
3	45	23	51
4	19	12	63

Average response for the four samples of agar, 61 per cent.

The results of these experiments show that the agar in which oats had grown was more toxic than that in which corn or cow-peas had grown. When oats agar was used the proportion of roots which left the tubes in experiments "*a*" and "*b*" was 80:100, showing that there was a sensible difference whether the used agar was within or without the tubes. From these relations we may conclude that the excreta of oats are more toxic to the roots of wheat seedlings than those of corn or cowpeas, a conclusion which is substantiated by the results obtained in crop rotation. If we represent the responses of the roots in the different experiments in the form of percentages, we obtain the following:

Wheat succeeding wheat, 44 per cent.

Wheat succeeding oats, 80 per cent.

Wheat succeeding corn, 95 per cent.

Wheat succeeding cowpeas, 90 per cent.

Summing up the results of these experiments which demonstrate the effect of root excreta from various sources upon wheat roots, it may be noted (1) that the excretions from no other roots were so deleterious to wheat as its own excretions, (2) that the excreta from oats were more harmful than those from the more distantly related plants, cowpeas and corn, (3) that the plants which succeed best in a rotation of crops with wheat, produce excreta which are least harmful to wheat.

THE RÔLE OF TOXIC EXCRETA IN THE ASSOCIATION AND SUCCESSION OF PLANTS

The production of such toxic excreta as have been demonstrated in this paper throws light upon the problem of association and migration of species and individuals in the vegetable kingdom. The problems of natural association and migration among plants were, as one of us has shown in another publication (Reed '05), among the first studies of ecologists. It has long been known that various physical factors, *e. g.* light, water, etc., often determine the limit of the range of a given species, but it has been repeatedly admitted that they are not sufficient to explain certain important problems of association and succession. The importance and activity of biological factors cannot now be overlooked by any student of ecology. The working of root excreta in causing association and succession are admirably illustrated by the investigations of the Woburn Experiment Station, Jones and Morse, and Jensen, cited in the first part of this paper.

A very apt illustration of the way in which toxic excreta may act in bringing about migration is the case of the "Fairy Ring" fungi. The curiously regular growth of the ring in a continually widening circle may be due to the production of toxic excreta by the growing fungus. The young mycelium grows best on the outside of the ring because it is less affected by the excreta left in the soil within the ring. The common explanation for the development of fairy rings is based upon the assumption that the soil within the ring is so depleted of nutrients that it is unable to support the growth. An investigation of the chemistry of fairy rings by Gilbert ('75) and Lawes ('83) showed such a slight difference between the soil inside and that outside of the ring that this difference cannot explain the entire absence of fungi within the ring. The total nitrogen outside of the rings (average of five rings) was .281 per cent.; inside of the rings it was .247 per cent., a difference of .034 per cent. The average content of carbon outside the rings was 3.30 per cent., inside the rings 2.78 per cent., a difference of .52 per cent. With our present knowledge of the ability of plants to absorb and utilize nutrients, these slight differences are utterly inadequate to explain the entire absence of fungi within the ring. The existence of toxic excreta in the soil would, however, explain it. It is of interest to note that such an explanation of fairy rings was suggested by Way ('47). This investigator admitted "that by far the most scientific and intelligible solution of the question is that which was based upon DeCandolle's theory of the excretions of plants." But on account of objections which appeared insuperable to him he was unable to accept it as a satisfactory explanation.

Another illustration of the possible effect of root excreta in producing associations may be found in the "oak openings." These characteristic grassy tracts existed in the natural oak forests of Ohio, Indiana and southern Michigan before they were modified by man. From some hitherto unexplained cause the forest was apparently unable to advance into these small prairies. In assuming that the grasses produced some substances which were unfavorable to the roots of trees, we have a factor which possibly has importance in the maintenance of such natural societies.

It is quite probable that the excretion of small amounts of deleterious substances is a general phenomenon among all plants.

In view of the very potent effect of the excretions of the plants which have been studied it can only be concluded that the excretions from plants and the accumulation of such excretions in the soil are of the utmost importance in determining such phenomena as association, invasion, and succession.

SUMMARY

1. It has long been known that certain of the lower plants produce substances of an excretory nature which render their environment unsuitable for further growth; but it is only recently that data have been presented to show that the roots of the higher plants may excrete substances which are deleterious to their further growth.

2. The experiments related in this paper show that healthy growing plants excrete from their roots substances which have a deleterious effect upon the growth of the root.

3. The excreta produced by the roots are so small in amount that, up to the present time, they have not been detected by chemical analysis. The chemotropic sensitiveness of the plant does, however, afford a means of detecting and demonstrating experimentally the presence of root excreta.

4. The experiments described in this paper show that, as a rule, the excreta produced by a plant are most toxic to plants of that same species. So far as studied the excreta are more toxic to closely related species than to distantly related ones. Observations in the field indicate that there are specific instances in which the excreta of one species are extremely toxic to other distantly related species.

5. The production of toxic excretions by the roots of the higher plants appears to afford an explanation of some of the important phenomena connected with association, invasion, and succession of plants. It is no less important as an explanation of certain underlying principles in agriculture, chief among which are those of crop rotation and the productivity of the soil.

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LITERATURE

Bennett, M. E. ('04.) Are roots aerotropic? Bot. Gaz. **37**: 241. 1904.

Boussingault, J. B. ('41.) De la discussion de la valeur relative des assolements par les résultats de l'analyse. Annal. Chim. et Phys. **1**: 217. 1841.

Braconnot, H. ('39.) Recherches sur l'influence des plantes sur le sol. Annal. Chim. et Phys. **72**: 27. 1839.

Brugmans, S. ('89.) De mutata humorum in regno organico indole a vi vitali vasorum derivanda. 1789.

Clark, J. F. ('02.) On the toxic properties of some copper compounds with special reference to Bordeaux mixture. Bot. Gaz. **33**: 26. 1902.

De Candolle, A. P. ('32.) Physiologie végétale. Paris, 1832.

Eijkman, C. ('04.) Über thermolabile Stoffwechselprodukte als Ursache der natürlichen Wachstumshemmung der Mikroorganismen. Centralbl. f. Bakt. I Abt. **37**: 436. 1904.

Emmerlich, R. & Loew, O. ('99.) Bakteriolytische Enzyme als Ursache der erworbenen Immunität und die Heilung von Infektionskrankheiten durch dieselben. Zeitschr. f. Hygiene **31**: 1. 1899.

——— **& Korschun, A.** ('02.) Die bakteriolytische Wirkung der Nukleasen und Nukleasen-immunproteidine als Ursache der natürlichen und kunstlichen Immunität. Centralbl. f. Bakt. I Abt. **31**: 1. 1902.

———. ('02.) Schutzimpfung durch Anthrakase-Immunproteidin gegen Milzbrand. Centralbl. f. Bakt. I Abt. **32**: 821. 1902.

Ferguson, M. C. ('02.) A preliminary study of the germination of the spores of *Agaricus campestris* and other basidiomycetous fungi. Bull. 16, Bur. Plant Industry, U. S. Dept. Agric. 1902.

Fulton, H. R. ('06.) The chemotropism of fungi. Bot. Gaz. **41**: 81. 1906.

Gasparrini, G. ('56.) Richerche sulla natura dei succiatori e la escrezione delle radici, ed osservazioni morfologiche sopra taluni organi della *Lemna minor*. Napoli, 1856.

———. ('57.) Bot. Zeit. **15**: 773. 1857.

Gilbert, J. H. ('75.) Note on the occurrence of fairy rings. Jour. Linn. Soc. Bot. **15**: 17. 1875.

Jensen, C. A. ('07.) Some mutual effects of tree roots and grasses upon soils. Science II. **25**: 871. 1907.

Jones, L. R. & Morse, W. J. ('03.) The shrubby cinquefoil as a weed. Ann. Rep. Vermont Agr. Exp. Sta. **16**: 188. 1903.

Lawes, G. & Warington, R. ('83.) Contribution to the chemistry of "fairy rings." Jour. Chem. Soc. **44**: 208. 1883.

Lilienfeldt, M. ('05.) Ueber den Chemotropismus der Wurzel. Ber. Deuts. Bot. Gesell. **23**: 91. 1905.

Livingston, B. E. ('05.) (With BRITTON, J. C. and REID, F. R.). Studies on the properties of an unproductive soil. Bull. 28, Bur. of Soils, U. S. Dept. Agric. 1905.

———. ('06.) A simple method for experiments with water cultures. Plant World **9**: 13. 1906.

Macaire-Prinsep, I. F. ('32.) Mémoire pour servir à l'histoire des assolemens. Mém. Soc. Phys. et Hist. Nat. Génève **5**: 287. 1832.

———. ('33.) Ann. d. Pharm. **8**: 78. 1833.

Newcombe, F. C. ('02.) The rheotropism of roots. Bot. Gaz. **33**: 343. 1902.

Plenck, J. J. ('94.) Physiologia et pathologia plantarum. 1794.

Rahn, O. ('06.) Über den Einfluss der Stoffwechselprodukte auf das Wachstum der Bakterien. Centralbl. f. Bakt. II Abt. **16**: 417. 1906.

Reed, H. S. ('03.) Methods in plant physiology. Jour. Appl. Micros. **6**: 2269. 1903.

———. ('05.) A brief history of ecological work in botany. Plant World **8**: 163, 198. 1905.

Unger, F. ('36.) Einfluss des Bodens auf der Vertheilung der Gerwächse. Wien, 1836.

Walser, E. ('38.) Untersuchungen über die Wurzelausscheidungen. Dissertation. Tübingen, 1838.

Way, J. T. ('47.) On the fairy rings of pastures as illustrating the use of inorganic manures. Jour. Roy. Agr. Soc. **7**: 549. 1847.

Wehmer, C. ('91.) Entstehung und physiologische Bedeutung Oxalsaüre in Stoffwechsel einiger Pilze. Bot. Zeit. **49**: 233. 1891.

———. ('06.) Die Bildung freier Oxalsaüre durch *Aspergillus niger*. Ber. Deuts. Bot. Gesell. **24**: 381. 1906.

Woburn Experimental Fruit Farm. ('03.) Third Report, 1903.

2

New species of fungi

CORNELIUS LOTT SHEAR

The following fungi appear to be undescribed. Most of them have been discovered during our studies of the fungous diseases of the cranberry. Type specimens of all are deposited in the pathological collections of the Department of Agriculture.

Ozonium omnivorum sp. nov.

No fructification definitely known. Sterile mycelium usually a dirty yellow, sometimes whitish when young or growing in cultures or in the vessels of vascular bundles of plants; hyphae forming strands and spreading from them, producing a rather dense arachnoid layer on the surface of the host and bearing 1 to 4 branches arising and growing at right angles from the same point near the ends, diameter 3–5 μ, tapering toward the ends.

Type, *no. 1447* C. L. S., on cotton root, Petty, Texas, Sept. 2, 1905. The fungus occurs from eastern Texas to southern California and has also been found in southern Oklahoma and Indian Territory. This fungus is a facultative parasite infesting the soil and attacking the roots of a great variety of plants and causing serious damage to cultivated crops, such as cotton, alfalfa, cowpeas, sweet potatoes, beets, and fruit trees. Few crops except grasses and grains are free from it. The fungus was described and figured by Pammel * who called it *Ozonium auricomum* Link. Having had an opportunity to examine Link's type at Berlin, we are convinced that this fungus is quite different from his. *O. auricomum* Link is somewhat similar in color but has a much coarser and looser mycelium, and lacks entirely the slender tapering branches arising at right angles which are so characteristic of *O. omnivorum*. *O. auricomum* occurs in Texas, but so far as observed only as a pure saprophyte. Owing to the important economic relations of this root-rot fungus, it seems desirable to give it a specific name, even though its fruiting form is not known. We

*Ann. Rep. Texas Agr. Exp. Sta. **2**: 61 et seq., *pl. 2, 3*. 1889.

have grown it in pure cultures on various media for several years, but it never produced spores of any kind.

Sporotrichum Quercuum sp. nov.

Sporotrichum sulfureum Grev. f. *Quercuum* Thüm. Mycotheca Universalis Exs. *no. 986*, without description.

Cespitulose, tufts subglobose, somewhat floccose, gregarious or scattered, 0.12–1 mm. in diam., sulphur-colored at first, becoming greenish as spores mature; each tuft is composed of small rounded masses of fertile hyphae bearing conidia; these masses are held together rather loosely by yellowish, branched, sterile hyphae; conidia greenish in mass, subglobose, 1.5–2μ diam., borne at the ends of densely packed globose masses of conidiophores, the ultimate divisions of which are about 6μ long.

Type, *no. 986* Thümen Myc. Univ., Dept. Agriculture set, on decaying oak leaf, collected by J. B. Ellis, in New Jersey presumably, summer of 1876. The species is common about Washington in the summer and autumn on partially buried oak leaves of various species and occasionally on leaves of other trees. It is also represented by *no. 1478* C.L.S., on buried leaves of *Quercus coccinea* and *Castanea dentata*, Takoma Park, Maryland, September 24, 1906.

The plant has a very characteristic macroscopic appearance. The groups of yellowish or greenish, globose masses when examined with a hand lens can be seen to consist of a cluster of smaller spore-masses, rather loosely held together by the floccose sterile hyphae. The larger hyphae at the base and interior of the mass are minutely roughened. Whether conidia are borne on these or not could not be determined. Judging from Greville's figure (Scot. Crypt. Fl. *pl. 108. f. 2*) our plant is not very closely related to his *S. sulphureum*.

Cladosporium Oxycocci sp. nov.

Sporophores hypophyllous, simple, septate, flexuous, yellowish-brown, erect or spreading, arranged in small tufts which arise from a small, compact, sclerotoid base and are scattered over the surface of reddish-brown spots which frequently become light-colored at the center when old, 50–100μ long; conidia acrogenous, yellowish-brown, 1–3 on each sporophore, subcylindrical or somewhat clavate when mature, continuous or uniseptate, 15–24 $\times$ 3–4μ.

Type, *no. 1492* C.L.S., on living leaves of *Vaccinium macrocarpum*, Arichat, Nova Scotia, June 21, 1902; also collected at Belleplain and Parkdale, N. J.; and near Wareham, Mass., June 7, 1906, H. J. Franklin.

Helminthosporium inaequale sp. nov.

Sterile hyphae effuse, decumbent, much branched, dark-brown, sometimes forming compact strands of 3–12 filaments. Fertile hyphae ascending or suberect, septate, very variable in length, 6–8μ diam., bearing both terminal and lateral conidia; conidia inequilateral or curved, 3–5-celled and thick-walled, brown, 22–32 $\times$ 11–14μ, central cell usually larger than the others and swollen. Erect, slender, somewhat branching, hard, black, sclerotoid bodies are formed in abundance in old cultures. These when transplanted will produce conidia, but no other form of fructification has occurred.

Type, slide *no. 1498* from pure culture *no. 457b* isolated from pulp of diseased cranberries from New Jersey, November, 1905. This fungus has only been obtained in cultures.

Phyllosticta putrefaciens sp. nov.

Pycnidia gregarious, buried or subsuperficial, globose or subglobose, membranous, dark-brown or nearly black, ostiolate, 75–100μ diam.; ostiole conspicuous, surrounded by a slightly elevated, somewhat irregular margin; spores variable in shape, ovoid or ovoid-elliptic, sometimes inequilateral or slightly curved, continuous, hyaline or faintly yellowish in mass, 3.5–5 $\times$ 2.5–3μ; sporophores simple, very short.

Type, slide *no. 1496* from pure culture *no. 312*, isolated from a diseased cranberry from Whitesville, New Jersey, September, 1905, C. L. S. *No. 1497* C. L. S., collected on cranberries which had been attacked by the berry worm at Wareham, Massachusetts, September 23, 1902, resembles this species rather closely and may be the same. The pycnidia in these specimens are not so well developed and the ostiole not so distinct as in the type, while the spores are slightly longer, varying from 4.5–6.5 $\times$ 3μ. Specimens have also been collected on old cranberry leaves (*no. 1503* C. L. S., Pierceville, Mass., May 21, 1907), which belong to this species.

Sphaeronema pomorum sp. nov.

Pycnidia gregarious or scattered, subsuperficial, submembranous, subglobose, 125–175μ diam. with an ostiolate neck 75–150μ long; spores oblong-cylindric or frequently ovoid or subelliptic, continuous, pale greenish yellow, 6–7 $\times$ 3μ.

Type, slide *no. 1495* C. L. S., from pure culture *no. 141b*. This fungus was isolated from a diseased cranberry, *Vaccinium macrocarpum*, from near Whitesville, New Jersey, October, 1905.

Septoria longispora sp. nov.

Pycnidia gregarious or somewhat scattered, globose or depressed-globose, somewhat erumpent, covered by the epidermis, ostiolate, 150–225μ diam.; ostiole small; spores hyaline, filiform, curved, frequently S-shaped, sometimes pseudo-septate, 150–240 $\times$ 3–4μ, when straightened some are 300μ long; sporophores simple, narrow, 6–9μ long.

The length of the spores of this species is quite remarkable and separates it easily from the other species thus far described. It occurs on both fruit and foliage.

Type, *no. 1499* C. L. S., on shrivelled rotten cranberries, still hanging on the vines, Hunters Mills, New Jersey, October 14, 1902. Also on fallen cranberry leaves, *no. 1500* C. L. S., same locality, June 21, 1906.

Sporonema Oxycocci sp. nov.

Pycnidia excipuliform, thickened at the base, gradually disappearing above, arising beneath the epidermis and becoming erumpent, depressed-globose, gregarious or scattered, amphigenous, 50–100 μ diam., sometimes collapsing, rupturing irregularly by a slit or triangular split; sporophores simple, oblong or subglobose, about one fourth the length of the spore or less; spores hyaline, cylindrical, straight, continuous, 17–19 $\times$ 3–4 μ; contents homogeneous.

Type, *no. 1484* C. L. S. (on slide) on dead leaf of *Vaccinium macrocarpum*, near Wareham, Massachusetts, H. J. Franklin, coll., May, 1906; also *no. 1485* C. L. S., Cape Cod, Massachusetts, September, 1906; and *no. 1486* C. L. S., near Whitesville, N. J., September 2, 1904.

This bears a superficial resemblance to *Phoma leptidea* (Fr.) Sacc., but that has a complete pycnidium and a distinct, regular ostiole. It may be the pycnidial stage of a *Phacidium*.

Sporonema pulvinatum sp. nov.

Pycnidia either epiphyllous or hypophyllous, arising from the epidermis, dark-brown, pulvinate, frequently collapsing, 300–420 μ diameter by 100–150 μ thick, chamber simple; ostiole wanting; manner of rupturing not observed; spores inequilateral or slightly curved, continuous, 6–8 $\times$ 2–2.5 μ, hyaline or slightly greenish-yellow in mass; sporophores simple, somewhat enlarged at the base, slightly longer than the mature spores.

Type, *no. 1480* C. L. S., on one-year old leaves of *Vaccinium macrocarpum* received from Morgantown, West Virginia, June, 1902, and kept in a moist chamber about two weeks. Specimens also from near Whitesville, New Jersey, *no. 1481*, November, 1905, and *no. 1482*, from Olympia, Washington, September, 1906.

Our plant, externally, closely resembles *Sporonema epiphyllum* (Fr.) Shear. A study of the literature relating to this species, as well as a careful examination of the specimens in Fries' herbarium leads us to believe that it is distinct from the plant just described.

The pycnidia in our species are larger and the spores appear to be constantly smaller, less curved and without indication of a pseudoseptum. It bears a superficial resemblance to young specimens of *Lophodermium melaleucum* (Fr.) DeNot. and it may be the pycnidial stage of this or of *Lophodermium Oxycocci* (Fr.) Karst.

Sporonema epiphyllum (Fr.) Shear

Sphaeria obturata var. b. *epiphyllum* Fr. Syst. Myc. **2**: 495. 1822; Scler. Suec. Exs. *128*.

S. (*Sphaeropsis*) *obtusata* (Typ. error) Curr. Simp. Sphaer. 329.

S. (*Sphaeropsis*) *obturata* Curr. Supp. Obs. Sphaer. 258.

Sporonema obturatum var. *epiphyllum* (Fr.) Sacc. Syll. Fung. **3**: 678. 1884.

Clinterium obturatum Fr. Summ. Veg. Scand. 418. 1849.

Clinterium obturatum Starbäck, Sphaer. Imp. Cog. 57. *pl. 3. f. 36a, b.* 1894.

The type of Fries' variety was his *Scleromyces Suecica no. 128*. The spores of this were first described by Curry (*l. c.*); later Starbäck (*l. c.*) described and figured the plant. What Fries species, *Sphaeria obturata*, is, does not seem to be definitely known. It appears from his treatment of it in Summ. Veg. Scand. that he regarded the variety as distinct, since he used the specific name under two genera. Under his new genus, *Clinterium* (*l. c.*, 418) he placed "*C. obturatum*," citing the specimen *no. 128* of his Scler. Suec., which represents his variety *epiphyllum*, and also Syst. Myc. **2**: 495, where his *Sphaeria obturata* and its varieties were first published. On page 402 of Summ. Veg. Scand., under the genus

Gibbera, he has "*G. obturata*," citing the original description of *Sphaeria obturata*, as in the other case, but not the specimen. This seems to indicate that he regarded the variety not only as a separate species, but as belonging to a different genus. He used the same name in both cases, instead of taking up his varietal name, thinking, perhaps, that no confusion would arise from such duplicate use of the name when placed in different genera. The plant has been well described and figured by Starbäck (*l. c.*). There may be some doubt as to whether this plant is a true *Sporonema*. *Sporonema* was a monotypic genus founded by Desmazières in 1847 on *S. phacidioides*.

The genus *Clinterium* was described by Fries in 1849 and the type specified: "Typus *Sph. Sclerotium* Schwein. et al. Americ."

Until this species of Schweinitz is better known it will be impossible to say whether it is congeneric with Fries' plant or not, but, judging from the description, it is not, and hence this plant would necessarily be referred to some other genus.

PLAGIORHABDUS* gen. nov.

Pycnidia containing somewhat irregular chambers or cavities which usually unite and open through a rather large, distinct ostiole, usually covered by a thin, effuse, black, or coriaceous stroma consisting of the modified tissue of the host; spores hyaline, continuous, with the oblique sporophore remaining attached in the form of a basal appendage.

A genus of the order *Sphaeropsidales* of the imperfect fungi. The type of the genus is *P. Crataegi*.

Plagiorhabdus Crataegi sp. nov.

Stroma thin, black, effuse, formed beneath and within the epidermis, surface slightly rugose; pycnidia thick-walled, irregular in size and shape, embedded in the host and covered with the stromatic crust; interior divided into more or less irregular cavities which open through a rather large, central ostiole; spores hyaline, allantoid, usually biguttulate and provided with a slender oblique appendage near the basal end of the spore, consisting of the sporophore which is abstricted at its base and remains attached to the spore, which is $9–12 \times 3–4\ \mu$, appendage $12–20 \times 1\ \mu$.

* Plagios = oblique, and rhabdos = rod, in allusion to the oblique appendage of the spores.

Type, *no. 1446* C. L. S., on old fruit of *Crataegus punctata* lying on the ground, Department of Agriculture grounds, Washington, D. C., December 20, 1902. The surface of the fruit is entirely covered with the thin black stroma.

Plagiorhabdus Oxycocci sp. nov.

Pycnidia scattered, mostly hypophyllous, irregularly depressed-globose, embedded in the tissue of the host, 125–190 μ diameter, usually very slightly erumpent with the upper portion mostly covered by a thin, dark, stromatic layer consisting of the modified epidermis; wall rather thin below and interior subsimple, or sometimes having a few irregular chambers uniting and opening through a single ostiole which is usually rather prominent; spores hyaline or faintly greenish-yellow in mass, slightly curved or allantoid, 8–10 × 3 μ, bearing a slender basal appendage consisting of the sporophore which is abstricted near its base; appendage 10–15 × 0.75 μ.

Type, *no. 1490* C. L. S., on leaves of dying cranberry plant, *Vaccinium macrocarpum*, Carver, Massachusetts, May, 1906, H. J. Franklin, coll. This species differs from *P. Crataegi* in its smaller, scattered, more simple pycnidia with thinner walls and poorly developed stromatic crust.

Leptothyrium Oxycocci sp. nov.

Pycnidia black, dimidiate, amphigenous, scattered, subcoriaceous, irregularly subglobose, 160–250 μ diameter, arising just beneath the epidermis, sometimes becoming superficial or subsuperficial and collapsing, rupturing irregularly and frequently breaking away about the base, exposing the spore-mass; wall somewhat irregular in thickness, especially at the apex, composed of parallel, elongate cells; spores subfusoid, hyaline, sometimes slightly curved, pseudoseptate, 10–15 × 2.5–3 μ, borne on simple, slightly tapering sporophores, slightly exceeding the length of the spores.

Type, *no. 1487* C. L. S., on dead leaves from diseased vines of *Vaccinium macrocarpum*, near Wareham, Massachusetts, May 22, 1906, H. J. Franklin, coll.; also from Pierceville, Massachusetts.

Rhabdospora Oxycocci sp. nov.

Pycnidia usually hypophyllous, scattered, buried, more or less irregularly depressed-globose, somewhat erumpent, greatest diameter 150–225 μ; ostiole small, plane, perforate; wall submembranous, consisting of two layers, the inner sometimes separated from the outer, except about the ostiole, and collapsing; the epidermal cells of the host overlying the pycnidia usually blackened; sporophores branched; spores hyaline, long fusiform, slightly curved, with 1–3 septa or pseudosepta, 20–26 × 2–3 μ.

Type, *no. 1479* C.L.S., on old leaves of *Vaccinium macrocarpum* lying on the ground under a pile of old vines which had been cut from an adjacent bog, near Whitesville, New Jersey, September 2, 1904.

Ceuthospora (?) lunata sp. nov.

Pycnidia scattered, amphigenous, disciform, subpulvinate, buried, slightly erumpent, remaining covered, 200 to 375 μ greatest diam., subcoriaceous, thick-walled, interior usually divided into irregular, incomplete chambers, opening through a rather prominent, slightly projecting ostiole; sporophores somewhat branched, ultimate divisions stout, shorter than the spores; spores subhyaline or slightly greenish-yellow in mass, inequilateral or somewhat lunate, 7–9 × 3–3.5 μ.

Type, *no. 1488* C.L.S., on fallen leaves from vines of *Vaccinium macrocarpum* which had been cut and piled on the margin of a cranberry bog near Whitesville, New Jersey, September 2, 1904; also *no. 1489* C.L.S., on leaves of dead vines, Wareham, Massachusetts, September, 1902.

The spores of this plant can scarcely be distinguished from those of *Phoma cytisporea* (Fr.) Starb. (*Cytispora endophylla* (Fr.) Sacc.). A scanty specimen in Fries' herbarium which we have examined, differs from the type of our species in having thin-walled pycnidia, with a single, simple chamber. The Massachusetts specimens have somewhat smaller pycnidia than the type and fewer chambers. This plant is referred to *Ceuthospora* with doubt. It appears to belong to this genus as defined by Saccardo,* who credits the name to Greville.† Fries,‡ however, was the original author of the genus and until it is revised its exact application cannot be determined.

BOTHRODISCUS § gen. nov.

Pycnidia in the form of regular cavities in a black, discoid, coriaceous, or subcorneus, substipitate stroma which has a peridium

* SACCARDO, P. A. Syll. Fung. 3: 277. 1884.

† GREVILLE, R. K. Scott. Crypt. Fl. 5: 253. 1827.

‡ FRIES, E. M. Syst. Orb. Veg. 119. 1825.

§ Bothros = pit, and discos = disk.

about the margin; spores elongate, hyaline or pale lemon-colored, continuous.

This genus should apparently be placed in the order *Sphaeropsidales* of the *Deuteromycetes*. It appears to be related to *Fückelia*, but differs in having the stroma furnished with a peridium which covers its upper part and ruptures at maturity, remaining as a spreading cup about the margin of the stroma. Its cavities are regular in shape and each has its own apical opening. The type of the genus is *B. pinicola*.

Bothrodiscus pinicola sp. nov.

Stroma dark-colored, obconic, substipitate, arising from the inner bark; disk black, areolate, 0.5–1 mm. in diameter, covered at first by a thin coriaceous peridium which ruptures at maturity and spreads in the form of a cup; pycnidia consisting of numerous, regular cavities, about 75 μ in diameter and 100 μ deep in the disk of the stroma, covered with a black layer at the top which ruptures irregularly; spores hyaline or faint greenish-yellow in mass, clavate-cylindric, more or less curved, multi-guttulate, continuous, 32–42 × 5–6 μ. When the stroma is pressed the spores, attached at their bases, are expelled in a globular mass.

Type, *no. 1475* C. L. S., on dead branches of *Pinus virginiana* collected by Mrs. T. A. Williams, Takoma Park, D. C., May, 1899.

Anthostomella destruens sp. nov.

Perithecia gregarious, submembranous, globose or subpyriform, 350–450 μ diam. usually somewhat contracted above into a short broad neck, ostiolate; asci 8-spored, cylindrical, subsessile 200–232 × 15–18 μ; paraphyses none; spores short elliptic, sometimes somewhat inequilateral, uniseriate, hyaline at first, changing to yellowish-brown, and at maturity a deep dark brown, almost opaque, 16–24 × 10.5–12 μ.

Type, slide *no. 1491* from pure culture *no. 450* on cornmeal, isolated from a diseased cranberry from New Jersey. This is not a typical *Anthostomella*, as paraphyses are wanting. It appears to be rather closely related to *A. Smilacis* H. Fab., but has much longer asci and larger different-shaped spores. Pure cultures grown from spores have produced no other spore form.

ACANTHORHYNCHUS * gen. nov.

Perithecia submembranous, scattered, buried, beaked; beak

* Acanthos = thorn, and rhynchos = beak, suggested by the spiny beak.

spiny, ostiolate; asci 8-spored, paraphysate; spores continuous, brownish-yellow.

Type, *A. Vaccinii.*

Acanthorhynchus Vaccinii sp. nov.

Perithecia amphigenous, scattered, subglobose, or somewhat flask-shaped, submembranous, buried, scarcely erumpent, 120–200 μ diam.; neck stout, exserted, ostiolate, $\frac{1}{3}$ to $\frac{1}{2}$ length the perithecium, beset with black, nonseptate spines, 50–70 × 8–9 μ at base; asci subelliptical or somewhat clavate, subsessile, 8-spored, having an apical pore, 120–155 × 24–44 μ; paraphyses septate, exceeding the asci; spores oblong-elliptic, continuous, pale brownish-yellow, surrounded by a mucilaginous layer of protoplasm, 24–32 × 12–18 μ.

Type, *no. 1493* C. L. S., on leaves of *Vaccinium macrocarpum*, West Mills, New Jersey, September, 1901. Specimens also examined from Nova Scotia, Massachusetts and West Virginia; also obtained in cultures from Wisconsin cranberries.

This genus is apparently nearly related to *Sordaria* and *Hypocopra* as treated by recent authors; the spores are forcibly discharged at maturity, and upon germination produce dark-brown crenate-lobed disk-shaped appressoria 50–100 μ in diameter. These can frequently be found attached to the surface of cranberry leaves into which they send germ-tubes. The protoplasm about the spores in the ascus extends to the apex and seems attached there in a manner somewhat similar to that described in *Hypocopra* by Griffiths and others. The form of the protoplasm suggests a secondary internal ascus-membrane, but this has not been demonstrated.

Glomerella rufomaculans Vaccinii var. nov.

Conidia. — Acervuli amphigenous, small, scattered, on a light-brownish, more or less indefinite spot; conidia forming gelatinous, pale-pinkish masses, oblong-cylindric or sub-clavate and sometimes slightly curved, 12–18 × 4.5–6 μ, guttulate, contents granular; sporophores simple, slightly tapering above, about twice the length of the conidia; setae rarely present.

Perithecia. — Perithecia scattered, gregarious or cespitose in cultures and more or less buried in a dark-brown, felt-like subiculum or pseudostroma, dark-brown or nearly black, submembranous, subglobose, slightly rostrate, ostiolate; asci 8-spored, oblong to clavate-cylindric, subsessile or short-stipitate, 60–72 × 10–12 μ, paraphyses fugacious; spores irregularly sub-biseriate, oblong-elliptic, hyaline or faintly yellowish-brown when mature, finely granular and having a light spot at the center, 9–18 × 5–7.5 μ.

Type, slide *no. 1447A* C. L. S., showing both conidia and perithecia, from a pure culture (*A*) made from an ascospore. Original material from which this ascospore was grown was from leaves of *Vaccinium macrocarpum* from New Jersey. The ascogenous form has not yet been found on the cranberry plant. The conidial stage has also been found on leaves and berries from Massachusetts. The fungus in both stages has been isolated from berries from New Jersey and Wisconsin.

This fungus shows no sufficiently constant morphological characters to separate it specifically from the plant found on the apple or the one on the grape. Whether it should be regarded as the same plant which occurs on the grape or apple depends on the possibility of its infecting those hosts. The efforts we have thus far made have been unsuccessful, but are not regarded as conclusive. There occur occasionally in young perithecia filaments about the mass of asci which have been regarded as paraphyses. Their inconstant character, however, renders them of little value for taxonomic purposes.

There is without much doubt an older name which should be applied to this genus, but until we have more certain knowledge of the type the name *Glomerella* may be used.

Gloeosporium minus sp. nov.

Acervuli amphigenous, small, scattered, not on a definite spot, when occurring on fruit the epidermis is dark-colored above and about them; conidia forming pale-pinkish, glutinous masses, oblong-elliptical or subcylindric, sometimes inequilateral or somewhat clavate, usually guttulate when fresh, 6–9 × 3–4 μ; sporophores simple, slightly tapering above, 1½–2 times the length of the conidia; no setae observed.

Type, *no. 1494*, on fruit of cranberry, *Vaccinium macrocarpum*, from the market, Washington, D. C., April, 1902, C. L. S.; also on cranberry leaves from New Jersey and isolated from leaves from the same state.

This has been grown in pure cultures for a long time, but no ascogenous form has been obtained. It agrees in general characters with the conidial form of *Glomerella rufomaculans Vaccinii* Shear, but the conidia are constantly smaller, being only half as long, and we have been unable to find any indication of intergradation in this respect.

Guignardia Vaccinii sp. nov.

Pycnidia. Pycnidia, rather thickly and evenly distributed over the surface of affected leaves, usually hypophyllous, 100–120 μ diameter, globose or depressed-globose, buried at first, finally somewhat erumpent, with the apex and short or nearly obsolete ostiolum breaking through the epidermis; pycnospores 10.5–13.5 $\times$ 5–6 μ, smooth, hyaline, or amber-colored when fully mature and in mass, obovate and usually somewhat flattened at the apex, bearing a somewhat inconspicuous, granulate-mucilaginous curved appendage averaging about three fourths the length of the spore; sporophores 10–15 μ long.

Perithecia. Perithecia practically identical in size, shape, texture and mode of growth, with the pycnidia; asci 8-spored, clavate-cylindric, usually short-stipitate, non-paraphysate, 60–80 $\times$ 9–12 μ; spores smooth, hyaline, or when fully mature pale greenish-yellow, elliptical or subrhomboid and somewhat inequilateral, 13.5–16.5 $\times$ 6.5–7 μ.

Type, *no. 1476* C. L. S., on leaves of *Vaccinium macrocarpum*, near Lakewood, New Jersey, September 4, 1904. We also have specimens from Morgantown, West Virginia; Wareham, Massachusetts; Arichat, Nova Scotia; and Grand Rapids, Wisconsin.

This fungus was described and figured without a name by Dr. B. D. Halsted in Bull. N. J. Agr. Exp. Sta. 64: 33–35. 1889. The figure of ascospores given by Dr. Halsted does not correspond exactly with our specimens, but the plant represented is probably the same. The plant has also been described and figured by the writer, but without specific name, in U. S. Dep. Agric. Farm. Bull. 221: 6. *f.* 1–4. 1905.

This species is closely related to *Guignardia Bidwellii* (Ell.) Viala & Rav.

It causes a serious disease of the cultivated cranberry, generally called "scald" by growers. It attacks the berries when they are very small, causing them to shrivel up, turn black and become covered with pycnidia; when half-grown or more the fruit becomes very soft and watery. The connection between the pycnidial and ascogenous forms has been demonstrated by numerous pure cultures from the mycelium and ascospores. A detailed account of the life history of this fungus will be published later.

Ustilago Claytoniae sp. nov.

Sori in ovaries, protected by the calyx of the host, ovate, flattened, 2–3 mm. long, forming a dark wine-colored or purplish mass; spores purplish, mostly spherical or subspherical, 11–16 μ in diameter with prominent winged reticulations 1–2 μ wide by 2.5 μ deep.

Type collected by Col. T. E. Wilcox, Vancouver Barracks, Washington State, April 8, 1903, on *Claytonia linearis* Dougl. (*Montia linearis* (Dougl.) Greene). Specimen in herbarium of National Museum and also in herbarium of the Department of Agriculture. This species appears to be related to *Ustilago Calandriniae* Clint.

Sorosporium Montiae Rostr. (1896), found on leaves and stems of *Montia minor* in Denmark, is apparently quite different from our species.

U. S. DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

INDEX TO AMERICAN BOTANICAL LITERATURE
(1907)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions their kindness will be appreciated.

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Andrews, E. F. Some effects of a tropical storm on vegetation. Plant World **10**: 67. Mr 1907.

Arthur, J. C. McAlpine's studies of Australian rusts. Jour. Myc. **13**: 41, 42. 30 Ap 1907.

Bacon, A. E. The common pimpernel in Vermont. Bull. Vt. Bot. Club **2**: 27, 28. Ap 1907.

Bailey, W. W. Peloria. Am. Bot. **12**: 66, 67. Ap 1907.

Bailey, W. W. Solomon's seal. Am. Bot. **12**: 49–51. Ap 1907. [Illust.]

Barnhart, J. H. The local floras of Vermont. Bull. Vt. Bot. Club **2**: 11–16. Ap 1907.

Bennett, A. Forms of *Potamogeton* new to Britain. Jour. Bot. **45**: 172–176. 1 My 1907.

Contains references to American species.

Berry, E. W. Recent discussions of the origin of gymnosperms. Science II. **25**: 470–472. 22 Mr 1907.

Berry, E. W. A *Tilia* from the New Jersey Pleistocene. Torreya **7**: 80, 81. 15 Ap 1907.

Bessey, C. E. Twinned pistils in partridge pea. Am. Bot. **12**: 65. Ap 1907.

Bessey, C. E. The forest trees of eastern Nebraska. Proc. Iowa Acad. Sci. **13**: 75–87. *maps.* [Mr] 1907.

Bessey, E. A. Spore forms of *Spegazzinia ornata* Sacc. Jour. Myc. **13**: 43–45. *pl. 101.* 30 Ap 1907.

Blakeslee, A. F. The nature and significance of sexual differentiation in plants. Science II. **25**: 366–372. 8 Mr 1907.

Blanchard, W. H. Our eastern shadwoods. Torreya **7**: 97–102. 20 My 1907.

Includes descriptions of 2 new species in *Amelanchier.*

Britten, J. Notes on *Halorrhagaceae.* Jour. Bot. **45**: 135–138. 1 Ap 1907.

A few South American references.

Britton, E. G. & Hollick, A. American fossil mosses, with description of a new species from Florissant, Colorado. Bull. Torrey Club **34**: 139–142. *pl. 9.* 7 My 1907.

Glyphomitrium Cockerellae sp. nov.

Britton, N. L. Report on the continuation of the botanical exploration of the Bahama Islands. Jour. N. Y. Bot. Gard. **8**: 71–81. Ap 1907.

Britton, N. L. *Ribes chihuahuense* sp. nov. Torreya **7**: 102. 20 My 1907.

Native of Mexico.

Brown, S. Botanizing in the Canadian Rockies. Proc. Acad. Nat. Sci. Phila. **58**: 429, 430. 7 Ja 1907.

Bush, B. F. *Pogonatum tenue.* Bryologist **10**: 53. 2 My 1907.

Caldwell, O. W. & Baker, C. F. The identity of *Microcycas calocoma.* Bot. Gaz. **43**: 330–335. *f. 1–3.* 16 My 1907.

Camsell, C. List of plants collected on the Peel River in 1906 by Mr. Charles Camsell. Ottawa Nat. **21**: 38. 7 My 1907.

Christ, H. Filices columbianae leg. C. Wercklé. Bull. Herb. Boiss. II. **7**: 274. 31 Mr 1907.

Gymnogramme (*Eugymnogramme*) *woodsioides* sp. nov.

Christ, H. Filices mexicanae. Bull. Herb. Boiss. II. **7**: 413–416. 27 Ap 1907.

Includes new species in *Cyathea*, *Leptochilus*, *Dryopteris*, *Elaphoglossum*, and *Polypodium.*

Christ, H. Primitiae florae costaricensis. Filices V. Bull. Herb. Boiss. II. **7**: 257–274. 31 Mr 1907.

Describes new species in *Polypodium* (3), *Dryopteris* (3), *Pteris*, *Diplazium* (5), *Cyathea* (3), and *Elaphoglossum* (2).

Clark, V. A. Delaying the blossoming of peach trees by etherization. Science II. **25**: 544, 545. 5 Ap 1907.

Clarke, C. H. A red *Andreaea*. Bryologist 10: 55. 2 My 1907.

Clute, W. N. *Asplenium pinnatifidum* in Connecticut. Fern Bull. **15**: 15. [Ap] 1907.

Clute, W. N. Rare forms of ferns.— II. A cut-leaved cinnamon fern. Fern Bull. **15**: 16, 17. [Ap] 1907. [Illust.]

Clute, W. N. The round-leaved filmy fern. *Trichomanes reniforme*. Fern Bull. **15**: 14, 15. *pl.* [Ap] 1907.

Clute, W. N. Some spring flowers. Am. Bot. **12**: 56–59. Ap 1907.

Cockerell, T. D. A. An instance of mutation. Bot. Gaz. **43**: 283, 284. 15 Ap 1907.

Crockett, A. L. An occurrence of *Catharinaea crispa* in Maine. Rhodora **9**: 74. 30 Ap 1907.

Davidson, A. The changes in our weeds. Bull. So. Calif. Acad. Sci. **6**: 11, 12. 30 Mr 1907.

Davis, W. T. The influence of winter on the high-water shrub. Proc. Staten Id. Asso. Arts & Sci. **1**: 75. 17 Ap 1907.

Dixon, H. N. A new species of *Splachnobryum*, with notes on the peristome. Jour. Bot. **45**: 81–85. *pl. 484 A.* 1 Mr 1907.

S. delicatulum sp. nov., discovered in orchid houses in England, but probably a native of tropical America.

Douglas, G. E. The formation of intumescences on potato plants. Bot. Gaz. **43**: 233–250. *f. 1–9.* 15 Ap 1907.

Dunham, E. M. *Polytrichum gracile* Dicks. in Maine. Rhodora **9**: 64. 8 Ap 1907.

Edgerton, C. W. The rate and period of growth of *Polyporus lucidus*. Torreya **7**: 89–97. *f. 1, 2.* 20 My 1907.

Eggleston, W. W. The flora of Pownal. Bull. Vt. Bot. Club **2**: 21–24. *map.* Ap 1907.

Eggleston, W. W. Peter Kalm's visit to Lake Champlain in July, 1749. Bull. Vt. Bot. Club **2**: 32, 33. Ap 1907.

Evans, A. W. Notes on New England *Hepaticae*, V. Rhodora **9**: 56–60. 8 Ap 1907; 65–73. *pl. 73.* 30 Ap 1907.

Includes *Calypogeia tenuis* sp. nov.

Fedde, F. *Hesperomeconis* generis duae species novae californicae. Repert. Nov. Sp. **3**: 274, 275. 31 Ja 1907.

Hesperomecon filiformis and *H. Greeneana* spp. nov.

Fedde, F. *Meconellae* generis specie snova (*M. Kakoethes*) Californiae australis. Repert. Nov. Sp. **3**: 275. 31 Ja 1907.

Fedde, F. Species novae ex "Extraits d'une monographie inédite du Genre *Populus*" a L.-A. Dode descriptae. V. Repert. Nov. Sp. **3**: 353–357. 10 Mr 1907.

Four new species credited to North America.

Ferriss, J. H. Hardiness of Florida crest fern. Fern Bull. **15**: 13. [Ap] 1907.

Fink, B. Floristic notes from an Illinois esker. Proc. Iowa Acad. Sci. **13**: 59–63. *pl. 4–6.* [Mr] 1907.

Fink, B. Further notes on cladonias. X. *Cladonia decorticata* and *Cladonia degenerans.* Bryologist **10**: 41–45. *f. 1, 2.* 2 My 1907.

Fink, B. Lichens and recent conceptions of species. Proc. Iowa Acad. Sci. **13**: 65–70. [Mr] 1907.

Fink, B. A memoir of Clara E. Cummings. Bryologist **10**: 37–41. *pl. 6.* 2 My 1907.

Fink, B. A round trip between Iowa and Puget Sound. Plant World **10**: 49–58. *f. 12, 13.* Mr 1907.

Fitzpatrick, T. J. The *Liliales* of Iowa. Proc. Iowa Acad. Sci. **13**: 115–160. [Mr] 1907.

Flynn, N. F. The Club's trip to Mt. Mansfield. Bull. Vt. Bot. Club **2**: 5, 6. Ap 1907.

Frye, T. C. Note on *Catharinea rosulata.* Bryologist **10**: 53, 54. 2 My 1907.

Gager, C. S. An occurrence of glands in the embryo of *Zea Mays.* Bull. Torrey Club **34**: 125–137. 7 My 1907.

Gager, C. S. Radium in biological research. Science II. **25**: 589, 590. 12 Ap 1907.

Ganong, W. F. New normal appliances for use in plant physiology. IV. Bot. Gaz. **43**: 274–279. *f. 1, 2.* 15 Ap 1907.

Ganong, W. F. The organization of the ecological investigation of the physiological life-histories of plants. Bot. Gaz. **43**: 341–344. 16 My 1907.

Graenicher, S. Wisconsin flowers and their pollination. II. *Saxifragaceae* and *Grossulariaceae.* Bull. Wis. Nat. Hist. Soc. II. **5**: 84–95. Ap 1907.

Griddle, N. How the seeds of plants are spread in nature. Ottawa Nat. **21**: 27–31. 7 My 1907.

Gürke, M. *Echinocactus Grossei* K. Schum. Monats. Kakteenk. **17**: 56, 59. 15 Ap 1907.

Harger, E. B. An interesting locality. Rhodora **9**: 62–64. 8 Ap 1907.

Hasselbring, H. Gravity as a form-stimulus in fungi. Bot. Gaz. **43**: 251–258. *f. 1–3.* 15 Ap 1907.

Hassler, E. Plantae paraguarienses novae vel minus cognitae III. Bull. Herb. Boiss. II. **7**: 353–368. 27 Ap 1907. [Illust.]

Includes new species in *Mimosa* (2), *Machaerium*, *Talisia*, *Brosimum*, *Borreria*, *Relbunium*, and *Pavonia*.

Hausman, L. A. Some wood-destroying fungi. Am. Bot. **12**: 51–56. Ap 1907.

Hawkins, I. A. The development of the sporangium of *Equisetum hyemale*. Ohio Nat. **7**: 122–128. *pl. 9, 10.* 18 Ap 1907.

Hayek, H. von. *Verbenaceae* novae herbarii vindobonensis. III. Repert. Nov. Sp. **3**: 273, 274. 31 Ja 1907.

Four new species of *Stachytarpheta* from South and Central America.

Hemsley, W. B. A substitute for coca. Kew Bull. Misc. Inf. **1907**: 136. Ap 1907.

Herre, A. W. C. T. Lichen distribution in the Santa Cruz Peninsula, California. Bot. Gaz. **43**: 267–273. 15 Ap 1907.

Holm, T. Linnaeus. May 23, 1707–January 10, 1778. Bot. Gaz. **43**: 336–340. 16 My 1907. [Illust.]

Holm, T. New plants from arctic North America. Repert. Nov. Sp. **3**: 337, 338. 10 Mr 1907.

New species in *Arctophila*, *Dupontia*, *Glyceria*, *Draba*, *Lychnis*, and *Arnica*.

Holm, T. *Ruellia* and *Dianthera*: an anatomical study. Bot. Gaz. **43**: 308–329. *pl. 11, 12 + f.* 1–3. 16 My 1907.

Hopkins, L. S. The fern flora of Ohio. Fern Bull. **15**: 1–13. [Ap] 1907.

Horton, F. B. Fern notes. Bull. Vt. Bot. Club **2**: 34. Ap 1907.

House, H. D. *Corallorhiza maculata* Rafinesque. Torreya **7**: 78. 15 Ap 1907.

House, H. D. Studies in the North American *Convolvulaceae*. III. *Calycobolus*, *Bonamia*, and *Stylisma*. Bull. Torrey Club **34**: 143–149. 7 My 1907.

Includes *Calycobolus Pringlei* sp. nov.

Jackson, A. B. *Climacium americanum* in decoration. Bryologist **10**: 54. 2 My 1907.

Johnston, E. L. Sage brush and cactus. Am. Bot. **12**: 59–63. Ap 1907.

Jones, L. R. Further observations on potato leaf fungi. Bull. Vt. Bot. Club **2**: 35. Ap 1907.

Knox, A. A. Fasciations in *Drosera*, *Ibervillea*, and *Cecropia*. Torreya **7**: 102, 103. *f. 3.* 20 My 1907.

Kofoid, C. A. *Dinoflagellata* of the San Diego region, III. Descriptions of new species. Univ. Calif. Publ. Zool. **3**: 299–340. *pl. 22–33.* 13 Ap 1907.

Kraemer, H. The structure of the starch grain. Am. Jour. Pharm. **79**: 217–229. *f. 1–39.* My 1907.

Reprinted from Bot. Gaz. **34**: 341–354. 20 N 1902.

Kraemer, H. A text-book of botany and pharmacognosy. Ed. 2. i–vi. 1–840. *f. 1–321.* Philadelphia. [Ap] 1907.

Kränzlin, F. *Scrophulariaceae-Antirrhinoideae-Calceolarieae.* Das Pflanzenreich 4^{257C}: 1–128. *f. 1–21.* 5 Ap 1907.

Leavitt, R. G. The geographic distribution of closely related species. Am. Nat. **41**: 207–240. 1 My 1907.

Lewis, W. S. Pubescence of plants. Am. Bot. **12**: 66. Ap 1907.

Lindly, J. M. Some of the flowering plants of Calcasieu Parish, Louisiana. Proc. Iowa Acad. Sci. **13**: 161–166. [Mr] 1907.

Lloyd, C. G. Mycological notes. 25: 309–324. *pl. 94–101 + f. 144–159.* Ap 1907.

Lorenz, A. *Catharinea* in Hartford County. Bryologist **10**: 45–47. 2 My 1907.

MacDougal, D. T. A realized mirage. Salton Sea, the wonderful desert lake where wood sinks and stones float, explored in a sailboat. Discovery **1**: 1–4. My 1907. [Illust.]

Mackenzie, K. K. A hybrid *Lespedeza.* Torreya **7**: 76–78. 15 Ap 1907.

L. hirta × *repens.*

Mackenzie, K. K. Notes on *Carex* — II. Bull. Torrey Club **34**: 151–155. 7 My 1907.

Descriptions of four new species.

Malme, G. O. A. Ein Beitrag zur Asclepiadaceen-Flora von Parana. Bull. Herb. Boiss. II. **7**: 407–410. 27 Ap 1907.

Marquette, W. Manifestations of polarity in plant cells which apparently are without centrosomes. Beih. Bot. Centralb. $\mathbf{21}^1$: 281–303. *pl. 13.* 15 Ap 1907.

Massee, G. Fungi exotici: VI. Kew Bull. Misc. Inf. **1907**: 121–124. Ap 1907.

Includes *Panus Bartlettii* sp. nov., from British Guiana.

Michael, H. A. Studies in plant and organic chemistry and literary papers. 1–423. *pl. 1, 2. portrait.* 1907.

Mottet, S. *Oxycoccus macrocarpus.* Rev. Hort. **79**: 187, 188. *f. 64.* 16 Ap 1907.

Native of North America.

Nash, G. V. Costa-Rican orchids — I. Bull. Torrey Club **34**: 113–124. *pl. 7, 8.* 7 My 1907.

Includes *Elleanthus caricoides* and *Zygostates costaricensis*, spp. nov.

Nelson, A. Is this birch new? Bot. Gaz. **43**: 279–281. *f.* 15 Ap 1907.

Nelson, A. Some new western plants and their collectors. Proc. Biol. Soc. Wash. **20**: 33–39. 27 Mr 1907.

New species in *Fritillaria*, *Roripa*, *Sidalcea*, *Zauschneria*, *Mertensia*, *Douglasia*, *Coleosanthus*, *Machaeranthera* (2), and *Antennaria*.

Nichols, J. T. New stations for *Chamaecyparis* on Long Island, New York. Rhodora **9**: 74. 30 Ap 1907.

Niles, G. G. Rare bog plants of Pownal. Bull. Vt. Bot. Club **2**: 16–19. *map.* Ap 1907.

Niles, G. G. Through Bristol swamp. Plant World **10**: 73–80. *f. 15.* Ap 1907.

Oleson, O. M. & Somes, M. P. A flora of Webster County, Iowa. Proc. Iowa Acad. Sci. **13**: 25–58. [Mr] 1907.

Olsson-Seffer, P. Visits to some botanic gardens abroad. Plant World **10**: 27–31. *f. 9–11.* [Mr] 1907; 58–62. *f. 14.* Mr 1907; 84–90. *f. 16–18.* Ap 1907.

Osterhout, G. E. Nuttall and Pursh and some early spring flowers of Colorado. Plant World **10**: 80–84. Ap 1907.

Pammel, L. H. Some diseases of Rocky Mountain plants. Proc. Iowa Acad. Sci. **13**: 89–114. [Mr] 1907.

Petitmengin, M. G. C. Études comparatives sur la flore Andine et sur celle des Alpes Européennes. Bull. Acad. Internat. Géogr. Bot. **16**: 2–11. 22 Ja 1907.

Phelps, O. P. Noteworthy plants of Salisbury, Connecticut. Rhodora **9**: 74, 75. 30 Ap 1907.

Pilger, R. Erganzungsheft II zu Engler & Prantl, Nat. Pflanzenfam. 193–288. *f. 26–45.* 1907.

Plitt, C. C. *Webera sessilis* and ants. Bryologist **10**: 54, 55. 2 My 1907.

Poyser, W. A. *Isoetes saccharata* in the Delaware River. Fern Bull. **15**: 18. [Ap] 1907.

Purpus, A. *Eryngium proteaefolium.* Gard. Chron. III. **41** : 248. *f. 106, 107.* 20 Ap 1907.

Purpus, J. A. *Mamillaria petrophila* Brandegee. Monats. Kakteenk. **17** : 55, 56. 15 Ap 1907. [Illust.]

Quehl, L. *Mamillaria Knippeliana* Quehl n. sp. Monats. Kakteenk. **17** : 59, 60. 15 Ap 1907.

Ramaley, F The silva of Colorado I. Trees of the pine family in Colorado. Univ. Colo. Stud. **4** : 109–122. F 1907. [Illust.]; II. The poplars, aspens and cottonwoods. Univ. Colo. Stud. **4** : 187–197. *f. 1–6.* Ap 1907.

Rand, E. L. *Arceuthobium pusillum* at Mt. Desert. Rhodora **9** : 75, 76. 30 Ap 1907.

Rehder, A. *Quercus prinoides* Willd. var. *rufescens* var. nov. Rhodora **9** : 60–62. 8 Ap 1907.

Rehder, A. *Rhododendron albiflorum* with double flowers. Bot. Gaz. **43** : 281, 282. 15 Ap 1907.

Rehm, H. *Ascomycetes* exs. fasc. 38. Ann. Myc. **5** : 78–85. 30 Mr 1907.

Several American references, including *Dermatea olivascens* sp. nov. from New Mexico.

Ricker, P. L. Third supplement to new genera of fungi published since the year 1900, with citations and original descriptions. Jour. Myc. **13** : 63–67. 30 Ap 1907.

Robertson, G. R. Southern station for *Botrychium simplex.* Fern Bull. **15** : 17. [Ap] 1907.

Robinson, B. L. On the rules of botanical nomenclature adopted by the Vienna congress. Rhodora **9** : 29–55. 8 Ap 1907.

Robinson, C. B. Contributions to a flora of Nova Scotia. I. Plants collected in eastern Nova Scotia in August, 1906. Bull. Pictou Acad. Sci. Asso. **1** : 30–44. [My] 1907.

Robinson, C. B. *Ipomaea triloba* L. in the Philippines. Torreya **7** : 78–80. 15 Ap 1907.

Rooney, B. M. Orchids of St. Johnsbury. Bull. Vt. Bot. Club **2** : 29. Ap 1907.

Rowlee, W. W. Localization of plants in the Finger Lake region and the adjacent Ontario lowlands of central New York. Torreya **7** : 69–73. 15 Ap 1907.

Rowlee, W. W. Two new willows from the Canadian Rocky Mountains. Bull. Torrey Club **34** : 157–159. 7 My 1907.

Salix albertana and *S. Maccalliana* spp. nov.

Rugg, H. G. *Osmunda regalis orbiculata.* Bull. Vt. Bot. Club **2**: 25, 26. Ap 1907.

Ruggles, B. P. Hartland grasses. Bull. Vt. Bot. Club **2**: 34, 35. Ap 1907.

Saccardo, P. A. New fungi from New York. Jour. Myc. **13**: 45–48. 30 Ap 1907. [Illust.]

New species in *Pleosphaeria, Sphaeropsis* (2), *Diplodia, Hymenopsis,* and *Zygodesmus.*

Saunders, C. F. Birds as botanists. Am. Bot. **12**: 64. Ap 1907.

Schaffner, J. H. Development of the forest belts in the northwestern part of Clay County, Kansas. Trans. Kansas Acad. Sci. **20**²: 74–79. [Ap] 1907.

Schlechter, R. *Orchidaceae* novae et criticae. Decas IX. Repert. Nov. Sp. **3**: 276–280. 31 Ja 1907.

Includes two new species of *Stelis* and one of *Pleurothallis* from Costa Rica.

Schneider, C. K. Conspectus generis *Amorphae.* Bot. Gaz. **43**: 297–307. 16 My 1907.

Includes *A. Schwerini* sp. nov., from North Carolina.

Seaver, F. J. Notes on the Discomycete flora of Iowa. Proc. Iowa Acad. Sci. **13**: 71–74. [Mr] 1907.

Seely, H. M. About red clover. Bull. Vt. Bot. Club **2**: 30, 31. Ap 1907.

Shafer, J. A. Report on a visit to the island of Montserrat. Jour. N. Y. Bot. Gard. **8**: 81–88. Ap 1907.

Shaw, C. H. Upon the teaching of the subject of respiration. Science II. **25**: 627–630. 19 Ap 1907.

Shear, C. L. & Wood, A. K. Ascogenous forms of *Gloeosporium* and *Colletotrichum.* Bot. Gaz. **43**: 259–266. 15 Ap 1907.

Shull, G. H. Elementary species and hybrids of *Bursa.* Science II. **25**: 590, 591. 12 Ap 1907.

Shull, G. H. Some latent characters of a white bean. Science II. **25**: 828–832. 24 My 1907.

Smith, E. F. & Townsend, C. O. A plant-tumor of bacterial origin. Science II. **25**: 671–673. 26 Ap 1907.

Smith, J. D. Enumeratio plantarum guatemalensium, necnon salvadorensium, hondurensium, nicaraguensium, costaricensium. **8**: 1–221. 1907.

Spalding, V. M. Spring flowers of the Arizona desert. Plant World **10**: 63, 64. Mr 1907.

Sprague, T. A. *Calliandra portoricensis* var. *major.* Curt. Bot. Mag. IV. **3**: *pl. 8129.* Ap 1907.
Native of Mexico and Central America.

Stapf, O. *Arctostaphylos Manzanita.* Curt. Bot. Mag. IV. **3**: *pl. 8128.* Ap 1907.
Native of California.

Stevens, F. L. List of New York fungi. Jour. Myc. **13**: 67–72. 30 Ap 1907.

Stevens, F. L. *Puccinia* upon *Melothria.* Bot. Gaz. **43**: 282, 283. *f.* 15 Ap 1907.

Stockberger, W. W. Pinkroot and its substitutions. Pharm. Rev. **25**: 2–21. *f. 1, 2.* F 1907; 66–84. *f. 11–18.* Mr 1907; 97–107. Ap 1907.

Stowe, S. B. Winter key to Ohio chestnuts. Ohio Nat. **7**: 118. 18 Ap 1907.

Straw, C. E. Additions to the flora of Stowe. Bull. Vt. Bot. Club **2**: 25. Ap 1907.

Strong, M. The finding of the male fern in Woodstock. Bull. Vt. Bot. Club **2**: 24. Ap 1907.

Terry, E. H. Herbarium-making of a century ago. Bull. Vt. Bot. Club **2**: 28. Ap 1907.

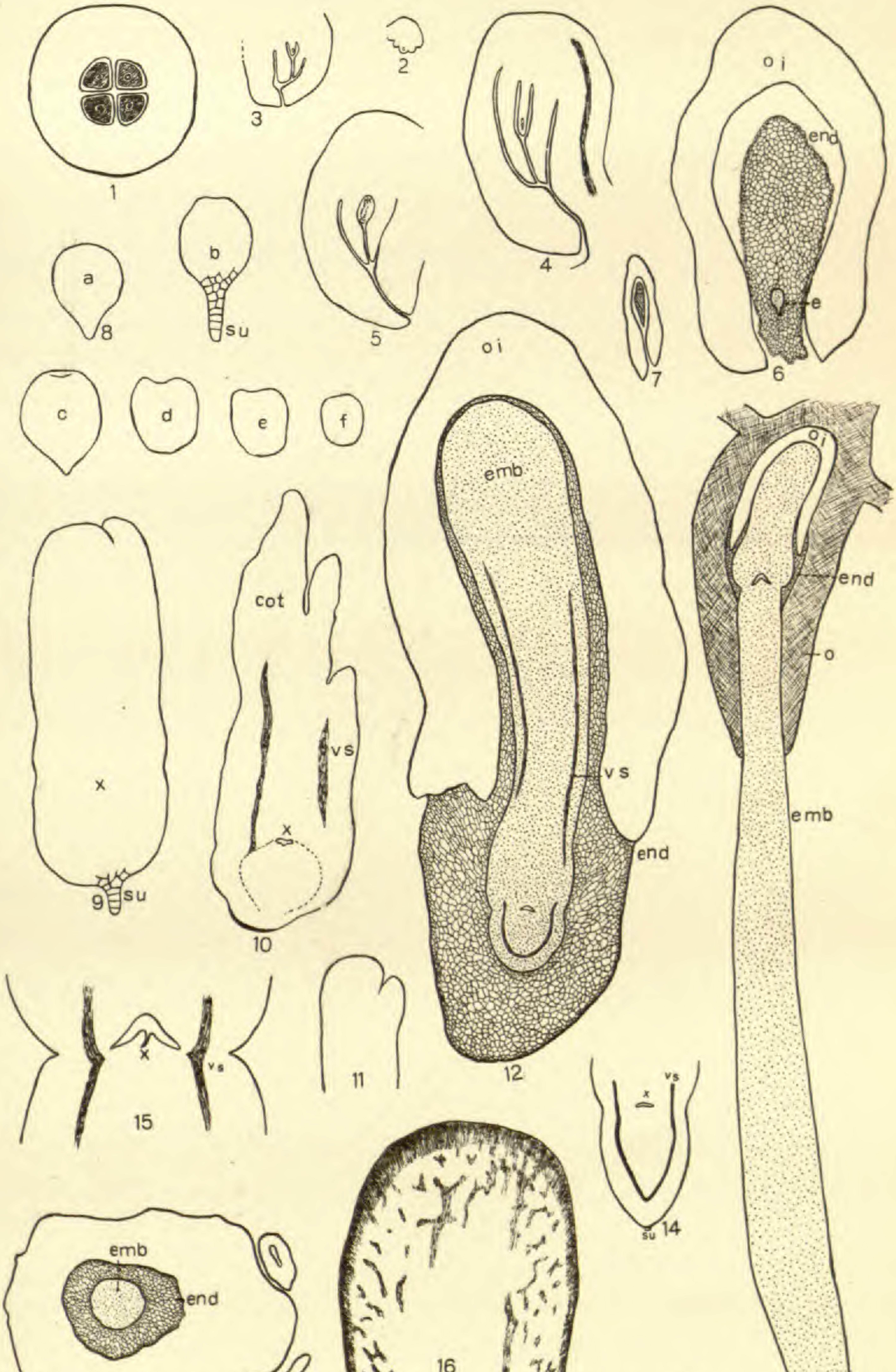
Thériot, I. *Weissia brasiliensis* Duby. Bull. Herb. Boiss. II. **7**: 277, 278. 31 Mr 1907.

Uhlbrich, E. Ueber die systematische Gliederung und geographische Verbreitung der Gattung *Anemone* L. Verh. Bot. Vereins Prov. Brandenb. **48**: 1–38. 1907.

Ule, E. II. Beiträge zur Flora der Hylaea nach den Sammlungen von Ule's Amazonas-Expedition. Verh. Bot. Vereins Prov. Brandenb. **48**: 117–208. *pl. 1, 2.* 1907.

Underwood, L. M. Concerning *Woodwardia paradoxa,* a supposedly new fern from British Columbia. Torreya **7**: 73–76. 15 Ap 1907.

Wilson, G. W. & Seaver, F. J. *Ascomycetes* and lower fungi. Jour. Myc. **13**: 48–52. 30 Ap 1907.



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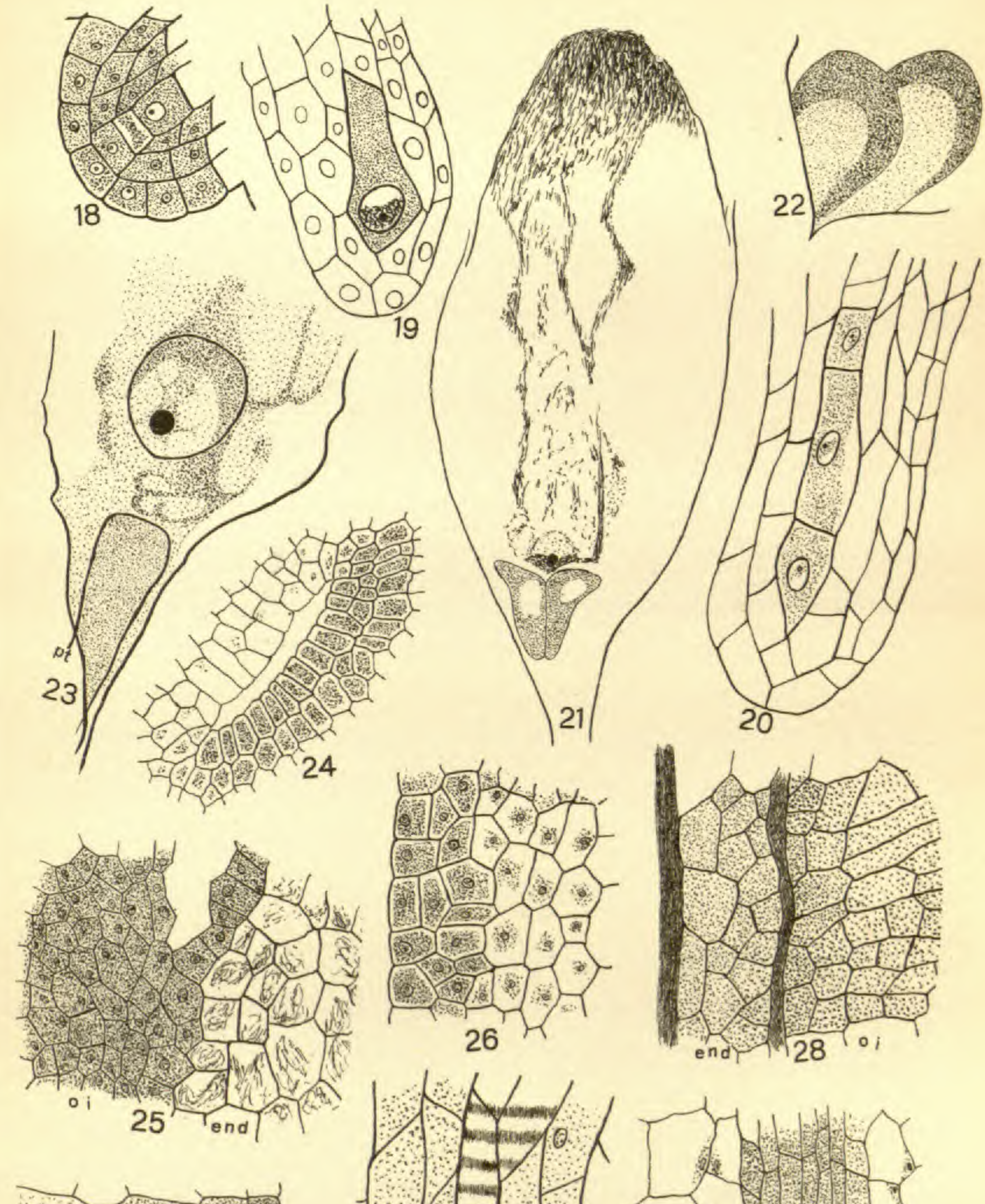

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Spruce, Richard. *Hepaticae* Bolivianae, in Andibus Boliviae orientalis, annis 1885–6, a cl. H. H. Rusby lectae. Pages 113–140. 20 Ja 1890.

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CONTENTS

The stem of Ibervillea Sonorae. (Plate 24.) . . ALICE ADELAIDE KNOX 329
New species of fungi . . . . CHARLES HORTON PECK 345
A midsummer journey through the coastal plain of the Carolinas and Virginia . . . . ROLAND M. HARPER 351
INDEX TO AMERICAN BOTANICAL LITERATURE 379

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BULLETIN

OF THE

TORREY BOTANICAL CLUB

JULY, 1907

The stem of Ibervillea Sonorae*

ALICE ADELAIDE KNOX

(WITH PLATE 24)

Among the representatives of the *Cucurbitaceae* at the New York Botanical Garden is a group of plants of *Ibervillea Sonorae*. They were brought from the southwest by Dr. D. T. MacDougal in 1902, and are interesting because of their unusual character for cucurbits as well as for their adaptation to desert conditions. A description of the plants is given by Miss J. T. Emerson collaborating with Mr. W. W. Welker in a paper, in coarse of preparation, on its chemistry and pharmacology (34). FIGURES A and B show the organographic characters of the species, both at the adult stage in its native habitat, and as a seedling from four to five years old. The "large projecting root" (21) of *Ibervillea* in the specimens in the greenhouses of the Botanical Garden reaches a diameter of from 25 to 30 cm. In the desert this enormous tuberous growth lying in the dry sand looks like a gray, dust-covered boulder. Frequently irregularities of shape give it still more the effect of stone, and it is only when the cortex is flecked off that one discovers the healthy green color beneath the superficial layer. From the tubers arise yearly long flexible liana-like shoots which reach a length of three or more meters. The shoots are round, smooth and green above, brown-gray and gray-spotted or streaked below. The flowers are dioecious, the tendrils branched, and the leaves bright-green and twice three-cleft as is so frequently the case throughout the family. The fruit is said to

*A research pursued in the laboratories of Barnard College during the winter of 1904–1905.

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be "amber-colored" (21) and one and a quarter to one and a half inches long; none has ripened in the greenhouse, as the flowers there are staminate only. The plant is able to persist in its arid habitat with remarkable vitality. In fact, so provident is it of water and nutritive substances that one in the museum case at the Garden which has been lying on a board since 1902 is in 1907 still sending up yearly shoots bearing leaves and tendrils. Every fall the shoots die back and sprout again early the next spring. The Indians of the desert call the plant "Guarequi," and a decoction of its root is much used as a cathartic.

The forms which show perennial growth among the *Cucurbitaceae* are comparatively few in number, and many of them are tropical species or types seldom seen. Of those which have tuberous stems or roots the most familiar are *Thladiantha* and *Bryonia*. The large slices of the *Bryonia* root are well known in pharmacy, and Weiss (10) refers to a root 20 cm. in diameter and 10 kg. in weight. More work has been done on *Bryonia* than on any other perennial form. It was pictured by Jacquin in 1774 as an example of perennial growth, and reference is made to it in most of the papers mentioned below.

The history of *Ibervillea* is given in full by Miss Emerson, so that only the most important citations are noted here. The first species of the genus was described by Gray (1) in 1850, from Texas and Mexico, as *Sicydium Lindheimeri*. In 1881 Cogniaux (11) separated from *Sicydium* the genus *Maximowiczia* Cogn., with three species. The first description of *Maximowiczia Sonorae* was published by Sereno Watson (21) in 1889. It was one of the numbers of the collection of Dr. E. Palmer found in 1887 about Guaymas, Mexico. Not only the range of *M. Sonorae* but that of the entire genus is purely American. As the name *Maximowiczia* had been previously used for another genus, the name *Ibervillea* was given to the present one by Greene (27) in 1895, and the species here discussed named by him as *Ibervillea Sonorae*. The only anatomical study of the genus has been made by Fischer (17), who included it in his thorough general survey of the family. It will be of advantage first to describe the normal structure of the Cucurbitaceous stem. The terminology used is that of Haberlandt (32).

The stems of cucurbits are usually five-angled, and only in exceptional cases seven-angled or terete. A transverse section through a stem of this type, or five-angled stem, exhibits two circles of bundles, five in each circle, the outer standing in the angles, the inner in the furrows. The bundles are normally all bicollateral, possessing an outer leptome, a hadrome region, and an inner leptome. Both inner and outer leptome contain very large and prominent sieve-tubes, as well as much leptome parenchyma. The common opinion seems to be that there is no inner cambium, though the outer cambium is a wide and active zone peripheral to each hadrome strand. The bundles are widely separated, and lie in a large-celled ground parenchyma. The pitted vessels of the hadrome are exceptionally large, and in older stems are braced by thyllae. A continuous ring of stereome borders the outer limit of the pericycle, and there is a row of starch-filled cells, accompanied by various arrangements of chlorophyl-free collenchyma just beneath the epidermis. There are frequently hairs or glands on the epidermis, and sieve-tubes scattered through the cortex and pericycle. Inner secretory passages are wanting, and deposits of calcium carbonate seem to occur only in the leaves. As the stems are mostly annual a periderm does not form, and for the same reason no true bark is found. Many species show a lysigenous cavity in the pith making the stem hollow, and because its secondary growth chokes this cavity and fills it up *Bryonia dioica* is mentioned as peculiar.

In describing *Ibervillea* it will be taken first as a primary stem at the end of the first year, and later as a secondary stem, and a diagram of the transverse section of the young shoot cut 24 cm. from its tip where the stem was fresh and green is given in PLATE 24, FIGURE 1. This shows the general outline of the section to be irregular with a possible tendency toward the seven-angled type, though its external appearance is smooth, the number of the blunt "angles" varies, and as it grows older it is always terete. The bundles are arranged in two rings, those of the outer being smaller. The number of those in the inner ring is always five, that of the outer ring varies from five to seven or even nine. An attempt is at once suggested to place the stem in one of the classes made by Lotar (12), Petersen (14), or Tondera (31). Different numbers of bundles are given by these authors for the same form, but in *Ibervillea*, as Weiss (15) found to be the case, the number may vary not only in the same species and the same plant, but even in the same internode. In a well-developed branching stem with a length of 310.6 cm. there were at the base ten bundles, at the first fork twelve bundles in each branch, thirteen in the main branch above, and in its side shoots most frequently twelve, but sometimes thirteen or fourteen. Lotar (12), too, says that differences may occur, due to the temporary splitting of individual bundles.

In the single growing tip which my material afforded there were eleven procambial strands, so that the number is not derived from a primitive procambial ten, but doubtless varies in the separation of the young meristems. The structure of the bundle is altogether normal. The well-formed hadrome, which is cut off centrifugally by the cambium which lies along its outer surface, shows the usual succession of ring, spiral, and pitted ducts, and the last are very large, and always surrounded by wood-parenchyma. The outer leptome contains large sieve-tubes with prominent sieve-plates and companion-cells; there is also much leptome-parenchyma and the outer and inner leptome are alike in their constituent elements. The outer cambium region consists of several rows of brick-shaped cells, while the inner or medullary cambium (FIGURE 10) shows cells more polygonal in outline, and is more localized in its later divisions.

The ground-tissue in *Ibervillea* is always solid, consisting of large parenchyma-cells of which the walls are more and more conspicuously pitted as the stems grow older. The cells are ordinarily full of starch which occurs in large grains crowded together so densely that the tissues of the bundles stand out in sharp contrast. Several rows of large cells intervene between the bundles and the stereome-ring. The latter (FIGURE 2, *st*) is from two to three cells wide and consists of lignified fibrous cells marked with cross-shaped pits. It breaks up as soon as the stem begins to enlarge, and the dilatation-changes progressively fill up the interstices. Without the stereome-ring is found a row of starch-containing cells (FIGURE 2, *end*) with the radial walls at right angles to the tangential, and slightly more oblong in cross-section than the adjacent parenchyma-cells, which Van Tieghem (13) cites as the endodermis. Outside of the endodermis there are two layers of chlorenchyma with autochthonous starch (FIGURE 2, *ch*), and then two layers of angle-collenchyma (*col*), chlorophyl-free, bordered by a large-celled epidermis. There are occasionally stomata, but they show no special adaptations to desert conditions, nor is the cutin-layer unusually thick.

There remains to be mentioned a system which has been admirably treated by Fischer (17), namely the sieve-tubes which are found scattered singly or in groups throughout the pericycle and the cortex. The discovery of supernumerary sieve-tubes just inside the stereome-ring was made by Sanio (4) in 1864 in *Cucumis sativus*. DeBary (6) found them in the same position in a number of other species, but Fischer added two new categories to those of Sanio and de Bary. To the study of their development and physiology he devotes 109 pages. He finds sieve-tubes with companion-cells and "nebencellen" without as well as within the stereome-ring. There are also horizontal series which he designates *commissural* sieve-tubes and sieve-bundles which connect with the leptome of the bundles and with each other. These sieve-tubes are to be seen only in the very young tips, for they function during the period of elongation, and owing to the pressure of the growing tissues about them soon lose their typical structure. Fischer describes their progressive phases of development according to Sachs' phases of growth, and treats especially of the meristematic period of elongation. The first sieve-tubes to appear in the stem, which function before any of the others, lie on the edge of the outer procambial strands between the more typical phloem region and the mother-tissue of the stereome-ring. At this stage the procambial strand borders closely on this mother-tissue, but later by the development of parenchyma they become more isolated from the bundle and stand out in the pericycle. In *Ibervillea* they are very prominent, with large conspicuous sieve-plates.

Following these there appear first the sieve-tubes of the outer leptome, and with them the subepidermal ectocyclic sieve-cells and the ectocyclic cells which are found among the collenchyma. The inner leptome comes next in order, and just before the end of the meristematic elongation the endocyclic sieve-tubes mature. The commissural strands may originate with, but never before, the endocyclic groups. All of these small sieve-bundles without the leptome and such commissural sieve-tubes as serve to connect them with each other are transitory in their activity, and by the end of the elongation-period are obliterated. The obliteration follows the reverse of the order in which they appeared, so that the endocyclic succeed the ectocyclic, and the commissures are the last to lose their identity. Fischer holds that the first sieve-tubes help to distribute the proteid substances to the young tissues of the stereome. Late they are reinforced in their office by the endocyclic sieve-tubes. They develop from the procambial strand, while the endocyclic sieve-tubes are derived partly from the mother-tissue of the stereome and partly from the ground-parenchyma. Ectocyclic sieve-tubes come from the mother-cells of the collenchyma and stereome, and at first support the young collenchyma, which grows rapidly in the early stages. When it has thickened and reached its maturity the outer ectocyclic cells are obliterated. The remaining ectocyclic tubes in the chlorenchyma and all commissural cells come from the secondary meristems derived from the parenchyma-cells of the pericycle and cortex.

The endocyclic sieve-tubes, as indicated above, nourish the developing stereome-ring and when its permanent character is determined they are obliterated. The commissures are obliterated last of all, and the order of their degeneration is one of the strong reasons why Fischer concludes that they serve to withdraw the proteid substance from the endocyclic sieve-tubes and from each other into the leptome of the bundles. The office of the sieve-tubes of the bundles and the course of their obliteration needs no special comment; the development of the procambial strand and the support of the growing cambium is dependent upon their activity. The sieve-tubes outside of the stereome-ring are connected with those inside only at the nodes, so that the endodermis and the mechanical tissue are never broken by the commissures.

The genera of the *Cucurbitaceae* are divided into classes upon the character of the supernumerary bundles, of which *Maximowiczia* (*Ibervillea*) belongs to the *Cyclanthera* type. There are said to be present countless endocyclic sieve-tubes (FIGURE 4) united partly with each other and partly with the vascular bundle by *very few* commissures. The *Ibervillea* at the Garden also possesses

(FIGURE 3) many ectocyclic sieve-tubes, but in only one or two instances has a young commissure appeared. In these cases the length of the members of the sieve-tube was that of the diameter of the mother parenchyma-cell, the two separated by a large, well-formed vertical sieve-plate. The peripheral sieve-tubes are easily seen in the very young stem (FIGURES 3 and 4) while the first tracheal elements are appearing and the sieve-plates are exceedingly delicate and distinct.

The obliteration of the sieve-tubes Fischer treats separately. They sometimes entirely lose their identity, owing to the pressure of the surrounding tissues and the torsions of the stem, but sometimes when the callose breaks down and the contents begin to degenerate, there appears in them a slimy substance giving to the older stem an appearance which leads him to say: "One may see that we have here another category of cell-derivatives, that our commissures and ectocyclic sieve-tubes belong to a hitherto overlooked latex-system," and again he says that the presence of these ramifying cells in the stem produces the effect of an internal secretory system. He takes up this point at length in a later paper (20) and refers to Hanstein's theory of the contents of the obliterated sieve-tubes as "Lebensaftgefässe," where Hanstein assumed that the contents were active while they were in reality hard and gum-like. A section through a stem of *Ibervillea* after its period of elongation is completed (FIGURES 9 and 2) shows inside of the medullary leptome, peripheral to the outer leptome, and through the pericycle and cortex, groups of cells both in structure and position identical with the obliterated sieve-elements. They contain a highly refrangible homogeneous substance of a brownish-yellow color which makes them very conspicuous. They occur ordinarily in pairs, frequently in groups of from three to twelve (FIGURES 5 and 6). The contents color orange with hydrochloric acid and phloroglucin, while the contents of the active sieve-tubes remain lemon-yellow. With Millon's reagent they turn brick-red.

Longitudinal sections frequently show the old sieve-plates, and the companion-cells seem to have contents identical with those of the sieve-tubes. The groups of cells are rarely seen to anastomose in young stems, but they frequently run a tangential or radial course, and may connect within a short distance in this manner. In older stems, especially where they widen toward the tuber, they form an elaborate ramifying system throughout the periphery and the pith, as well as in connection with the supernumerary bundles which then develop (FIGURES 5 and 8). When such stems, perhaps two and a half centimeters in diameter, are cut, the contents of these passages ooze out, forming a large viscid transparent drop which covers the wound and which immediately hardens, forming a variety of wound-gum. When the sieve-tubes retain their content so generally, and when the contents are so evidently secretory in nature, one seems to be justified in calling them a secretory system of the secondary stem, and might take exception to Solereder (28) for saying generally for the entire family "Innere Sekretbehälter fehlen."

The secondary growth in the sense of the growth of a second year is illustrated in FIGURE 9. Its most prominent features are the increase in the size of the bundles and in the amount of leptome and hadrome, the great width of the medullary rays, the breaking of the stereome-ring, and the presence of a prominent periderm entirely surrounding the terete stem. One is also struck by the absence of any appearance of distortion due to the compression of the tissues, as this is true only in the horny regions of the leptome. The increase in the size of the bundles has been effected by the constant activity of both inner and outer cambium.

The amount of leptome produced is enormous. The outer cambium gives rise to all the hadrome elements, vessels, and wood-parenchyma, and by its centrifugal divisions also generates the outer leptome. It consists of a succession of brick-shaped cells which spread across the entire tangential surface of the hadrome. Peripheral to this is the mass of the outer leptome which contains parenchyma and many large conspicuous sieve-plates in the sieve-tubes. The inner leptome is similar to the outer in character, but the cambium is less regularly distributed. It is represented by a group of meristematic cells just within the inner tangential surface of the hadrome (FIGURE 11 c_2). These cells are polygonal in outline and are confined to the middle of the surface. The lines of cells x and y can be traced back to this origin. In many bundles a second series of divisions is localized so as to make a distinct line across the outer surface of the leptome (as in FIGURE 11) with the appearance of a normal cambium. The line does not always show distinctly and is more apt to occur in large bundles.

These conclusions concerning an inner cambium do not agree with those of Bertrand (9), Lotar (12), and Schenck (26), who found hadrome formed by the inner cambium, nor with those of Fischer (17), who remarks the absence of an active inner cambium, saying that for a while the still procambial cells have the appearance of one. It is rather the state of things noted by Vesque (5), who claims as a false cambium one which produces only leptome; and afterward found by Scott and Brebner (25) in *Thladiantha*. The latter authors state that when a cambium is present it produces leptome only.

Around the oldest tangential borders of the leptome-regions are found the horny walls of the disorganized (obliterated) sieve-elements as well as masses of cells filled with yellow-brown gum whose localization is illustrated in FIGURE 9. The breaks in the stereome-ring are filled up with parenchyma, and dilatation-changes also occur in the medullary rays and the pericycle by which they keep pace with the increase in the size of the stem.

It occasionally happens, as Hérail (19) found to be the case in *Ecballium*, that the tangential divisions of the parenchyma may be so localized between two bundles as to give the appearance of an interfascicular cambium. Potter (22) found an interesting interfascicular cambium in *Thladiantha* which connected bundles of the inner and outer circles, showing as de Bary had said that the two concentric rows function as a single ring. New medullary rays are not formed yearly. In large old stems two or perhaps three may occur (FIGURE 13), but this is in very old plants, and they develop only at long intervals. The periderm is superficial in origin. It arises from the layer of the collenchyma just beneath the epidermis. It soon becomes spotted or streaked with deposits of calcium carbonate in the radial and tangential walls of the phellem. The epidermis breaks away over the encrusted areas, and the gray color which appears in the stem is due to the exposure of such groups of cells. When the calcium carbonate is dissolved out with hydrochloric acid, the walls of the cells give the lignin reaction with phloroglucin.

A section at the base of a stem two and a half centimeters in diameter shows a new feature of considerable interest. This is the appearance in the medullary rays of supernumerary leptome-bundles which Pitard (30) calls tertiary bundles, consisting of semicircular meristematic areas of which the long axes of the meristems are

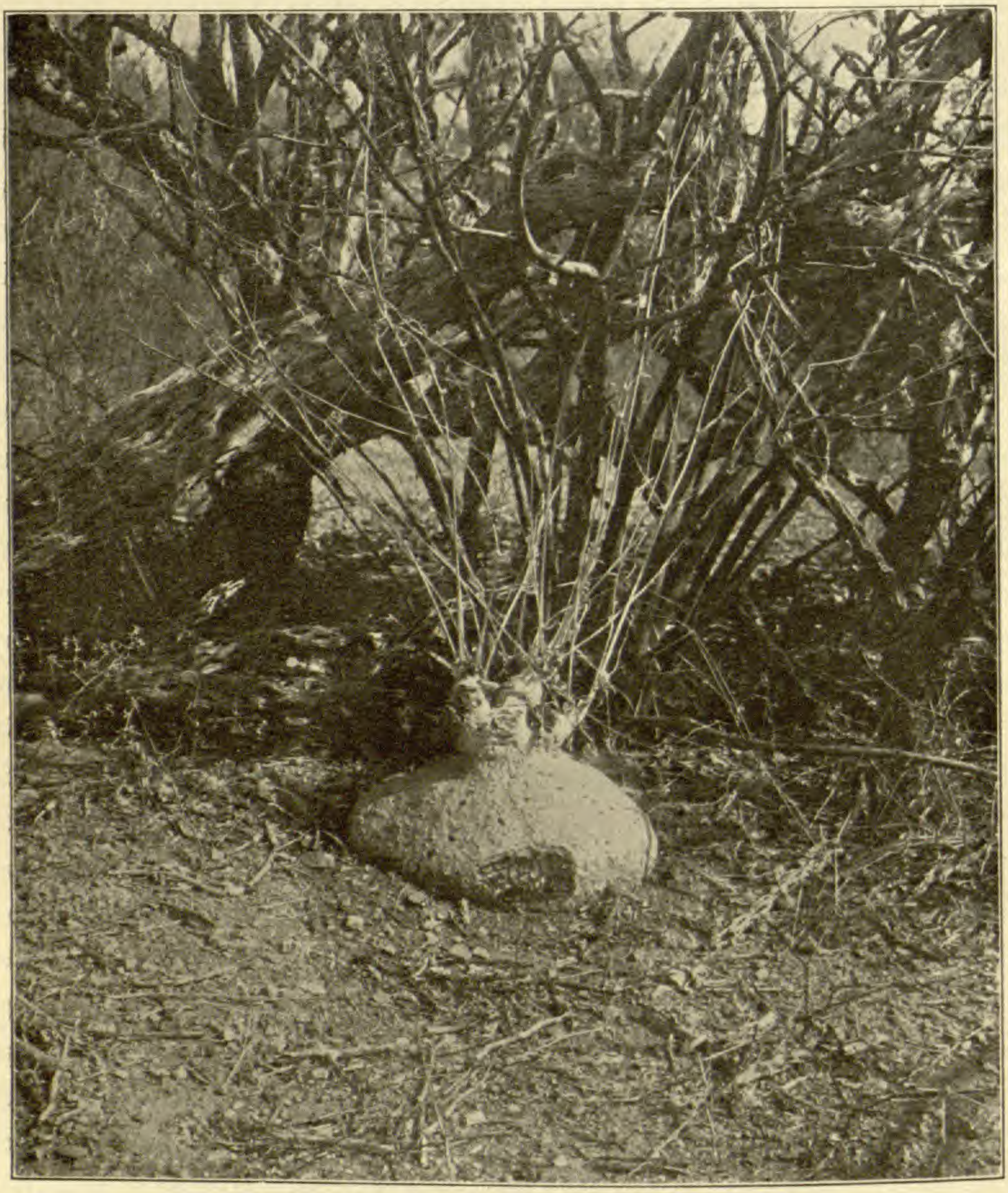

FIGURE A. *Ibervillea Sonorae* in its native habitat.*

parallel with the medullary rays, so that the axis of any bundle is at right angles to that of the primary bundle next to it. The bundles frequently appear to be collateral and contain hadrome elements on the side next the wood of the primary bundles. The phenomenon is one not infrequently found among the *Cucurbitaceae*.

* This photograph was used for *plate 16* of Carnegie Inst. Publ. No. 6.

It is treated by Leisering (29), deBary (6), Morot (18), Hérail (19), VanTieghem (24), and Weiss (15). Weiss pictures such bundles in the root of *Bryonia*, where masses of leptome are found to be associated with hadrome elements. He concludes that tracheae are separated by dilatation-parenchyma from the primary masses of the hadrome, and serve as centers of meristematic division in the ground-parenchyma, while the semicircular meristem gives rise to the leptome. The meristematic parenchyma-cells are said to come originally from the primary cambium. Scott and Brebner (25) describe their work with *Thladiantha*. They find, elaborating Dutailly's treatment of the same form (7), the elements of the hadrome separated out by dilatation-changes, but differ from Weiss in finding that the leptome bears no constant relation to the tracheae, and that it is partly formed directly from the cambium. This work in each case is on the root. In *Ibervillea* the general dilatation extends to the unlignified parenchyma of the hadrome, and of the parenchyma adjacent to the bundle. Such parenchyma lateral to the hadrome begins to divide and sometimes tracheae are "nipped" off by the changes and isolated with the meristematic cell. In either case the formation of new cells in the dilatation pushes the meristem out into the medullary ray. The meristem then produces leptome but never hadrome, and as the stem increases in size the course of the bundles becomes irregular, so that it is often easy to see the sieve-tubes in longitudinal position. FIGURE 12 shows such a meristem in the midst of a starch-filled parenchyma.

One of the characters of the older secondary stems is the anastomosing of the bundles. Both the leptome and the hadrome frequently run a horizontal course from bundle to bundle, so that the center of the stem is a medley of supernumerary sieve-regions and it is impossible to trace any regular arrangement. As a whole the stem retains the character of its first secondary growth. The parenchma of the medullary rays continues to divide tangentially and radially and the increase in pericycle and cortex is through the same sort of change. Minute fragments are all that remain of the stereome-ring, though opposite these one can still trace the old cortical parenchyma. A relatively large production of phelloderm adds most of the soft tissue in the outer part of the periphery of the tuber, and like the ground-parenchyma the walls of all these cells are pitted and very thick. The periderm renews itself constantly and continues to be sloughed off, while the abundant calcium carbonate gives the gray color to the entire surface. There is no true bark, nor are there any deeper-seated phellogens. The course of the bundles has not been investigated. De Bary says that the bundles of the *Cucurbitaceae* are bundles of the leaf-trace running up two internodes. Accounts are given by Bertrand (9) and by Lotar (12), and later by Leisering (29) and by Tondera (31). The latter, by sections and maceration combined, has secured details of the complicated connection at the nodes which he presents in a series of elaborate diagrams.

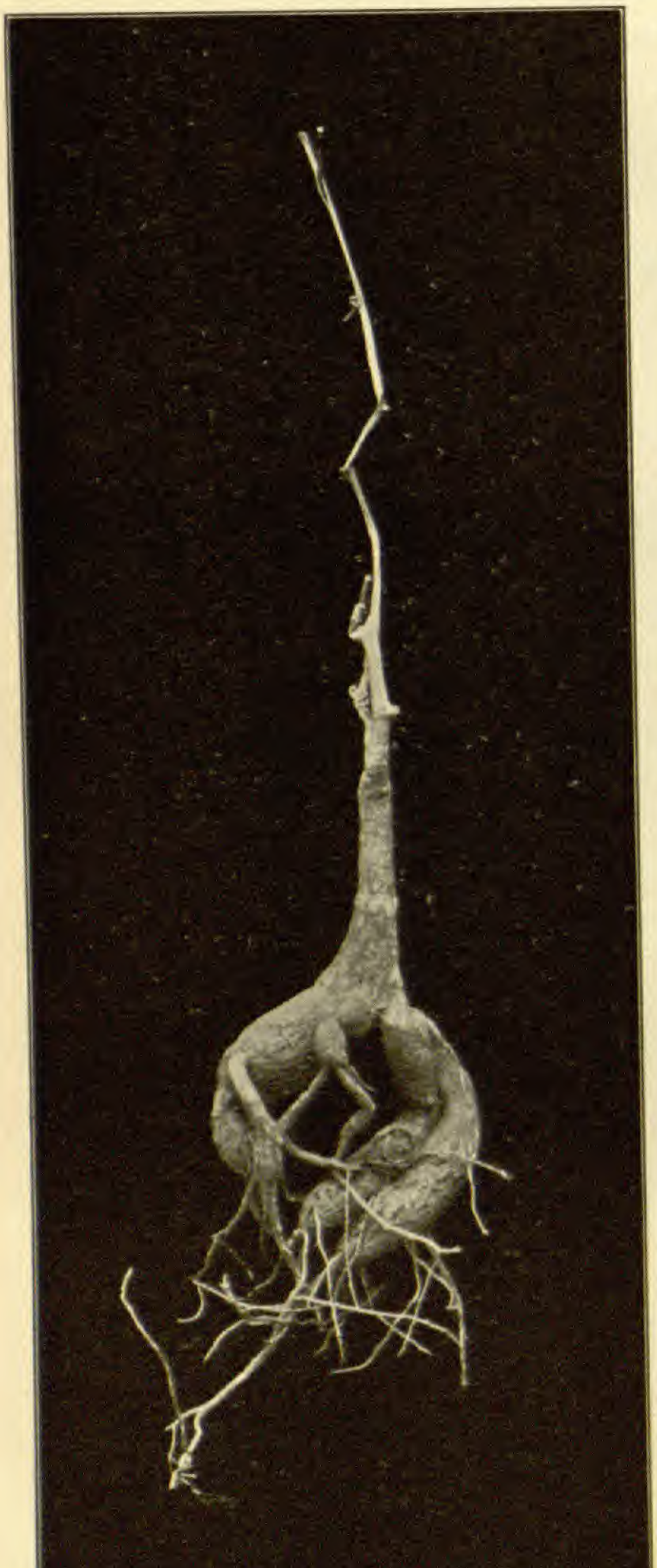

FIGURE B. *Ibervillea Sonorae*, four or five years old.

A reference to the description of *Ibervillea* (21) will remind one that this tuber is ordinarily referred to as a root, and that its closest analogies seem to be the roots of *Bryonia* and *Thladiantha*. The picture of the old plant (FIGURE A), with its shoots rising from the tuber, shows the gradual enlargement of the stem, though the appearance of the seedling (FIGURE B) would indicate that the swollen portion includes root, hypocotyl and stem. As far as this investigation goes the formation is stem, and at least half of the swollen portion may claim that distinction, and as the bases of the shoots are sometimes four and a half centimeters broad one can get intermediate stages between green lianas and tubers. The age of the plants is difficult to estimate. The seedling photographed has been in the greenhouse four years. The shoot in FIGURE 9 is over two years old. The size of the ducts must seemingly be taken as the criterion, and each two or possibly three large tracheae must constitute the growth of a season. There is usually associated with the fall growth the formation of unlignified wood-parenchyma at the side of the hadrome, so that the region presents the jagged appearance noted in FIGURE 13. That the large tubers are fifty years old is doubtless a most conservative estimate.

The pharmaceutical character of the stem is only known empirically to the Indians, who regard it as very poisonous, but more so than has been found to be the case by Miss Emerson and Mr. Welker. The stem shows quantites of starch at the end of the growing season, but the shoots die back so short a distance that it is extremely improbable that the nutritive substances are withdrawn into the tuber. In the desert, the drier condition may effect a change in its habit so that the shoots shrivel further down toward its base. The mechanics of the stem after the breaking up of the stereome-ring are those of a true liana. The plant is not only quick of development in a short rainy season as well as resistant in a dry one, but it is able to twine about surrounding woody growth and to expose a relatively large leaf-surface above the sandy levels. It is perhaps to be noted that the leaves when older have a white spotted appearance, and would doubtless prove to be good material for the study of cystoliths.

The differential characters of the stem may be summed up as follows:

1. The shape is terete, with from ten to fourteen bundles.

2. It possesses endocyclic as well as ectocyclic and commissural sieve-tubes.

3. It has an active inner cambium.

4. The obliteration of the sieve-tubes changes them into a secretory system of which the contents serve as wound-gum.

5. There is a periderm with phellem and phellogen.

6. Deposition of calcium carbonate is abundant.

7. There develop in the secondary stem supernumerary leptome-

bundles formed by meristematic parenchyma of the medullary rays.

8. There is absence of interfascicular cambium and dilatation of all parenchyma.

LITERATURE

1. **Gray, A.** Plantae Lindheimerianae. Boston Jour. Nat. Hist. **6**: 194. 1850.
2. **Naudin, C.** Revue des Cucurbitacées. Ann. Sci. Nat. IV. **12**: 79–164. 1859.
3. **Naudin, C.** Espèces et variétés nouvelles des Cucurbitacées. Ann. Sci. Nat. IV. **16**: 154–199. *pl. 1–4, 13.* 1862.
4. **Sanio, C.** Über endogene Gefässbündelbildung. Bot. Zeit. **22**: 193–200, 201–208, 209–216, 221–226. *pl. 6–8.* 1864.
5. **Vesque, J.** Mémoire sur l'anatomie comparée de l'écorce. Ann. Sci. Nat. VI. **2**: 81–198. *pl. 9–11.* 1875.
6. **DeBary, A.** Vergleichende Anatomie der Vegetationsorgane der Phanerogamen und Farne. Leipzig, 1877.
7. **Dutailly, G.** Sur quelques phénpmènes déterminés par l'apparition tardive d'éléments nouveaux dans les tiges et les racines des dicotylédones. Thèse. Paris, 1879.
8. **Dutailly, G.** Recherches anatomiques et organogéniques sur les Cucurbitacées et les Passiflorées. Assoc. Fr. Avanc. Sci. **8** (1879): 711–725. 1880.
9. **Bertrand, C.** Théorie du faisceau. Bull. Sci. Départ. Nord II: **3**. 1880.
10. **Weiss, J.** Anatomie und Physiologie fleishigverdickter Wurzeln. Flora **63**: 81–89, 97–112, 113–123. *pl. 3–4.* 1880.
11. **Cogniaux, A.** In DeCandolle's Monographiae Phanerogamarum. **3**: 726. 1881.
12. **Lotar, H. A.** Essai sur l'anatomie comparée des organes végétatifs et des téguments séminaux des Cucurbitacées. Thése. Lille, 1881.
13. **Van Tieghem, P.** Sur quelques points de l'anatomie des Cucurbitacées. Bull. Soc. Bot. Fr. **29**: 277–283. 1882.
14. **Petersen, O.** Über das Auftreten bicollateraler Gefässbündel. Bot. Jahrb. **3**: 359–402. *pl. 4–8.* 1882.
15. **Weiss, J.** Das markständige Gefässbündelsystem einiger Dikotyledonen in seiner Beziehung zu den Blattspuren. Bot. Centralb. **15**: 280–295. 318–327, 358–367, 390–397, 401–415. *pl. 1.* 1883.
16. **Fischer, A.** Das Siebröhrensystem von *Cucurbita*. Ber. Deutsch. Bot. Gesells. **1**: 276–279. 1883.
17. **Fischer, A.** Untersuchungen über das Siebröhren-System der Cucurbitaceen. Berlin, 1884.

18. **Morot, L.** Recherches sur le péricycle. Ann. Sci. Nat. VI. **20**: 217–309. *pl. 9–14.* 1885.

19. **Hérail, J.** Recherches sur l'anatomie comparée de la tige des dicotylédones. Ann. Sci. Nat. VII. **2**: 203–314. *pl. 15–20.* 1885.

20. **Fischer, A.** Neue Beiträge zur Kenntniss der Siebröhren. Ber. Verh. Math. Phys. Klasse K. Sächs. Gesellsch. Wiss. **38**: 291–336. *pl. 1–2.* 1886.

21. **Watson, S.** Upon a collection of plants made by Dr. E. Palmer. Proc. Am. Acad. **24**: 51. 1889.

22. **Potter, M. C.** The increase in thickness of the stem of the *Cucurbitaceae.* Proc. Cambridge Phil. Soc. **7**: 14. 1890.

23. **Lamounette, B.** Recherches sur l'origine morphologique du liber interne. Ann. Sci. Nat. VII. **11**: 193–282. *pl. 10–12.* 1890.

24. **Van Tieghem, P.** Sur les tubes criblés extralibériens et les vaisseaux extraligneux. Jour. de Bot. **5**: 117–128. 1891.

25. **Scott, D. & Brebner, G.** On internal phloem in the root and stem of dicotyledons. Ann. Bot. **5**: 259–300. *pl. 18–20.* 1891.

26. **Schenck, H.** Beiträge zur Anatomie der Lianen. In Schimper's Botanische Mittheilungen aus den Tropen, Heft 5. 1893.

27. **Greene, E. L.** Corrections in nomenclature VI. Erythea **3**: 75. 1895.

28. **Solereder, H.** Über den systematische Anatomie der Dicotyledonen. Stuttgart, 1899.

29. **Leisering, B.** Über die Entwickelungsgeschichte des interxylärem Leptoms bei den Dikotyledonen. Bot. Centralb. **80**: 289–298, 321–331, 369–376, 414–422, 465–470, 497–504. *pl. 1–3.* 1899.

30. **Pitard, C. J.** Sur les faisceaux libériens tertiaires des tiges des Cucurbitacées. Procés Verbaux Soc. Linn. Bordeaux **56**: civ–cviii. 1901.

31. **Tondera, F.** Das Gefässbundelsystem der Cucurbitaceen. Sitz.-ber. Math. Nat. Kl. Akad. Wiss. Wien **112**: 23–59. *pl. 1–5.* 1903.

32. **Haberlandt, G.** Physiologische Pflanzenanatomie. Third edition. Leipzig, 1904.

33. **Emerson, J. T. & Welker, W. H.** On the composition and toxic properties of *Ibervillea Sonorae.* Science II. **23**: 336. 1906.

34. **Emerson, J. T. & Welker, W. H.** A further study of the chemistry and pharmacology of *Ibervillea Sonorae.* Science II. **25**: 460. 1907.

35. **MacDougal, D. T.** Morphology and physiology of storage organs. Year Book Carneg. Instit. Wash. **5**: 127. 1907.

Explanation of plate 24

The figures were drawn with Leitz lenses and an Abbé camera-lucida and the magnifications have been reduced two-thirds in reproduction.

FIG. 1. Diagram of transverse section of primary stem. l_1, outer leptome; l_2, inner leptome; *st*, stereome-ring; *h*, hadrome; *x*, bundle pictured in FIGURE 10. × 414.

FIG. 2. Transverse section of portion of cortex of primary stem. *e*, epidermis; *col*, collenchyma; *ch*, chlorenchyma; *os*, obliterated sieve-tubes; *end*, endodermis; *st*, stereome. × 775.

FIGS. 3 and 4. Transverse sections of portions of cortex of young stem. *e*, epidermis; *col*, collenchyma; *st*, stereome; *ec. s*, ectocyclic sieve-tube; *en. s*, endocyclic sieve-tube. × 775.

FIGS. 5–8. Transverse sections of cortex of stems, showing appearance of groups of obliterated sieve-tubes. *st*, stereome; *pr*, parenchyma; *ph*, phellem; *pd*, phelloderm. FIG. 5, periphery of outer leptome; FIGS. 6–8, cortex. × 650.

FIG. 9. Diagram of transverse section of two-year stem. *p*, periderm; *os*, obliterated sieve-tubes; *h*, hadrome; l_1, outer leptome; l_2, inner leptome; *st*, stereome. × 44.

FIG. 10. Transverse section of bundle of inner ring showing inner cambium of a primary stem. FIG. 11 the same on a secondary stem. *p. d*, pitted duct; *s. d*, spiral duct; *p. h*, protohadrome; c_2, inner cambium; *s*, sieve-tube; *os*, obliterated sieve-tube; *gp*, ground-parenchyma. × 480.

FIG. 12. Transverse section of old secondary stem showing tertiary bundle. The arrow shows the direction of the axis of the primary bundle. Lettering as in FIGS. 10 and 11.

FIG. 13. Diagram of section of very old stem. Lettering as before; b_3, tertiary bundle. The shaded portions are leptome. × 180.

New species of fungi

CHARLES HORTON PECK

Collybia subsulphurea

Pileus fleshy but thin, somewhat tough, reviving under the influence of moisture, broadly convex, often becoming centrally depressed, glabrous, sulfur-yellow, sometimes tinged with pink or pale tan-color in the center, flesh hygrophanous, white when dry, odor strong, fungoid; lamellae thin, narrow, close, rounded behind, adnexed or nearly free, pale sulfur-colored or whitish; stem rather long, tough, glabrous, hollow, tapering downwards, even when moist, striate-sulcate when dry, sulfur-colored or pallid; spores elliptic, 6 μ long, 3 μ broad.

Pileus 2.5–6 cm. broad; stem 5–12 cm. long, 2–6 mm. thick.

Cespitose. Among fallen leaves under oak trees. Stockton, Kansas. June. E. Bartholomew.

Closely allied to *C. dryophila* (Bull.) Fr., but larger, more cespitose, of a different color, with a strong odor and smaller spores.

Omphalia vestita

Pileus thin, membranaceous, convex nearly plane or slightly depressed in the center, minutely pruinose or tomentose, white; lamellae few, very distant, adnate or decurrent, white or whitish; stem slender, short, solid or stuffed, pruinose-pubescent either wholly or on the basal half only, whitish or pallid, often becoming brownish with age; spores subglobose, 4–5 μ in diameter.

Pileus 2–3 mm. broad; stem 6–10 mm. long, 0.5–1 mm. thick.

Decaying vegetable matter in damp places. Horseshoe island, Ontario, Canada. August. C. Guillet.

This is a very small white species closely related to *O. integrella* Pers. and *O. pusillissima* Peck, from both of which it is separated by the minute tomentose covering of the pileus.

Omphalia curvipes

Pileus submembranous, convex, umbilicate, glabrous, moist, sometimes obscurely striate on the incurved margin, brown, grayish-brown or dark-gray, sometimes paler in the center when dry; lamellae thin, moderately close, arcuate, adnate or slightly decurrent, white or whitish; stem short, curved, stuffed or hollow, white or whitish, slightly thickened and distinctly whitish villose at the base; spores minute, 4 μ long, 2 μ broad.

Pileus 4–10 mm. broad; stem 1.5–2.5 cm. long, 1–2 mm. thick.

Decaying wood. Ontario, Canada. August. C. Guillet.

The species belongs to the section *Pyxidatae*. The curving of the stem is due to the place of growth, which is on the sides of prostrate trunks of trees. The villosity at the base of the stem is a conspicuous feature of the species.

Lactarius rufulus

Pileus fleshy, firm, broadly convex becoming subinfundibuliform, brownish-red, flesh white, milk scanty, yellowish-white, taste acrid; lamellae close, adnate or slightly decurrent, pinkish-yellow becoming darker with age and pruinose; stem equal or slightly tapering upward, stuffed, often tufted and showing yellowish-brown strigose hairs at the base, sometimes radicating, colored like but paler than the pileus; spores creamy-white, globose, verruculose, 8–10 μ in diameter.

Pileus 5–10 cm. broad; stem 4–8 cm. long, 5–6 mm. thick.

Rich soil and leaf-mold under oak trees. Stanford University, California. March. Miss A. M. Patterson and S. Nohara.

This species resembles *Lactarius rufus* (Scop.) Fr. in color, but differs from it in its stouter habit, cespitose mode of growth, absence of an umbo, and yellowish-tinted spores.

Lactarius xanthogalactus

Pileus fleshy, convex or nearly plane becoming infundibuliform with age, glabrous, zonate, pinkish-yellow becoming reddish-brown in drying, flesh yellowish, milk yellow, taste acrid; lamellae close, adnate or decurrent, pinkish-yellow, pruinose when old and dry; stem cylindric or sometimes compressed, stuffed or hollow, mealy-pruinose or subglandular, whitish or pallid; spores globose, 7–8 μ in diameter.

Pileus 5–6 cm. broad; stem 5–6 cm. long, 1–1.5 cm. thick.

Under live-oak trees. Stanford University, California. February. Miss A. M. Patterson.

The pinkish-yellow zonate pileus, yellow milk, and acrid or peppery taste are distinguishing characters of this species.

Entoloma modestum

Pileus thin, campanulate or convex, glabrous, obtuse, hygrophanous, dark smoky-brown and striatulate when moist, isabelline or pale grayish-brown when dry; lamellae rather broad, subdistant, adnate, at first pallid, then flesh-colored; stem slender, equal, hollow, glabrous, colored like the pileus; spores angular, uninucleate, obliquely apiculate at one end, 10–14 μ long, 8–9 μ broad.

Pileus 1.5–2.5 cm. broad; stem 2.5–4 cm. long, 2–4 mm. thick.

Stow, Massachusetts. May. G. E. Morris and S. Davis.

Eccilia cinericola

Pileus thin, fragile, glabrous, slightly scabrous, broadly convex, becoming expanded and broadly umbilicate or centrally depressed, white tinged with yellow, becoming cream-colored with age; lamellae thick, distant, broad, adnate or slightly decurrent, sometimes slightly sinuate, white becoming pink, dusted by the spores; stem subcartilaginous, fragile, hollow, slightly enlarged at the top, white at first, then colored like the pileus; spores subglobose, angular, 10–12 μ long, 8–10 μ broad.

Pileus 1.2–2.5 cm. broad; stem 2–2.5 cm. long, 2 mm. thick.

Gravelly ground among grasses, specially where coal ashes have been lying for a long time. Boston, Massachusetts. June. S. Davis.

Naucoria tabacina bicolor var. nov.

Scarcely differing from the typical form except in the pileus, which with the escape of moisture becomes ochroleucous or a pale creamy-white.

Stow, Massachusets. May. G. E. Morris and S. Davis.

Agaricus Pattersonae

Pileus fleshy, firm, convex or nearly plane, glabrous or minutely silky, white or whitish, often mottled with brownish squamules, flesh firm, white, taste fungoid; lamellae close, free, pink becoming blackish-brown or black with age; stem equal or slightly tapering upward, firm, stuffed, bulbous, white or whitish, the annulus white, often rupturing and partly adhering to the margin of the pileus; spores broadly elliptic, 8–9 μ long, 5–6 μ broad.

Pileus 6–14 cm. broad; stem 7–12 cm. long, 2–3 cm. thick.

Ground under pine and cypress trees. Stanford University, California. January. Miss A. M. Patterson.

This species is similar to *Agaricus bulbosus* McCl. in having a bulbous stem, but it differs in color (no yellowish hues being found in it), in flavor, and in the size of the spores. It is respectfully dedicated to its discoverer.

Psathyrella caespitosa

Pileus thin, convex, subumbonate, striate or subsulcate on the margin, grayish-brown, flesh gray, taste farinaceous; lamellae thin, subdistant, adnate, cinereous, becoming black or blackish-brown; stem slender, hollow, mealy and white at the top, brownish below; spores black, oblong or narrowly elliptic, 15–20 μ long, 8–10 μ broad.

Pileus 1.5–2.5 cm. broad; stem 6–7 cm. long, 2–3 mm. thick.

Cespitose; in rich soil and grassy places under sycamore trees. San José, California. February. Miss A. M. Patterson.

A species well-marked by its tufted mode of growth, there being 15 or more individuals in a tuft. In the dried state the pileus appears to be rugose-striate.

Hydnum Kauffmani

Pileus dimidiate, sessile, convex or nearly plane, soft but tough or coriaceous, strigose with rather long subappressed fascicles of fibers, uneven, subochraceous, flesh whitish, radiately fibrous; aculei subcylindric or subulate, 2–3 mm. long, sometimes adhering to each other and forming clusters as if gelatinous, acute, creamy-white, becoming darker in drying, sometimes stained with yellow, especially around the margin; spores hyaline, elliptic, 4–5 μ long, 2–3 μ broad.

Pileus about 6 cm. broad; stem about 4 cm. long.

Decaying cottonwood. Marquette, Michigan. August. C. H. Kauffman, to whom the species is respectfully dedicated. The adhering aculei constitute a prominent distinguishing character.

Macrophoma tiliacea

Perithecia scattered, nestling in the bark, covered by the epidermis which is minutely punctured by the erumpent ostiola, depressed or broadly conic, pierced by a circular ostiolum, black; spores oblong, hyaline, rounded at the ends, 18–30 μ long, 8–9 μ broad.

Dead branches of basswood, *Tilia americana* L. Oberlin, Ohio. March. F. O. Grover.

Cucurbitaria erratica

Perithecia cespitose, subglobose, more or less hairy, black, penetrating to the inner bark and forming orbicular or oblong clusters, soon erumpent and surrounded by the ruptured epidermis; asci cylindric, about 200 μ long, 20–22 μ broad; spores commonly monostichous, oblong, colored, 5–7-septate, with 1–3 cells longitudinally divided, constricted in the middle, 30–40 μ long, 15–20 μ broad, the basal half of the spore often more narrow than the other, paraphyses absent.

Dead branches of Ohio buckeye, *Aesculus glabra* Willd. Oberlin, Ohio. March. F. O. Grover.

This species is referred provisionally to the genus *Cucurbitaria*, from which it differs in its hairy perithecia and in the absence of paraphyses. It approaches *C. Sorbi* Karst. in some of its characters.

GEOLOGICAL HALL,
ALBANY, NEW YORK.

A midsummer journey through the coastal plain of the Carolinas and Virginia

Roland M. Harper

INTRODUCTION

In discussing the vegetation of the Atlantic coastal plain, a territory about ten times as long as wide, it becomes expedient to divide the region transversely into several districts of convenient size. For this purpose there are probably no better natural boundaries than the large rivers which rise in the highlands and cross the whole width of the coastal plain.* That portion between the James River and the Savannah, embracing the whole of the coastal plain of the Carolinas and about half that of Virginia, may conveniently be treated as a unit, since these two rivers seem to mark the divisions between perceptibly different parts of the coastal plain, and as far as known there is no other boundary of equal importance lying between them.

The Savannah River coincides pretty closely with the boundary between the topographically diversified and the comparatively monotonous portions of the coastal plain, as shown below, while the James seems to mark the northeastern limit of *Pinus palustris*, *P. serotina*, *Aristida stricta*, *Quercus Catesbaei*, and numerous other characteristic pine-barren plants. (There is, however, almost nothing on record about the flora of the coastal plain of Virginia north of the James River, doubtless chiefly because most of the counties in that part of the state have never had railroad facilities.) The James and its tributary, the Appomattox, are the southernmost rivers whose estuaries extend all the way across the coastal plain.

The region in question has been worked over more or less by botanists and other observers for 200 years or so, and there is consequently a considerable amount of information about the

* A similar method has been employed by McGee (Ann. Rep. U. S. Geol. Surv. 12[1]: 360–364. 1892) in discussing the topography, though his resulting districts do not coincide with mine.

plants of that part of the country scattered through literature which may be roughly classified as follows:

1. Descriptive manuals, such as those of Elliott, Chapman, Wood, and Small, covering more than one state, making little or no distinction between the coastal plain and other natural regions, and containing no rational treatment of habitats.

2. Monographs of families or genera, or scattered descriptions of species, too numerous to mention.*

3. Works relating to trees primarily, such as Sargent's Tenth Census report,† Pinchot & Ashe on the trees of North Carolina,‡ Mohr's Timber Pines,§ and Bulletins 43 and 56 ‖ of the U. S. Bureau (formerly Division) of Forestry, on South Carolina.

4. State and local lists, lacking details of habitat or distribution, or both; such as Curtis on North Carolina, 1867, Croom on Newbern, 1837, and Wood & McCarthy on Wilmington, 1887.

5. Notes on selected species, or narratives of botanical expeditions, with few or no references to earlier workers in the same fields. Among these are Bartram's Travels, Michaux's Journal,¶ and several short semi-popular papers on Dismal Swamp and vicinity, most of which are cited in (and practically superseded by) Mr. Kearney's elaborate survey of that region.

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* For the Altamaha Grit region of Georgia about two years ago I could find less than a dozen works of this class, but the number for the Virginia-Carolina coastal plain would doubtless run into the hundreds.

† Vol. 9. 1884. The forests of the Carolinas are briefly described on pages 515–519, with four maps.

‡ Bull. 6, N. C. Geol. Surv. 1898.

§ Bull. 13, Division of Forestry, U. S. Dep. Agr. 1896. Revised 1897.

‖ Bulletin 56, on a working plan for forest lands in Berkeley County, by C. S. Chapman, was published early in 1906, and contains considerable interesting information which will be referred to farther on; but the list of trees and shrubs on pages 45 and 46 is so misleading that it should not be allowed to remain unchallenged. For example, the cypress is probably not all *Taxodium distichum*, and the "black gum" is almost certainly *Nyssa biflora* rather than *N. sylvatica*, which is rare in the coastal plain, especially in such flat country as that under consideration. The "titi" is doubtless *Cyrilla*, for it is too far north and east for *Cliftonia*. The "hurrah bush" must be *Pieris nitida* (which goes by a similar name in Okefinokee Swamp), for *P. floribunda* (*Andromeda*) is confined to the mountains, as far as known. The buckeye is in all probability *Aesculus Pavia*, and the "prickly ash" *Aralia spinosa*.

¶ Journal of André Michaux, 1787–1796. Edited by C. S. Sargent. Proc. Am. Phil. Soc. 26: 1–145. 1889. Part of the same is reprinted in vol. 3 of Thwaites's "Early Western Travels," 1904.

6. Descriptions of the vegetation of restricted areas, with plants classified according to habitat in a scientific manner, like Kearney's reports on Ocracoke Island and Dismal Swamp in the fifth volume of the Contributions from the U. S. National Herbarium, and Coker's paper on the Isle of Palms, S. C.*

7. A number of primarily geological, geographical, descriptive, agricultural, ethnological and even ornithological works, in which plants are mentioned only incidentally and mostly by their common names, if at all, furnish valuable information to one familiar with the principles of plant distribution in the coastal plain, and should not be overlooked. Among the best of these are some of the early reports of the North Carolina Geological Survey by Emmons and Kerr, the reports on cotton production † by Kerr and Hammond in the 6th volume of the Tenth Census reports (1884), the soil surveys published by the U. S. Department of Agriculture during the present century ‡, the supplements to Redway & Hinman's geographies, on North Carolina by Cobb and on South Carolina by Glenn; and Water Supply and Irrigation paper no. 114 of the U. S. Geological Survey, which contains up-to-date though brief summaries of the present knowledge of the stratigraphy of the three states in question (by Darton, Fuller, and Glenn), as well as of all the other eastern states. (References to many other primarily geological works for each state, which are worth consulting, may be found in Bulletins 127, 188, 189, and 301 of the U. S. Geological Survey, which are bibliographies of North American geological literature from 1731 to 1905.)

But even yet, as may be inferred from the foregoing, the vege-

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* Torreya 5: 135–145. *f. 1–4.* 1905.

† Under this too modest title are concealed some of the best geographical descriptions of the southeastern states ever published, including among other things valuable notes on the native vegetation. The essential geographical features of all these cotton production reports, including the maps, are condensed into a little known pamphlet by Dr. Eugene A. Smith, reprinted from the 4th report of the U. S. Entomological Commission, pp. 59–80 and 2 maps. 1884.

‡ The soil survey reports hitherto published for the region in question are those of the Norfolk area, Virginia; Raleigh to Newbern, the Craven area, and Perquimans, Pasquotank, Duplin, and New Hanover counties, North Carolina; and the Darlington, Orangeburg, and Charleston areas, South Carolina. Others for each state are said to be in preparation. These reports, which contain excellent maps and other interesting matter, would be a little more satisfactory if their authors had taken advantage of some easily accessible earlier descriptions of the same regions.

tation of the Virginia-Carolina coastal plain is practically undescribed, except for the vicinity of Dismal Swamp, and two or three spots on the seacoast farther south. The geology of the region is also by no means as well known as one might wish, chiefly because of the scarcity of rock outcrops and the lack of diversity in the topography, as compared with the corresponding portions of the Gulf States.

NARRATIVE

With a view of gaining some knowledge of the region in question at first-hand, I made it a point on the way from Alabama to New York in July, 1906, to travel through the coastal plain most of the way, and to see as much of it as possible in the few days at my disposal. My principal objects in taking such a roundabout route were: first, to ascertain whether the Altamaha Grit formation, which I had just been studying in Georgia,* extended beyond the Savannah River into South Carolina; second, to see if the ranges of certain plants followed geological belts approximately parallel to the coast, as so many do in Georgia and Alabama; and third, to discover the northeastern limits of as many coastal plain species as possible, and the reasons therefor. What success was attained in solving these and other problems which presented themselves will appear in the following pages.

From the time I entered South Carolina by crossing the Savannah River a few miles below Augusta, until I reached Richmond on the banks of the James, five days later, I traveled entirely in the coastal plain, by daylight, and over railroads which were new to me (except the first and last 25 miles or so), so that new facts were gathered on nearly every mile of the journey. Every species recognizable from the car-window was noted as many times as possible (except in the case of a few of the commonest trees), and no botanizing was done on foot, except a very little near Charleston and Florence, S. C., and one afternoon on and near Wrightsville Beach, N. C.

Itinerary. — My itinerary through the three states was as follows: From Augusta to Yemassee and Charleston on the afternoon of July 25th, from Charleston to Florence, S. C., the next afternoon,

* See Torreya 6: 241–246. 1906.

from Florence to Wilmington, N. C., and Wrightsville Beach on the 27th, from Wilmington to Rocky Mount and Tarboro, N. C., and Norfolk, Va., on the 28th, and from Norfolk to Petersburg, Richmond and northward on the afternoon of the 30th. By this zigzag route I crossed the coastal plain several times while working gradually lengthwise of it, thus obtaining a broad view of it which could hardly be surpassed in so short a time. Augusta, Rocky Mount, Petersburg, and Richmond are fall-line cities, Charleston, Wilmington, and Norfolk are seaports, and Florence, at another of the angles of the route, is about two-thirds of the way from the coast to the fall-line. From Richmond to New York the rest of my way lay along the fall-line — the coastal plain between these points being so interrupted by bays and estuaries that one cannot travel far in it by rail — and this part of the route, which was already more or less familiar to me, was traversed in the dark.

Topography and geology. — The topography of the Virginia-Carolina coastal plain seems very simple and monotonous, as compared with that of Georgia, Alabama, and Mississippi. Slightly undulating near the fall-line, where the average altitude is about 300 feet, the relief, the general slope, and the elevation gradually and almost insensibly decrease toward the coast. Here there seem to be no sudden changes in the aspect of the country, such as are encountered at intervals in crossing the coastal plain almost anywhere between the Savannah and Mississippi Rivers, where the different geological divisions are so well marked by their topography and vegetation that it requires no knowledge of paleontology, and not a great deal of experience, to distinguish them.

On this journey of about 700 miles through three states I do not remember seeing any rocks, bluffs, escarpments, hills, ravines, gullies, springs, or hammocks, or passing through any railroad cuts deep enough to obstruct the view, unless perhaps a few near the fall-line. The flatness of most of this region (which is quite comparable in this respect with the coastal plain or southern portion of Long Island and the flat pine-barren region of Georgia) could easily be inferred, with the aid of a good map, from the straightness of the railroads. No curves were noticed in a distance of about 50 miles through Pender and Duplin counties, N. C., and there are probably other tangents of equal or even greater length in the same general region.*

One or two slight exceptions to the general monotony of the topography toward the coast may be worth noting. In the immediate vicinity of Yemassee, S. C., the country seems just a little more broken than it is for some distance farther inland; and the city of Wilmington is remarkably hilly for a southern seaport, perhaps more so than any other place so near the coast between New York and Florida. The topography between Wilmington and Wrightsville Beach, a distance of ten or eleven miles, seems as undulating as in many places in the Altamaha Grit region of Georgia,† and looking inland from the beach the land is seen to have a decided elevation, quite different from the extreme flatness which characterizes the coasts of South Carolina and Georgia. The exact cause of these local variations in topography is probably unknown, but it seems from the soil survey map of New Hanover County (published in February of this year) that Wilmington is on the sand-hills of the Cape Fear River, one of the largest rivers in the state, so this may partly account for its topography.

The flatness of the greater part of this coastal plain is evidently correlated with a state of affairs well known to geologists, namely, that the Cretaceous and Tertiary strata in Virginia and the Carolinas are much more nearly horizontal than they are farther west and south, so that Cretaceous rocks are exposed near Wilmington, and Miocene near the fall-line in all three states. This approach to horizontality seems to culminate in the latitude of Cape Hatteras, according to several geologists who have investigated it.

Ponds are seen at frequent intervals in the pine-barrens of South Carolina, less frequently in North Carolina, and rarely if at all in Virginia. As in Georgia, most of them seem too shallow to contain water throughout the year. In North Carolina, but scarcely in the other two states, are several large lakes, most of them not very far from the coast. The only one which I passed within sight of is Lake Waccamaw, in Columbus County, but Kerr ‡ mentions fifteen others. At present they do not seem to

* See Glenn, Jour. School Geog. 2: 91. 1898; also Bull. 43, U. S. Bureau of Forestry, *pl. 4–13;* and Torreya 6: 41. 1906.

† See Bull. Torrey Club 32: 145. 1905; Ann. N. Y. Acad. Sci. 17: 23. 1906.

‡ Rep. Geol. Surv. N. C. for 1875, page 13.

be as well known to botanists as they are to ornithologists, * but they should be most interesting places for ecological study.

The streams of the Virginia-Carolina coastal plain can be divided into two classes according to length, namely, the muddy, almost opaque, rivers which rise in the Piedmont region or in the mountains beyond, and the smaller coffee-colored streams which rise in the sandy and little eroded coastal plain. † Those of the former class which I crossed (between the Savannah and the James) are the Santee, Lynch's, and Peedee rivers in South Carolina, the Cape Fear, Neuse, Tar, Roanoke, and Chowan in North Carolina, and the Appomattox in Virginia. More will be said about some of these later. To the latter class belong the Salkehatchie or Combahee, Edisto, Black, and Lumber rivers in South Carolina, the Northeast Cape Fear in North Carolina, the Blackwater in Virginia, and all the creeks and branches.‡ None of the rivers seemed to have deep channels or well defined banks where I crossed them, being bordered on both sides by extensive swamps.‡

Unmistakable fluvial sand-hills § were seen only on the left sides of the Peedee, Lumber, and Blackwater rivers, and the right side of the Northeast Cape Fear opposite Castle Hayne; though there seemed to be a faint development of them on the left side of the Neuse near Goldsboro.‖ The flora of all these areas appeared to be much less varied than that in similar situations in Georgia, where most of the known sand-hill species may be found.

As far as the geology is concerned I can add very little to what is already known of this region. In South Carolina, especially in Hampton County, I looked closely for evidences of the Altamaha Grit, but did not see any of the rock of this formation,¶ or even any of the characteristic topography, which is unmistak-

* For some pretty good illustrations of one of them see T. G. Pearson, Bird-Lore 7: 121–126. 1905.

† A similar distinction was made nearly 200 years ago by Catesby in the appendix to the second volume of his "Natural History of Carolina."

‡ For definition of these terms, see Ann. N. Y. Acad. Sci. 17: 25. 1906.

§ See Ann. N. Y. Acad. Sci. 17: 25–27. 1906.

‖ See in this connection Field Operations of the Bureau of Soils for 1900, page 200.

¶ This fact in itself, however, does not prove anything, for outcrops of it are very scarce even in Georgia (see Torreya 6: 245–246. 1906).

ably displayed in the adjoining county of Screven in Georgia.* In most of the railroad cuts in South Carolina, however, could be seen that red-and-white mottled loam which lies between the Grand Gulf and Lafayette formations in Alabama and Mississippi and seems to intergrade with the Altamaha Grit in Georgia.† Going northeastward from the Savannah River this mottled phase seemed to become gradually paler and more homogeneous, until by the time Virginia was reached it was no longer distinguishable from the Lafayette if it was present at all.

The Columbia sand seems to cover the greater part of the area examined, as has been shown by McGee ‡ and others, but rather thinly, except on the sand-hills along the fall-line and rivers, and the dunes along the coast. The Lafayette loam immediately underlying it is exposed over considerable areas up toward the fall-line, just as it is in the upper third of the coastal plain in Georgia and the greater part of the same province in Alabama.

Effects of civilization. — Some of the publications cited herein, particularly the reports on trees by Mohr and by Ashe,§ and the soil survey reports, describe the effects of civilization in the region under consideration, but as economic conditions are continually changing, a few more words on the subject may be of interest.

Those pioneer industries, turpentining and lumbering of long-leaf pine, are decidedly on the wane in the Carolinas, and will doubtless soon be practically at an end unless conservative methods are speedily and widely adopted. I do not remember seeing a single mature and round (*i. e.*, unboxed) long-leaf pine in either state, though this may be partly explainable by the fact that all the railroads I traveled on after leaving Georgia are comparatively old. Along the newer lines, and away from all railroads and streams, conditions should of course be a little better. *Pinus Taeda* now furnishes a large proportion of the pine lumber of the region, and is even being tapped in a few places for turpentine, but with what success I did not ascertain.

* The formation may possibly occur in Beaufort County (the southernmost in South Carolina) for *Pinckneya*, *Cliftonia*, *Nyssa Ogeche*, and *Serenoa* have been found there, and apparently nowhere else in the state. (See Bull. Torrey Club 32: 147. 1905.)

† See Ann. N. Y. Acad. Sci. 17: 23; Torreya 6: 241. 1906.

‡ Ann. Rep. U. S. Geol. Surv. 12[1]: 386–388. 1892.

§ Bulletins 5 to 7 of the North Carolina Geological Survey.

The proportion of cleared land in eastern Virginia and the Carolinas seems somewhat greater than in South Georgia, doubtless because these more northeasterly states have been settled longer, and because their shorter distance from the great centers of population makes truck farming more profitable than it is in Georgia. As in Georgia, the destruction caused by agriculture has been much greater outside of the pine-barren region than within it.* The density of population in the regions traversed (outside of the cities of course) ranged from about 20 to 40 inhabitants per square mile in 1900, and is probably very little greater at the present time, for the evidences of recent growth which are conspicuous all through the pine-barrens of Georgia, Alabama, and Mississippi † were scarcely noticeable in these older states.

Vegetation. — The study of the laws of distribution of vegetation in the coastal plain northeast of the Savannah River is by no means easy, especially as there is so little previous work to go by. The correlations between ranges of species and vegetation types on the one hand and the areas of various Tertiary formations on the other, which are so pronounced in Georgia and Alabama, seem to be very indistinct in the Carolinas, doubtless chiefly because of the flatness of the country and the approximate horizontality of the strata, already mentioned. Next to the water-content of the soil, which here of course depends mainly on the local topography, and historical development, which has to be taken into consideration everywhere, the present distribution of plants in the region under consideration probably depends on the extent and thickness of the Columbia sand as much as on any other one factor.

In general it may be said that between the Roanoke and Savannah rivers the pine-barrens proper ‡ extend about two-thirds of

* This is pretty well shown by the maps in the Tenth Census reports showing the ratio between the area cultivated in cotton and the total area. On account of the prevalence of cleared land I was able to make comparatively few notes in such counties as Aiken, Barnwell, and Florence in South Carolina, and Wayne, Wilson, and all north of there in North Carolina.

† See Bull. Torrey Club 32: 142. 1905; Torreya 6: 200. 1906; Ann. N. Y. Acad. Sci. 17: 120. 1906.

‡ See Bull. Torrey Club 32: 452. 1905; Torreya 6: 42. 1906; Ann. N. Y. Acad. Sci. 17: 16. 1906.

the way from the coast to the fall-line, and that in the remaining third (exclusive of the fall-line sand-hills) oaks and other angiospermous trees predominate, just as in the upper third of the coastal plain of Georgia. On the way from Augusta to Yemassee, although *Pinus palustris* can be seen in scattered groups or individuals nearly the whole distance,* the real pine-barrens only begin about the inland edge of Hampton County, and seem to terminate near its coastward edge.† Between Yemassee and Charleston the railroad passes mostly through the maritime or littoral region (very similar to that of Georgia ‡), where *Pinus palustris* is rare and *P. Taeda* common. Beyond Charleston the limits of the pine-barrens are less clearly defined.

The illustrations in Bulletins 43 and 56 § of the U. S. Bureau of Forestry give an excellent idea of the general appearance of the South Carolina pine-barrens, and the forests of the North Carolina coastal plain have been so well described by Mr. Ashe in Bulletins 5 and 6 of the North Carolina Geological Survey that it would be useless to attempt to improve on his observations with so little preparation; but there is still room for a few notes on the herbaceous vegetation, and for some statistics of distribution, which may serve as suggestions for future work in this region.

Pine-barren vegetation, if we may judge by the number of species in a given area, seems to center at present in Georgia and Florida,|| and as a rule grows gradually poorer and less typical with increasing distance from this center, the proportion of older species from the highlands at the same time increasing, as I had excellent opportunity to observe on this trip. *Pinus Elliottii*, whose distribution in Georgia coincides almost exactly with the pine-barrens, extends only a short distance into South Carolina.¶ *Pinus*

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* In Georgia it seems to skip a good deal of the Eocene region. See Bull. Torrey Club 31: 15. 1904; 32: 456. 1905; Ann. N. Y. Acad. Sci. 17: 305. 1906.

† This is corroborated by Hammond's agricultural map of South Carolina in the Tenth Census report already cited, and by Glenn's physical outline map in his South Carolina supplement to Redway & Hinman's geography.

‡ See Ann. N. Y. Acad. Sci. 17: 20. 1906.

§ It should be observed that *plate 1* in Bulletin 56 is from the same photograph as *plate 12* in Bulletin 43, which purports to show *Pinus Elliottii* among other things, and therefore was not taken in Berkeley County.

|| See Torreya 7: 43; Science II. 25: 540. 1907.

¶ For details see the latter part of this paper. In the other direction it is not *palustris*, which is preëminently the tree of the pine-barrens, very gradually gives way to *P. Taeda* northeastward, disappearing entirely before reaching the James River. In fact there are in the Carolinas some limited areas which might reasonably be called pine-barrens where the pines are all *P. Taeda.* * This is probably never the case within the range of *P. Elliottii.*

A notable exception to the general thinning out of the pine-barren vegetation northeastward is found in the southern corner of North Carolina, where *Pinus palustris* becomes again the prevailing pine, and the flora is perceptibly richer than it is a little to the southwest as well as to the north, with little if any corresponding increase in diversity of habitats. Some of the species characterizing this minor pine-barren center are enumerated below.

Within the pine-barrens the local diversity of the vegetation is of course governed mainly by the slight inequalities of the surface. The greater part of the area consists of dry and moist pine-barrens, the latter mostly occupying broad shallow depressions or nearly flat areas, rather than evident slopes as in the Altamaha Grit region of Georgia. The ponds of course contain their own characteristic flora, quite different from that of the moist pine-barrens. All the streams are bordered by swamps, the width of each of which is approximately proportional to the volume of the stream. As in all pine-barren regions, most of the angiospermous trees are confined to the vicinity of streams, and the swamps or rivers originating above the fall-line have quite a different flora from those of the pine-barren streams, as will be illustrated below in discussing the distribution and habitat of certain species.

Scattered through the flat parts of North Carolina, and to a lesser extent in adjacent territory, are many "pocosins." † These

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known to extend beyond Mississippi. (See Torreya 6: 200, 201. 1906.) *Serenoa serrulata*, *Quercus geminata*, *Cliftonia monophylla* and several other species have a similar distribution.

*Civilization has of course changed the relative abundance of these trees to some extent, but in making the statements in this paragraph I have tried to reconstruct the primeval conditions as far as possible.

†Often spelled "pocosons." The use of this term seems to be almost confined to eastern North Carolina, but it appears to some extent in other states, though with variations in meaning in different localities, as in the case of several other native habitat names, like swamp, hammock, prairie, bay, savanna, brake, etc. The northernmost record of such a word which I have come across is in York County, Virginia, where

are described or mentioned in nearly all works of a geographical nature dealing with the coastal plain of North Carolina, especially the publications of Emmons,* Kerr,† Ashe, ‡ and the U. S. Bureau of Soils, § but in all these descriptions unfortunately most of the plants are mentioned only by their common names, and nothing like a complete list of species is attempted. A pocosin may be briefly described as an extensive flat, damp, sandy or peaty area, supporting a scattered growth of pine (mostly *Pinus serotina*) and a very dense growth of shrubs, mostly evergreens, giving the whole a decided heath-like aspect — the term heath being used here in the sense of a certain type of vegetation ‖ rather than as the name of a certain class of plants, though these shrubs are indeed largely of the Ericaceae and allied families. What the earlier and later stages of a pocosin may be, probably no one has ever determined; but this would be a most interesting subject for ecological study. Pocosins have no exact counterpart in Georgia, but in their vegetation, though not so much in topography, they much resemble some

there is a settlement named Poquoson on a river of the same name. In South Carolina the term seems to be used in a somewhat different sense. John Lawson, in his "New Voyage to Carolina," published in 1709, speaks of "Percoarson, a sort of low Land," near the Santee River, containing cypress trees (which are not at all characteristic of the North Carolina pocosins), and the "pocosons" described by C. S. Chapman in Bulletin 56 of the U. S. Bureau of Forestry seem to be nothing more nor less than cypress ponds. (On the other hand, the "savannas" of these two writers correspond more nearly with pocosins as here understood.) Just as I was leaving Alabama on this same trip I heard of a "pocosin" in Pike County (Eocene region of the coastal plain) which from the description given must have been much like some of the hammocks of South Georgia and adjacent Florida (particularly those described by Croom in Am. Jour. Sci. **26**: 318. 1834). In Georgia, however, I have never found the slightest evidence of the use of such a word. It is a curious coincidence that while pocosins, like hammocks, are confined to the coastal plain, they do not seem to be known within the range of *Pinus Elliottii*. This is illustrated by the absence of the term from Georgia, Florida, and the Alabama pine-barrens, as far as known, and by Bulletin 43 of the U. S. Bureau of Forestry, which treats of a part of South Carolina not far distant from that described in Bulletin 56, but within the range of this pine. In this bulletin the word pocosin is not used, and no feature of that kind is even described.

* 2d Rep. N. C. Geol. Surv. (Agriculture of the eastern counties), page 38. 1858.

† Rep. N. C. Geol. Surv. for 1875; also report on cotton production in 6th vol. of Tenth Census, 1884.

‡ Bull. N. C. Geol. Surv. **5**: 17, 28, 34; **6**: 179–181.

§ Field Operations of the Bureau of Soils, **1900**: 36, 38, 204–205, *pl. 25*; **1903**: 269–270; **1905**: (in reports on Perquimans, Pasquotank and Duplin counties, not yet paged consecutively).

‖ See Cowles, Bot Gaz. **27**: 367–369. *f. 24–26.* 1899.

of the sand-hill bogs of the Altamaha Grit region,* the low islands in Okefinokee Swamp, and some densely bushy places in the flat pine-barrens near the coast.

In the pine-barrens of Brunswick and Pender Counties, North Carolina, one occasionally passes extensive flat meadow-like areas, or savannas, with no shrubs and very few trees, recalling the "pine meadows" of southeastern Mississippi.† One such place near Burgaw ‡ contained no trees or even stumps in an area of several hundred acres, being a veritable prairie, and at the same time apparently perfectly natural. The vegetation of such places is composed chiefly of grasses (especially *Campulosus aromaticus*) and other monocotyledons, as might be expected.

Floristics. — The total number of species noted in the three states in five days was about 200, all seen and identified from the car windows except a few near Florence, S. C., on the morning of July 27, and about thirty in the vicinity of Wrightsville Beach, N. C., on the afternoon of the same day, which had not been observed from the railroads. Counting both native and introduced species, the monocotyledons constitute 25.7 per cent. of the angiosperms in my notes for this trip; while of the native angiosperms alone, the monocotyledons are 26.2 per cent. Although these figures are a little less than those I have obtained for several other coastal plain areas, § the discrepancy is easily explainable by the fact that all the trees and nearly all the shrubs are dicotyledons, and my car-window notes are of course more complete for these than for the herbs. Considering the comparatively small number of species recorded, the correspondence seems remarkably close.

About 45 species noted in South Carolina were not seen after leaving that state, and some 15 others were evidently more frequent in South than in North Carolina. These 60 species, or the majority of them, can be divided into several groups according to habitat and origin, as follows:

First, plants of alluvial swamps along the larger rivers, a habi-

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* See Ann. N. Y. Acad. Sci. 17: *pl. 12. f. 2.* 1906.

† See Torreya 6: 204–205. 1906; also McGee, Ann. Rep. U. S. Geol. Surv. 12[1]: 368, 475. 1892.

‡ Described in Kerr's report for 1875 (pages 19, 178) as the "Burgaw Savannah."

§ See Torreya 5: 207–210. 1906.

tat which is evidently best developed in the Mississippi valley.* *Tecoma radicans*, *Bignonia crucigera*, *Fraxinus caroliniana*, *Hibiscus militaris*, *Gleditsia aquatica*, *Platanus occidentalis*, *Planera aquatica*, *Populus* sp., *Hicoria aquatica*, *Sabal glabra*. Most of these occur somewhere in North Carolina, but probably less abundantly. Thirty years ago Prof. L. F. Ward † commented on the absence of some of the same species from Dismal Swamp.

Second, plants chiefly confined to hammocks and allied habitats. *Polymnia Uvedalia*, *Batodendron arboreum*, *Vitis rotundifolia*, *Cercis canadensis*, *Magnolia grandiflora*, *Quercus virginiana*, *Fagus americana*, *Smilax lanceolata*, *Tillandsia usneoides*, *Juniperus virginiana*.

Third, plants of pine-barren ponds, a kind of habitat which, as already noted, seems to be more frequent in South Carolina than in the other two states. *Asclepias lanceolata*, *Sabbatia campanulata*, *Oxypolis filiformis*, *Ludwigia suffruticosa*, *Hypericum fasciculatum*, *Polygala cymosa*, *Castalia odorata*, *Pontederia cordata*, *Rynchospora corniculata*, *Panicum digitarioides*, *Taxodium imbricarium*, *Pinus Elliottii*.

Fourth, plants of fresh marshes and ditches, doubtfully indigenous. *Sambucus canadensis*, *Aeschynomene virginica*, *Juncus effusus*, *Lemna* sp., *Limnobium Spongia*, *Typha latifolia*, *Azolla caroliniana*.

Fifth, weeds, mostly from the tropics or with tropical affinities. *Eupatorium compositifolium*, *Ambrosia artemisiaefolia*, *Polypremum procumbens*, *Passiflora incarnata*, *Sida rhombifolia*, *Euphorbia maculata*, *E. eriogonoides*, *Bradburya virginiana*, *Glottidium vesicarium*, *Cyperus rotundus*, *C. Iria*, *Echinochloa colona*.

Of about 30 species seen in both Carolinas but not in Virginia, some belong to the same categories as those just mentioned, but the majority are typical pine-barren plants, which are rarely or never seen as far north as Virginia.

A very interesting group of plants comprises those noted oftener within about 50 miles of Wilmington than anywhere else on the whole journey. Several of these were not seen in South

* See Ann. N. Y. Acad. Sci. 17: 74. 1906; Torreya 7: 44. 1907; Science II. 25: 541. 1907.

† Field & Forest 3: 29. 1877.

Carolina at all, though they nearly all grow in Georgia. The following is a somewhat incomplete list: *

Marshallia graminifolia (Walt.) Small.
Pterocaulon undulatum (Walt.) Mohr.
Aster squarrosus Walt.
Chondrophora nudata (Michx.) Britton.
Vernonia angustifolia Michx.
Sabbatia lanceolata (Walt.) T. & G.
Vaccinium crassifolium Andr.†
Rhexia Alifanus Walt.
Gordonia Lasianthus L.
Cyrilla racemiflora L.
Polygala ramosa Ell.
" *lutea* L.
Amorpha herbacea Walt.
Aronia arbutifolia (L.) Pers.
Sarracenia flava L.
Sarracenia minor Walt.
Quercus cinerea Michx.
Myrica pumila (Michx.) Small.
Habenaria blephariglottis (Willd.) Torr.
Habenaria cristata (Michx.) R. Br.
Gyrotheca tinctoria (Walt.) Sal.
Smilax laurifolia L.
Lilium Catesbaei Walt.
Zygadenus glaberrimus Michx.
Tofieldia racemosa (Walt.) B. S. P.
Eriocaulon decangulare L.
Carex glaucescens Ell.
Dichromena latifolia Baldw.
Campulosus aromaticus (Walt.) Trin.
Aristida stricta Michx.

No attempt is made to include in this list any plants of dunes and marshes which were seen only at Wrightsville Beach, or any species whose apparently greater abundance in that vicinity was probably due only to the fact that I spent a few hours on the ground in New Hanover County, and nowhere else in North Carolina. The species listed here all grow in dry, intermediate or moist pine-barrens or in branch-swamps, and the reason for their frequency near Wilmington and comparative scarcity a hundred miles away in either direction is as yet obscure, though it is probably connected in some way with the geological peculiarities mentioned above. The fact that the vicinity of Wilmington is a sort

* See also Torreya 7: 43, where are enumerated a few species apparently confined to this vicinity, none of which I happened to see on this trip.

† I saw this only once, in moist pine-barrens near Wrightsville. In the spring of 1794 Michaux found it near Wilmington, and 65 miles north of there. I have not come across any authentic published record of its occurrence outside of eastern North Carolina.

of distribution center has been noticed before, by Kerr,* Gray,† and perhaps others, but apparently not yet explained.

Another interesting though smaller group of plants includes those seen oftener in Virginia than in North Carolina. These happen to be all trees and shrubs,‡ namely, *Oxydendrum arboreum*, *Aralia spinosa*, *Cornus florida*, *Rhus copallina*, *Quercus alba*, *Q. minor*, *Q. Phellos*, *Fagus americana* and *Pinus echinata*.§ As I traveled 275 miles by rail through North Carolina (or about 295 including trip from Wilmington to Wrightsville Beach and back by electric cars), and only 137 in Virginia by daylight, traversed the whole width of the coastal plain in both states, and tried to note each species as often as possible, it is safe to assume from the returns that all these are at least twice as frequent in southeastern Virginia as in the corresponding parts of North Carolina.

The causes of their greater frequency in Virginia are doubtless somewhat complex, and need not be discussed here. An examination of their general distribution and habitats brings out some interesting points. In the coastal plain of Georgia and Alabama all these species grow on bluffs or in hammocks or bottom-lands, especially outside of the pine-barrens, and they evidently belong to a stage of vegetation much more nearly approaching the climax condition than does that of the pine-barrens. ‖ They are all common in the northwestern portion of the coastal plain of Alabama, a region notable for the lack of diversity in its flora and the wide distribution of nearly all the species inhabiting it.¶

Some notes on the commoner species of the region traversed, and their habitats, may be of interest. The following were seen in all three states, and in most of the 25 or 30 counties in which notes were taken:

Eupatorium rotundifolium L. (intermediate pine-barrens, etc.).

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* Rep. Geol. Surv. N. C. 1875: 106.

† Am. Jour. Sci. III. 28: 336. 1884.

‡ Probably mostly because herbs are relatively much less abundant and conspicuous (in natural plant-communities) outside of the pine-barrens.

§ For notes on the occurrence of some of these in the vicinity of Dismal Swamp, see Ward, Field and Forest 3: 30. 1877; Kearney, Contr. U. S. Nat. Herb. 5: 404, 476–479. 1901.

‖ See Ann. N. Y. Acad. 17: 103; Plant World 9: 267. 1906.

¶ See Torreya 7: 45. 1907; also Mohr, Contr. U. S. Nat. Herb. 6: 90. 1901.

Clethra alnifolia L. (pocosins and bushy pine-barrens).
Nyssa uniflora Wang. (creek- and river-swamps).
" *biflora* Walt. (along all streams, and in ponds).
Acer rubrum L. (creek-swamps mostly).
Liquidambar Styraciflua L. (nearly everywhere, but mostly small and scattered).
Liriodendron Tulipifera L. (branch-swamps and other low grounds).
Magnolia glauca L. (non-alluvial swamps and pocosins).
Quercus marylandica Muench. (dry woods and pine-barrens).
Alnus rugosa Koch (along branches mostly).
Salix nigra Marsh. (along creeks mostly).
Pinus Taeda L. (nearly everywhere).
" *serotina* Michx. (pocosins and other damp sandy places).
Taxodium distichum (L.) Rich. (creeks and rivers).

The following were also seen in all three states, but less frequently than those just mentioned:

Ilex glabra (L.) Gray (intermediate pine-barrens, etc.).
Phoradendron flavescens (Pursh) Nutt. (on *Nyssa biflora*).
Quercus digitata (Marsh.) Sudw. (dry woods, etc.).
" *Catesbaei* Michx. (dry pine-barrens and sand-hills).
" *Phellos* L. (low grounds).
Betula nigra L. (along creeks and rivers).
Myrica cerifera L. (bushy pine-barrens, and low grounds).
Spartina glabra Muhl. (salt marshes).
Pinus echinata Mill. (sand-hills and dry woods).
Anchistea virginica (L.) Presl (damp sandy places).
Pteridium aquilinum (L.) Kuhn. (intermediate pine-barrens, etc.).

NOTEWORTHY SPECIES

The following seem to deserve separate mention.

SENECIO TOMENTOSUS Michx.

Seen only along the railroad right-of-way, in Bertie, Hertford, and Gates counties, N. C., and Nansemond County, Va., where it was quite common. Mr. Kearney * noted its abundance in the same general region, and it was previously reported from the

* Contr. U. S. Nat. Herb. 5: 408, 472, 547. 1901.

vicinity of Hampton, Va.,* and Elizabeth City, N. C., † by Chickering, and near Weldon, N. C., by Ward; ‡ all these places being within 125 miles of each other. In Georgia it behaves quite differently, being chiefly confined to flat rocks; § and at the time it was described it was known only from Flat Rock, a large granite exposure in Kershaw County, S. C. This, together with the fact that it has not been reported from any natural habitat in the Dismal Swamp region, suggests that it may have been introduced there in comparatively recent times. More information about its distribution is greatly to be desired.

ACANTHOSPERMUM AUSTRALE (L.) Kuntze

A few years ago || I noted the gradual spread of this tropical weed northward along railroads in North Carolina. This time I saw it at several stations (*i. e.*, railroad stations) in the pine-barrens, then in Gates County, and finally across the state line in Nansemond County, Virginia. So it is now to be added to the flora of the Manual region.¶

LIMONIUM NASHII Small.

A plant which looks exactly like this species as I have seen it on the Georgia coast, and does not fit the description of *L. carolinianum*, was seen in considerable quantity just back of the dunes on Wrightsville Beach, N. C. It seemed to be the only *Limonium* there, and is doubtless the "*Statice Limonium ?* (Masonborough)" of Curtis's catalogue,** and the *Statice caroliniana* of Wood & McCarthy's Wilmington Flora.†† *L. Nashii* has not been previously reported north of Georgia.

LUDWIGIA MARITIMA Harper, Torreya 4: 163. *f. 2.* 1904.

I had seen no specimens of this from the Carolinas until I

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* Field and Forest 3: 1. 1877; 3: 152. 1878.

† Am. Nat. 7: 523. 1873.

‡ Bot. Gaz. 11: 38. 1886.

§ See Ann. N. Y. Acad. Sci. 17: 42, 43, 134; Torreya 6: 243, 244. 1906.

|| Torreya 3: 124. 1903.

¶ It has recently been reported as a waif in Lawrence, Mass., by E. S. Schneider in Rhodora (9: 26. 1907), but that of course has no special significance.

** Bost. Jour. Nat. Hist. 1: 101. 1835. Masonboro is only a couple of miles from Wrightsville Beach.

†† Jour. Elisha Mitchell Sci. Soc. 3: 109. 1887.

found it in the pine-barrens near Wrightsville, N. C. It was behaving suspiciously like a weed, as it and some of its congeners usually do in Georgia, and it may possibly be a comparatively recent (say within 200 years) mutation * from its nearest relative, *L. virgata* Michx.

SASSAFRAS VARIIFOLIUM (Sal.) Kuntze, Rev. 574. 1891.†

Seen in Florence County, S. C., New Hanover and Wayne counties, N. C., and Prince George County, Va., but always as a weed; and it is altogether probable that it is not native anywhere in the Carolina coastal plain, for its normal habitat seems to be on bluffs, which are very scarce in this region, as noted above.

GORDONIA LASIANTHUS L.

Pinchot & Ashe mention no particular localities in North Carolina for this tree, but I saw some small specimens, in flower, a little north and south of Magnolia ‡ in Duplin County, and perhaps also in New Hanover and Brunswick counties. On March 1, 1794, Michaux noted it near (old) Washington, 38 miles north of Wilmington, which must have been within ten miles of where I saw it. It was also reported from the vicinity of Newbern by Croom, and from near the present city of Washington, in Beaufort County, by McCarthy.§

HIBISCUS MILITARIS Cav.

Seen only in the muddy swamps of two of the rivers of the first class mentioned above, the Santee and Peedee, in Berkeley, Williamsburg and Florence counties, S. C. In Georgia likewise I have seen it only along two rivers of the same class, the Savannah and the Ocmulgee; and in Alabama Dr. Mohr knew it only from the Alabama River and its connections in the coastal plain.‖

ACER SACCHARINUM L. (*A. dasycarpum* Ehrh.)

If I am not mistaken I saw some specimens of this tree on the bank of the Roanoke River in Bertie County, N. C. It does not

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* See in this connection Ann. N. Y. Acad. Sci. 17: 116. 1906.

† See Rusby, Nat. Stand. Dispensatory 1105, 1367. 1905; Henkel, U. S. Dept. Agr. Bur. Pl. Ind. Bull. 89: 62. 1906. Robinson, Rhodora 8: 199. 1906.

‡ Could the name of the place perhaps have some connection with this tree?

§ Bot. Gaz. 10: 385. 1885; 12: 78. 1887.

‖ "Tennessee" in his remarks about this species (Contr. U. S. Nat. Herb. 6: 617) is of course a typographical error for "Tensas."

seem to have been reported from eastern North Carolina before, but there is no known reason why it should not grow there, for in Georgia and Alabama it follows the larger rivers some distance down into the coastal plain.*

CYRILLA RACEMIFLORA L.

Seen a number of times, mostly in pocosins, in Columbus, Brunswick, New Hanover, Pender and Duplin counties, N. C., but nowhere else on this trip. I cannot imagine why I did not see it in South Carolina, for it is common in Georgia; or farther north than Duplin County, for it has been reported from Beaufort County, N. C., by McCarthy,† within a mile of the Virginia line by Michaux (February 23, 1794), and from Virginia by Ward ‡ and Heller. §

EUPHORBIA ERIOGONOIDES Small.

Observed in the outskirts of Florence, S. C., with *E. maculata*, in sand along a railroad track, which is just the usual habitat of both in South Georgia. In fact only two natural stations for *E. eriogonoides* are known, both in the Altamaha Grit region of Georgia.|| It has not previously been reported northeast of Georgia.

POLYGALA LUTEA L.

This has been mentioned above as one of the plants which is evidently more abundant in southeastern North Carolina than in adjacent territory. I might say further that I noted it thirty-one times (in seven counties) in North Carolina, and once in Virginia, but not once in South Carolina, though it is common enough in the pine-barrens of Georgia.

PLATANUS OCCIDENTALIS L.

The only object in mentioning this common tree here is to place on record something probably not generally known, namely, that in the pine-barrens of the Carolinas it seems to be confined

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* See Bull. Torrey Club 32: 147. 1905; and Dr. Mohr's remarks on the same species.

† Bot. Gaz. 10: 384. 1885; 12: 78. 1887.

‡ Bot. Gaz. 11: 38. 1886.

§ Bull. Torrey Club 21: 23. 1894.

|| See Ann. N. Y. Acad. Sci. 17: 212. 1906.

to the banks of the muddy rivers, just as in Georgia.* In the Carolinas I saw it only along the Santee, Peedee, and Tar rivers; but in Virginia, where the coastal plain vegetation is further advanced toward the climax stage, it occurs along some smaller streams.

SARRACENIA FLAVA L.

Occurs in moist pine-barrens, sometimes sparingly and sometimes abundantly, in Hampton, Berkeley, Williamsburg and Marion counties, S. C., and Columbus, Brunswick, New Hanover, Pender, Duplin and Edgecombe counties, N. C.; but nowhere in all this territory was it as large or as abundant as it usually is in Georgia. On this trip I did not see it at all in Virginia, though I looked specially for it all through that state. But when reporting it from Dinwiddie County a few years ago † I overlooked the fact that Croom ‡ had long before cited specimens from Southampton County, Va., which is southeast of where I last saw it in 1904, and a little northeast of where I first saw it in 1903.§ There seems to be as yet no record of it within twenty miles of Dismal Swamp.

NYMPHAEA FLUVIATILIS Harper, Bull. Torrey Club 33: 234. 1906

What looks just like this species was seen in the Santee River in South Carolina and in the Chowan in North Carolina. It was previously known only from Georgia, but there is no apparent reason why it should be confined to that state.

MAGNOLIA GRANDIFLORA L.

Noted only twice in Barnwell County and once in Berkeley County, S. C. Mr. McCarthy ‖ reported it from the vicinity of Washington, N. C., but this is probably an error, unless it refers to cultivated specimens.

MAGNOLIA GLAUCA L.

Common in most of the counties passed through, in all three states, but never growing very large. In low pine-barrens and

* See Bull. Torrey Club 32: 147. 1905.

† Torreya 4: 123. 1904.

‡ Ann. Lyc. N. Y. 4: 103. 1837.

§ See Torreya 3: 123. 1903.

‖ Bot. Gaz. 10: 384. 1885.

pocosins, especially in Hampton and Williamsburg counties, S. C., and Columbus, Brunswick, New Hanover, Pender, Duplin, Wayne and Edgecombe counties, N. C., it is represented chiefly by low bushes, often very abundant, just as in many places in the Altamaha Grit region of Georgia.* Arborescent specimens were also seen in non-alluvial swamps in Columbus, Brunswick, Edgecombe and perhaps other counties.

PLANERA AQUATICA (Walt.) Gmel.

Observed only in the swamps of the Santee, Black and Peedee rivers, in Berkeley, Williamsburg, Florence and Marion counties, S. C. (Michaux noted the same species on the Santee River, a little higher up than where I crossed it, on April 20, 1795, and April 10, 1796.) Its habitat is thus much like that of *Platanus occidentalis*, though its distribution is quite different in one respect, for it is very nearly confined to the coastal plain, but not altogether to the largest streams. It is one of those species which seems to center in the Mississippi embayment of the coastal plain, and does not extend as far northeast as Virginia.†

QUERCUS CATESBAEI Michx.

I noted this tree in most of the counties passed through southwest of Goldsboro, N. C., and then did not see it again until I passed the sand-hills of the Blackwater River near Zuni, Isle of Wight County, Virginia (half way between Norfolk and Petersburg), where it seems to be quite abundant, though of small size. As I was traveling about 40 miles an hour at the time, and secured no specimens, some persons may be reluctant to admit it to the flora of the "Manual region" without more evidence. I notice however that Pinchot & Ashe report it from Gates County, N. C. (one of the northern tier of counties), which would lead one to expect it in Virginia, even though their map of its range does not correspond with this statement.

FAGUS AMERICANA Sweet

This common tree was seen only a few times in South Carolina and Virginia, and not at all in North Carolina. This is not

* See Ann. N. Y. Acad. Sci. 17: 59, 239, 333. 1906. Its dimorphism as to size has also been briefly mentioned by Pinchot & Ashe.

† See Ann. N. Y. Acad. Sci. 17: 246; Bull. Torrey Club 33: 534. 1906; Torreya 7: 44; Science II. 25: 541. 1907.

surprising, however, considering its distribution in the coastal plain of Georgia.*

POPULUS DELTOIDES Marsh., and HICORIA AQUATICA (Michx. f.) Britton

These were noted only in the swamps of the Santee and Peedee rivers, like *Hibiscus militaris.* The *Populus,* like *Platanus,* is not known in the Altamaha Grit region of Georgia at all, while the *Hicoria* has a distribution much like that of *Planera.*

MYRICA CERIFERA L.

This was seen in three counties in South Carolina, four in North Carolina, and three in Virginia, and about three times in each, on the average; while its near relative *M. carolinensis* Mill. was noted only once, in a bog near Wrightsville, New Hanover County, N. C. Mr. Kearney scarcely mentions *M. cerifera* in his botanical survey of the Dismal Swamp region, but he appears to have partly confused the two species, as many others have done. Of the numerous references to *M. carolinensis* in his report, those on pages 370–372, 377, 386, 390, 392, 540 and 545 are doubtless correct, while those on pages 382, 400, 404, 473 and 477 almost certainly pertain to *M. cerifera.* The two species look much alike, but when their habitats are considered there is little danger of confusing them. *M. carolinensis* is distinctly a pioneer plant, growing in rocky pastures and barrens in the glaciated region, on dunes on the Middle Atlantic coast, and in sandy bogs in the coastal plain and lower mountains southward; while *M. cerifera* is much more of a climax plant, normally inhabiting hammocks, bluffs, etc., in the coastal plain from Maryland southward. The two species must have had a very different history. *M. carolinensis* is probably losing ground nearly everywhere, like most pioneer plants,† while *M. cerifera,* like several other species whose ranges extend into the tropics,‡ is doubtless tending to spread in the pine-barrens, if not elsewhere. In Georgia *M. cerifera* espe-

* See Bull. Torrey Club 32: 147. 1905; Ann. N. Y. Acad. Sci. 17: 106, 330. 1906.

† See Bull. Torrey Club 33: 528. 1906.

‡ Such as *Andropogon tener* and *Pinus Elliottii.* See Ann. N. Y. Acad. Sci. 17: 301–302, 305–306. 1906.

cially favors those rich spots where the Lafayette formation is absent (in this too it behaves like several other subtropical species);* but away from this main pine-barren center it is not so particular.

The following references to places where the ranges, habitats or morphological characters of these plants are described may be helpful.

M. CERIFERA.

Curtiss, Gard. and For. 1: 280. 1888.
Sargent, Gard. and For. 7: 474–476. 1894; Silva N. A. 9: 87–90. 1896.
Lloyd & Tracy, Bull. Torrey Club 28: 74 (as *M. Gale*), 91. 1901.
Northrop, Mem. Torrey Club 12: 32, 91. 1902.
Coker, Torreya 5: 140–144 (as *M. carolinensis*). 1905.
C. S. Chapman, U. S. Forestry Bull. 56: 8, 10, 12. 1906. ("Wax myrtle.")
A. H. Moore, List of plants collected in Bermuda. 8. 1906.
Ann. N. Y. Acad. Sci. 17: 15, 103, 106, 110, 111, 252. 1906.
Max Rothkugel, Forestry Quarterly 5: 3. 1907. ("Myrtle.")

M. CAROLINENSIS.

Treat, Gard. and For. 1: 494 (*M. cerifera*). 1888.
Sargent, Gard. and For. 7: 474, 477. 1894; Silva N. A. 9: 84. 1896.
Harshberger, Gard. and For. 5: 45–46. 1892; Proc. Acad. Nat. Sci. Phila. 1900: 643, 646, 649, 653; 1903: 354; 1904: 604 (as *M. cerifera*).
Hollick, Bull. N. Y. Bot. Gard. 2: 394, 395. 1902.
Snow, Bot. Gaz. 34: 294, 296, 298, 301, 305. 1902 (as *M. cerifera*).
Blankinship, Rhodora 5: 128 (as *M. cerifera*). 1904.
Chrysler, Rhodora 7: 123, 125, 127. 1905.
Rhodora 7: 74. 1905; Bull. Torrey Club 33: 528. 1906; Ann. N. Y. Acad. Sci. 17: 55, 90, 91, 252. 1906; Torreya 6: 214. 1906.

JUNCUS SCIRPOIDES COMPOSITUS Harper, Bull. Torrey Club 33: 233. 1906

Unmistakable specimens of this were seen in rather dry pine-barrens near Wrightsville, N. C. This discovery extends its known range eastward about 200 miles, and northward about 150, if the artificial station near Aiken, S. C. (cited in the original description), be disregarded.

JUNCUS BIFLORUS Ell. (See Bull. Torrey Club 33: 232. 1906)

Found in very nearly the same place as the preceding, which gives an authentic record in North Carolina for this neglected species.

* See Ann. N. Y. Acad. Sci. 17: 112, 191, 337.

TILLANDSIA USNEOIDES L.

Common nearly all the way through South Carolina, especially in Colleton and Berkeley counties; but much rarer in North Carolina, where I saw it in only five counties, and only once in each. Last noticed near the Roanoke River in Halifax County.

RYNCHOSPORA SEMIPLUMOSA Gray

In rather dry pine-barrens near Wrightsville, N. C. Not previously reported northeast of Georgia.

PINUS PALUSTRIS Mill.

It seems almost superfluous to add anything to what Mohr, Pinchot and Ashe have already written about this important tree in their well-known bulletins, cited above, but I might say that I observed it in every county passed through in the Carolinas except Charleston, S. C., and Nash, N. C. (I have very few notes, though, from these two counties). It becomes very scattered toward its northern limit, however, and I did not see it in Virginia at all. In fact, I know of no one who has seen it in that state in the last decade or two.*

PINUS ELLIOTTII Engelm.

The range of this in South Carolina is very limited, and I saw it only in Hampton County and near the borders of the adjoining counties of Barnwell and Colleton. It perhaps does not grow within thirty miles of Charleston. Many notes on its occurrence in Hampton and Beaufort counties can be found in Bulletin 43 of the U. S. Bureau of Forestry, under the name of "Cuban pine."

PINUS TAEDA L.

This is undoubtedly at present the commonest tree of the whole region, having been seen nearly every mile of the way, in every county passed through, in all three states. It varies considerably

*Michaux, traveling southward along the fall-line on February 24, 1794, first encountered this tree six miles south of the Virginia-North Carolina boundary and ten from Halifax. But Kerr, in his report on the cotton production of Virginia (Tenth Census U. S. 6: 635–637. 1884), mentions its former occurrence in Nansemond and parts of Isle of Wight, Sussex and Prince George counties. Croom has some interesting notes on this species on pages 47 and 48 of his flora of Newbern and vicinity. See also Kearney, Contr. U. S. Nat. Herb. 5: 398, 406, 449. 1901.

in abundance, being apparently most abundant where *P. palustris* is least so (in Virginia and the upper third and lower tenth of the coastal plain of South Carolina, for instance), and vice versa.

PINUS SEROTINA Michx.

In the Carolina coastal plain this tree is almost as frequent as *P. Taeda*, though generally much less abundant. In a few places, however, particularly around Ashton, in Pender County, N. C., it is almost the only pine in sight over a considerable area. It is much more particular as to habitat than *P. Taeda*, being chiefly confined to pocosins and other sandy bogs, and avoiding the least trace of alluvium.

On this trip I saw a good deal of it in Nansemond County, Virginia, as in 1903,* and a little in Sussex County and perhaps a specimen or two in Chesterfield. In the northern edge of Dismal Swamp, along the N. & W. Ry., a few miles east of Suffolk, are many individuals at least a foot in diameter and forty feet tall.

I did not notice until very recently that Mr. Ashe † mentioned the occurrence of this species in Virginia long before I did, but in such an inconspicuous way that it has been overlooked by nearly every subsequent writer. An interesting problem which still awaits solution is to determine how far north *P. serotina* really extends, and whether it overlaps or intergrades with its nearest relative *P. rigida*.

TAXODIUM IMBRICARIUM (Nutt.) Harper

Noted in six counties in South Carolina (especially in Barnwell, Hampton and Williamsburg), but in only two in North Carolina (Columbus and New Hanover). It is common in places along the car line between Wilmington and the beach, where some specimens fully a foot in diameter and forty or fifty feet tall were observed; so it seems strange that Wood & McCarthy knew it from only one spot in that county. After leaving Wilmington I did not see any more of this tree, strange to say, unless a few specimens in the northern edge of Dismal Swamp, which I did

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* See Torreya 3: 122. 1903.

† Bull. N. C. Geol. Surv. 5: 15, 31. 1894. See also Kearney, Contr. U. S. Nat. Herb. 5: 483. 1901.

not get a good look at, should prove to be of this species. Authentic records of it farther north than Wilmington are not wanting, however, for Croom reported it from the vicinity of Newbern, and from Drowning Creek, 32 miles southwest of Fayetteville,* which must be almost exactly where I saw it in 1905.†

CHAMAECYPARIS THYOIDES (L.) B.S.P.

This tree is evidently much more local in distribution than is commonly supposed, for I did not see a single specimen between Tuscaloosa and New York (a distance of 1900 miles by the route I took), though I was in or near its supposed range the whole distance. To determine and explain its exact distribution would be a most interesting problem.‡

SELAGINELLA ACANTHONOTA Underw.

Seems quite abundant on the sand-hills of the Lumber River in the northern corner of Horry County, South Carolina. Not previously reported from that state. Ordinarily one could not be sure of the identity of such a small plant when viewing it from a moving train, but as I had seen it under similar circumstances in Georgia just a week before,§ and its habitat at the new station was the same as it usually is in Georgia, ||I had very little doubt on that score. Having been discovered in North Carolina¶ and collected several times in Georgia, there was no reason why this species should not turn up in South Carolina.

COLLEGE POINT, NEW YORK.

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* Am. Jour. Sci. **28**: 166. 1835.

† See Torreya **6**: 42. 1906.

‡ The following references to notes on its local distribution may be of interest: Torreya 3: 122. 1903; **6**: 43. 1906; 7: 43. 1907. Also Croom, Am. Jour. Sci. **26**: 316. 1834.

§ See Torreya **6**: 245. 1906.

|| See Bull. Torrey Club **32**: 152. *f. 3;* Fern Bull. **13**: 15. 1905; Ann. N. Y. Acad. Sci. **17**: 309. *pl. 28.* 1906.

¶ The type locality is near Wilmington, presumably on the sand-hills of the Cape Fear River. This is undoubtedly the "*Lycopodium rupestre*" of Curtis's flora of Wilmington, and probably the "clusters of moss" mentioned in the soil survey of New Hanover County (p. 19) as a characteristic feature of the sand-hills.

INDEX TO AMERICAN BOTANICAL LITERATURE
(1907)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions their kindness will be appreciated.

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Anderson, M. P. Early European botanists in Japan. Jour. N. Y. Bot. Gard. **8**: 99–110. *f. 15.* [Je] 1907.

Arthur, J. C., *and others.* American code of botanical nomenclature. Bull. Torrey Club **34**: 167–178. 11 Je 1907.

Atkinson, G. F. A mushroom parasitic on another mushroom. Plant World **10**: 121–130. *f. 22–24.* Je 1907.

Autran, E. Les Tropéolacées argentines et le genre *Magallana* Cav. Anal. Soc. Ci. Arg. **63**: 74–81. *pl.* F 1907.

Becker, W. Systematische Bearbeitung der Violen-Sektion *Leptidium* (Ging. pro parte maxima). Beih. Bot. Centralb. **22**^{2}: 78–96. *pl. 1.* 1 Je 1907.

Berger, A. *Opuntia Gosseliniana* Web. Monats. Kakteenk. **17**: 68–71. 15 My 1907. [Illust.]

Native of Baja California.

Berry, E. W. Contributions to the Mesozoic flora of the Atlantic coastal plain — II. North Carolina. Bull. Torrey Club **34**: 185–206. *pl. 11–16.* 11 Je 1907.

New species described in *Myrica, Quercus, Planera, Liriodendron,* and *Pterospermites* (2).

Blakeslee, A. F. Heterothallism in bread mold, *Rhizopus nigricans.* Bot. Gaz. **43**: 415–418. 17 Je 1907.

Blumer, J. C. Notes on heliotropism of *Sisymbrium canescens*. Plant World **10**: 141, 142. Je 1907.

Brainerd, E. The behavior of the seedlings of certain violet hybrids. Science II. **25**: 941–944. 14 Je 1907.

Broadway, W. E. A Grenada mountain estate. Gard. Chron. III. **41**: 410. 22 Je 1907.

Broadway, W. E. Grenada, W. I. Gard. Chron. III. **41**: 383. 15 Je 1907.

Notes on a few native and introduced species.

Brotherus, V. F. *Musci*, in Engler & Prantl, Die nat. Pflanzenfam. **1**^{3}: 865–960. *f. 635–700*. 1907.

Lembophyllaceae (Schluss), *Entodontaceae*, *Fabroniaceae*, *Pilotrichaceae*, *Nematoceae*, und *Hookeriaceae*.

Brown, S. A new spruce from the Canadian Rocky Mountains. Torreya **7**: 123–125. 19 Je 1907.

Picea albertiana sp. nov., native of Alberta.

Burlingham, G. S. Suggestions for the study of the *Lactariae*. Torreya **7**: 118–123. 19 Je 1907.

Clinton, G. P. Dry rot fungus, *Merulius lacrymans* (Wulf.) Schum. Rep. Conn. Agric. Exp. Sta. **1906**: 336–341. *pl. 26–28*. My 1907.

Clinton, G. P. Notes on fungous diseases, etc., for 1906. Rep. Conn. Agric. Exp. Sta. **1906**: 307–331. *pl. 17–22*. My 1907.

Clinton, G. P. Root rot of tobacco, *Thielavia basicola* (B. & Br.) Zopf. Rep. Conn. Agric. Exp. Sta. **1906**: 342–368. *f. 14* + *pl. 29–32*. My 1907.

Cockerell, T. D. A. A new *Mertensia* from Colorado. Muhlenbergia **3**: 68. 8 Je 1907.

Cockerell, T. D. A. A new plant (*Ficus*) from the Fox Hills Cretaceous. Univ. Colo. Stud. **4**: 152, 153. Ap 1907.

Scientific expedition to northeastern Colorado.

Collins, F. S. The basis of nomenclature for algae. Rhodora **9**: 77–80. 3 Je 1907.

Cook, M. T. The embryology of *Rhytidophyllum*. Bull. Torrey Club **34**: 179–184. *pl. 10*. 11 Je 1907.

Cook, M. T. Notes on polyembryony. Torreya **7**: 113–117. *f. 1–3*. 19 Je 1907.

Cook, O. F. Transmission inheritance distinct from expression inheritance. Science II. **25**: 911–912. 7 Je 1907.

Cooke, M. C. Root-rot fungus. Gard. Chron. III. **41**: 361. *f. 153.* 8 Je 1907.

Copeland, E. B. Pteridophyta halconenses: a list of the ferns and fern-allies collected by Elmer D. Merrill on Mount Halcon, Mindoro. Philipp. Jour. Sci. **2**: Bot. 119–151. *pl. 1–4.* Ap 1907.

Includes new species in *Dennstaedtia*, *Diplazium* (4), *Asplenium*, *Plagiogyria*, *Acrosorus*, *Prosaptia*, *Polypodium* (4), *Hymenophyllum*, and *Alsophila*.

Deichmann, H. & Rosenvinge, L. K. Bemaerkninger om Isfod og Tangrand ved Grønlands Kyster. Bot. Tidssk. **28**: 171–181. *f. 1–3.* 1907.

Deichmann, H. & Rosenvinge, L. K. Note sur la limite supérieure des Fucacées et sur le bord de glace ("Isfod") sur les côtes du Groenland. Bot. Tidssk. **28**: 182–184. 1907.

DeVries, H. Plant breeding. Comments on the experiments of Nilsson and Burbank. i–xiii. 1–360. *f. 1–114.* Chicago, 1907.

Dillingham, F. T. The staff-tree, *Celastrus scandens*, as a former food supply of starving Indians. Am. Nat. **41**: 391–393. 22 Je 1907.

Dismier G. Note sur quelques *Philonotis* de l'Amérique du Nord et de l'Europe. Rev. Bryol. **34**: 50–52. [My] 1907.

Farr, E. M. Contributions to a catalogue of the flora of the Canadian Rocky Mountains and the Selkirk Range. Contr. Bot. Lab. Univ. Penn. **3**: 1–88. *map.* Je 1907.

Ferguson, M. C. Two embryo-sac mother-cells in *Lilium longiflorum*. Bot. Gaz. **43**: 418, 419. *f. 1.* 17 Je 1907.

Fernald, M. L. Diagnoses of new spermatophytes from Mexico. Proc. Am. Acad. Arts & Sci. **43**: 61–68. 26 Je 1907.

New species described in *Carex* (2), *Alnus* (2), *Heliotropium*, *Salvia* (9), *Castilleja*, and *Ruellia*.

Fernald, M. L., & Eames, A. J. Preliminary lists of New England plants, — XX. *Sparganiaceae*. Rhodora **9**: 86–90. 3 Je 1907.

Includes *Sparganium lucidum* sp. nov.

Fitzpatrick, T. J. A proposed new species of *Lilium*. Iowa Nat. **2**: 30, 31. 14 My 1907.

L. lanceolatum, a native of Iowa.

Fletcher, E. F. *Alchemilla pratensis* found at Westford, Massachusetts. Rhodora **9**: 92. 3 Je 1907.

Fobe, F. Einiges über die Blütenbefruchtung der Kakteen. Monats. Kakteenk. **17**: 75–77. 15 My 1907.

Fowler, J. Report on the flora of Canso, Nova Scotia. Further Contrib. Can. Biol. **1902–1905**: 59–70. 1907.

Freeman, E. M. The ether freezing microtome, in botanical technique. Science II. **25**: 747–749. 10 My 1907. [Illust.]

Greenman, J. M. New species of *Senecio* and *Schoenocaulon* from Mexico. Proc. Am. Acad. Arts & Sci. **43**: 19–21. 26 Je 1907.
Two new species of *Senecio* and three of *Schoenocaulon*.

Griffiths, D. Concerning some west American fungi. Bull. Torrey Club **34**: 207–211. 11 Je 1907.
Includes new species in *Sclerospora*, *Ustilago*, *Sorosporium*, *Urocystis*, *Aecidium*, and *Puccinia*.

Grignan, G. T. Trois beaux *Salvia*. *Salvia azurea grandiflora*, *S. splendens Boule de feu*, *S. splendens Surprise*. Rev. Hort. **79**: 279–281. *f. 94* + *pl.* 16 Je 1907.

Harper, R. M. Competition between two oaks. Plant World **10**: 114–117. *f. 20, 21.* My 1907.

Harrison, A. K., *and others*. Reports on the flora of the Boston district, I. Rhodora **9**: 81–86. 3 Je 1907.

Harshberger, J. W. The Mexican cypress. Forest Leaves **11**: 24. Ap 1907. [Illust.]

Hassler, E. Plantae paraguarienses novae vel minus cognitae IV. Bull. Herb. Boiss. II. **7**: 445–460. 30 My 1907. [Illust.]
New species in *Lobelia* (2), *Paspalum*, *Panicum*, and *Sida*.

Hay, G. U. Observations on weather and plants, 1906. Bull. Nat. Hist. Soc. New Brunswick **5**: 559–561. 1907.

Hay, G. U. Report of committee on botany. Bull. Nat. His. Soc. New Brunswick **5**: 563, 564. 1907.

Haynes, C. C. Ten lophozias. Bryologist **10**: 9–12. *pl. 2, 3.* 2 Ja 1907.

Heald, F. D. Field work in plant pathology. Plant World **10**: 104–109. My 1907.

Hemsley, W. B. American rubber plants. Kew Bull. Misc. Inf. **1907**: 153–156. My 1907.

Hemsley, W. B. *Eupatorium glandulosum.* Curt. Bot. Mag. IV. **3**: *pl. 8139.* Je 1907.
Native of Mexico.

Hibbard, R. P. The influence of tension on the formation of mechanical tissue in plants. Bot. Gaz. **43**: 361–382. 17 Je 1907.

Holm, T. The genus *Carex* in north-west America. Beih. Bot. Centralb. **22**^{2}: 1–29. 1 Je 1907.

Holway, E. W. D. North American *Uredineae.* **1**: 57–80. *f.* + *pl. 24–36.* 10 My 1907.
Includes descriptions of 3 new species of *Puccinia*.

House, H. D. New or noteworthy North American *Convolvulaceae.* Bot. Gaz. **43**: 408–414. *f. 1–4.* 17 Je 1907.

Includes 9 new species in *Ipomoea*, natives of Mexico or Central America.

Hoyt, W. D. Periodicity in the production of the sexual cells of *Dictyota dichotoma.* Bot. Gaz. **43**: 383–392. 17 Je 1907.

Jeffrey, E. C. & Chrysler, M. A. The microgametophyte of the *Podocarpineae.* Am. Nat. **41**: 355–364. *f. 1–5.* 22 Je 1907.

Jensen, C. A. Some mutual effects of tree-roots and grasses on soils. Science II. **25**: 871–874. 31 My 1907.

Judd, C. S. A mesquite grove in Hawaii. Forestry & Irrig. **13**: 186, 187. Ap 1907.

Livingston, B. E. Relative transpiration in cacti. Plant World **10**: 110–114. *f. 19.* My 1907.

Loew, O. A correction. Science II. **25**: 940. 14 Je 1907.

MacDougal, D. T. Natural hybrids. Plant World **10**: 138, 139. Je 1907.

MacKay, A. H. The *Diatomaceae* of Canso Harbour, Nova Scotia. A provisional list. Further Contrib. Can. Biol. **1902–1905**: 55–58. 1907.

Macloskie, G. The Patagonian flora. Plant World **10**: 97–103. My 1907.

Merrill, E. D. The occurrence of *Antiaris* in the Philippines. Philipp. Jour. Sci. **2**: Bot. 111, 112. Ap 1907.

Mottet, S. L'*Hibiscus Moscheutos* et ses variétés. Rev. Hort. **79**: 201–203. *f. 66.* 1 My 1907.

Murrill, W. A. Exercises commemorative of the two hundredth anniversary of the birth of Linnaeus. Jour. N. Y. Bot. Gard. **8**: 123–139. *pl. 39 + f. 16–20.* Je 1907.

Includes description of *Linnaea serpyllifolia* Rydberg sp. nov., a native of Alaska.

Noter, R. de. Rusticité de quelques *Crinum.* Rev. Hort. **79**: 265–267. 1 Je 1907.

Parish, S. B. Recent additions to the flora of Southern California. Muhlenbergia **3**: 57–62. 8 Je 1907.

Perrédès, P. É. F. The botanical characters of some Californian species of *Grindelia.* Wellcome Chem. Res. Lab. **65**: 1–3. *pl. 1, 2.* 1907.

Phillips, F. J. Notes on *Robinia neo-mexicana.* Forestry & Irrig. **13**: 89–94. F 1907. [Illust.]

Poisson, H. *Saundersia mirabilis.* Rev. Hort. **79**: 233, 234. 16 My 1907.
Native of Brazil.

Pollock, J. B. Some physiological variations of plants, and their general significance. Science II. **25**: 881–889. 7 Je 1907.

Quehl, L. *Mamillaria phellosperma* Engelm. Monats. Kakteenk. **17**: 67, 68. 15 My 1907.
Native of Arizona and California.

Queva, C. Contributions à l'anatomie des Monocotylédonées. II. Les Uvulariées rhizomateuses. Beih. Bot. Centralb. **22**[2]: 30–77. *f. 1–49.* 1 Je 1907.

Ramaley, F. Botany — Account of collections made. Univ. Colo. Stud. **4**: 161-165. Ap 1907.
Scientific expedition to northeastern Colorado.

Rick, J. *Fungi* austro-americani fasc. V u. VI. Ann. Myc. **5**: 28–31. 30 Mr 1907.
Includes new species in *Puccinia* and *Gibberidea.*

Robinson, B. L. New or otherwise noteworthy spermatophytes, chiefly from Mexico. Proc. Am. Acad. Arts & Sci. **43**: 21–48. 26 Je 1907.
New species described in *Tigridia*, *Schoepfia*, *Mimosa*, *Pedilanthus*, *Bonplandia*, *Brittonastrum* (3), *Russelia*, *Stemodia*, *Piqueria*, *Stevia* (2), *Eupatorium* (10), *Brickellia*, *Guardiola*, *Zinnia*, *Cymophora* gen. nov. (2), *Perymenium*, *Coreopsis*, *Tridax*, *Pericome*, *Loxothysanus* gen. nov., *Tagetes*, *Cacalia* (3), and *Perezia* (2).

Robinson, B. L. The scientific name of the osage orange. Rhodora **9**: 91. 3 Je 1907.

Robinson, B. L. & Bartlett, H. H. New plants from Guatemala and Mexico, collected chiefly by C. C. Deam. Proc. Am. Acad. Arts & Sci. **43**: 48–60. 26 Je 1907.
New species described in *Polypodium*, *Paspalum*, *Fuirena*, *Myriocarpa*, *Polygonum*, *Ruprechtia*, *Aeschynomene*, *Mimosa*, *Tetrapteris*, *Euphorbia*, *Acalypha*, *Clusia*, *Rinorea*, *Hybanthus*, *Ipomoea*, *Cordia*, *Russelia*, *Tetramerium*, *Isertia*, and *Liabum* (2).

Robinson, C. B. The seaweeds of Canso. Being a contribution to the study of eastern Nova Scotia algae. Further Contrib. Can. Biol. **1902–1905**: 71–74. 1907.

Robinson, C. B. Some features of the mountain flora of the Philippines. Jour. N. Y. Bot. Gard. **8**: 113–117. [Je] 1907.

Saccardo, P. A. Notae mycologicae. Series IX. Ann. Myc. **5**: 177–179. 15 My 1907.
Includes new American species in *Calonectria*, *Dimerosporium*, and *Tuberculina.*

Schulz, O. E. *Erythroxylaceae.* Symb. Antill. **5**: 188–211. 20 My 1907.

Includes descriptions of 6 new species of *Erythroxylum.*

Shull, G. H. The significance of latent characters. Science II. **25**: 792–794. 17 My 1907.

Shull, G. H. Some latent characters of a white bean. Science II. **25**: 828–832. 24 My 1907.

Skottsberg, C. Zur Kenntnis subantarktischen und antarktischen Meeresalgen. I. Phaeophyceen. Wissensch. Ergeb. Schwed. Südpolar-Exped. 1901–1903 **4**[6]: 1–172. *f. 1–187* + *pl. 1–10. map.* 1907.

Includes new species in *Ectocarpus* (2), *Geminocarpus* (gen. nov.), *Myrionema* (2), *Leptonema, Elachistea, Lessonia,* and a new genus *Utriculidium,* from the Falkland Islands and Tierra del Fuego.

Small, J. K. Additions to the tree flora of the United States. Torreya **7**: 123–125. 19 Je 1907.

Smith, E. H. The blossom end rot of tomatoes. Tech. Bull. Mass. Agric. Exp. Sta. **3**: 3–19. *f. 1–6.* Ap 1907.

Sterki, V. Hibernacula of *Utricularia.* Ohio Nat. **7**: 158. 15 My 1907.

Sudworth, G. B. A new California oak (*Quercus Pricei*). Forestry & Irrig. **13**: 157, 158. *f. A.* Mr 1907.

Sudworth, G. B. A new tree juniper for New Mexico (*Juniperus megalocarpa*). Forestry & Irrig. **13**: 307–310. *f. 1, 2.* Je 1907.

Terry, W. A. Causes of variation in color in some red algae. Rhodora **9**: 90, 91. 3 Je 1907.

Turner, J. B. Variation in the corolla of *Linaria vulgaris* Mill. Science II. **25**: 1003, 1004. 28 Je 1907.

Underwood, L. M. The progress of our knowledge of the flora of North America. Pop. Sci. Mo. **70**: 497–517. *f. 1–7.* Je 1907.

Urban, I. *Compositarum* genera nonnulla. Symb. Antill. **5**: 212–286. 20 My 1907.

Includes new species in *Mikania* (2), *Baccharis,* and *Pectis* (7).

Urban, I. Nova genera et species III. Symb. Antill. **5**: 287–352. 20 My 1907.

New species described in *Arundinaria* (2), *Zephyranthes* (2), *Gymnosiphon* (2), *Piper,* (2), *Peperomia* (7), *Pilea* (27), *Boehmeria* (2), *Dendropemon, Phoradendrum* (3), *Dendrophthora, Coccoloba* (3), *Iresine, Portulaca* (4), *Cleome* (3), *Morisonia, Alchemilla,* and *Prunus.*

Urban, I. *Olacaceae.* Symb. Antill. **5**: 177–187. 20 My 1907.

Includes descriptions of 3 new species of *Schoepfia.*

Van Tieghem, P. Supplément aux Ochnacées suivi d'une table alphabétique des genres et espèces qui composent actuellement cette famille. Ann. Sci. Nat. Bot. IX. **5**: 157–192. 1907.

Contains lists of plants belonging to this family from Martinique, Guadeloupe, and French Guiana.

Vinson, A. E. The function of invertase in the formation of cane and invert sugar dates. Bot. Gaz. **43**: 393–407. 17 Je 1907.

Weingart, W. *Cereus xanthocarpus* K. Schum. Monats. Kakteenk. **17**: 65–67. 15 My 1907.

Native of Paraguay.

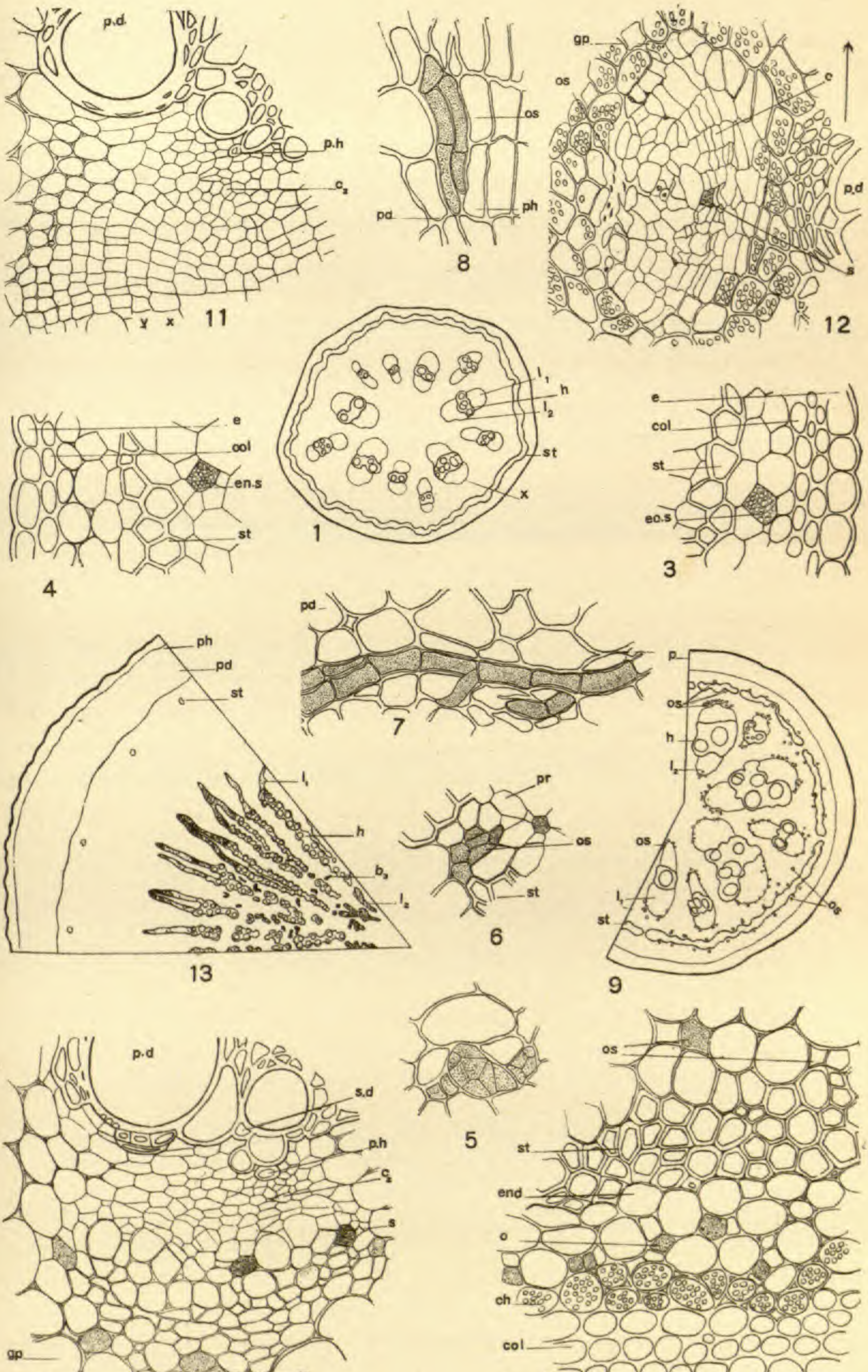
Wercklé, C. Eine interessante *Rhipsalis*-Art aus Costarica. Monats. Kakteenk. **17**: 71, 72. 15 My 1907.

Williamson, E. B. A collecting trip north of Sault Ste. Marie, Ontario. Ohio Nat. **7**: 129–148. 15 My 1907.

Contains a list of plants collected at Searchmont and Hayden, New Ontario.

Wilson, A. D. Some common weeds and their eradication. Ann. Rep. Agric. Exp. Sta. Univ. Minn. **14**: 195–237. *f. 164–188.* 1907.

Wright, R. R. The plankton of eastern Nova Scotia waters. An account of floating organisms upon which young food-fishes mainly subsist. Further Contrib. Can. Biol. **1902–1905**: 1–19. *pl. 1–7.* 1907.



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Spruce, Richard. *Hepaticae* Bolivianae, in Andibus Boliviae orientalis, annis 1885–6, a cl. H. H. Rusby lectae. Pages 113–140. 20 Ja 1890.

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Wheelock, William Efner. The genus *Polygala* in North America. Pages 109–152. 30 D 1891.

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Small, John Kunkel & Heller, Amos Arthur. Flora of western North Carolina and contiguous territory. Pages 1–39. 20 F 1892.

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Morong, Thomas. The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74*. 15 Mr 1893.

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Vol. 4, No. 1; not furnished separately:

Underwood, Lucien Marcus. Index *Hepaticarum*. Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

Small, John Kunkel & Vail, Anna Murray. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 93–201, *plates 75–82*. 18 N 1893–17 Ap 1894.

Vol. 4, No. 3; price, 50 cents:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

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Northrop, Alice Rich. Flora of New Providence and Andros (Bahama Islands). Pages 1–98, *plates 1–19 + map*. 10 D 1902.

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Banker, Howard James. A contribution to a revision of the North American *Hydnaceae*. Pages 99–194. 13 Je 1906.

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CONTENTS

Studies in North American Peronosporales—II. Phytophthoreae and Rhysotheceae . . . . . GUY WEST WILSON 387
Studies on the Rocky Mountain flora—XVIII. . . . PER AXEL RYDBERG 417
INDEX TO AMERICAN BOTANICAL LITERATURE 439

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AUGUST, 1907

Studies in North American Peronosporales—II. Phytophthoreae and Rhysotheceae

Guy West Wilson

The family *Peronosporaceae*, which includes all the genera of the order except *Albugo*, may be briefly characterized as follows:

Mycelium intercellular; conidiophores aerial, variously branched; conidia borne singly at the apex of the ultimate branchlets of the coniophores, germinating by zoöspores or rarely by a germ-tube; oöspores globular, variously sculptured, germinating by a germ-tube.

Of the three well-defined tribes which constitute this family, the first two are discussed in this paper. It is usual to follow the older authors in considering the species embraced in the genera at present under discussion, as clearly distinguished from the remaining members of the family by the method of germination of the conidia, which in the *Phytophthoreae* and *Rhysotheceae* is normally by zoöspores, while those of the *Peronosporeae* germinate by means of a germ-tube. It is, however, well known that under certain conditions the conidia of these species do not throw out zoöspores, but produce one or more germ-tubes. This is probably due to conditions which cause the potential zoöspores, which are already formed within the conidium, to germinate before escaping from the conidial membrane.* With this real or apparent intergradation of characters, it is desirable to have a more stable basis for grouping the genera within the family. Characters which are much more easily observed and subject to less important variation are afforded by the conidiophores, the habit of branching of which conforms to the method of conidial germination.

*See Hartig, Unters. Forstbot. Inst. München 1: *pl. 3*.

[The BULLETIN for July, 1907 (34: 329–386, *pl. 24*) was issued 12 S 1907.]

Like many other plants, the *Peronosporaceae* do not lend themselves readily to characterization. The conidia vary greatly in size and often to a surprising extent in outline, and the conidiophores from their very nature are difficult of description. For this reason it appears desirable to add the heading "icones" under which as complete a list as practicable of illustrations in American works and the chief foreign ones is given for each species. A key to the genera is also given in which the three tribes are characterized and the genera under the first two included, the third tribe being reserved for future treatment.

A serious handicap in the treatment of the species of this family is the lack of information upon many points which are of taxonomic importance. While in America the present family has received more attention than almost any other group of *Phycomycetes*, a wide field for investigation is still open. The oöspores of many species are unknown, and even when known are of rare occurrence in herbaria; the germination of but few species has been studied in America, our knowledge on this point being frequently derived from European sources; the problems of oögenesis are practically untouched; but few inoculation experiments have been conducted to determine the range of hosts which a single species will affect. It is therefore apparent that a final, or even a reasonably satisfactory treatment of the group at the present time is impracticable.

In conclusion I wish to express my sincere appreciation of the courtesies shown me in my work, and especially to those botanists who have so kindly supplied me with material in addition to that which was available in preparing the previous paper of this series.

Conidiophores not clearly differentiated from the mycelium, scorpioid-cymosely branched; conidia germinating normally by zoöspores. PHYTOPHTHOREAE.

A single genus. 1. *Phytophthora.*

Conidiophores clearly differentiated from the mycelium.

Conidiophores monopodially branched, the branches usually arising at right angles to the main axis, successively shorter; conidia germinating normally by zoöspores. RHYSOTHECEAE.

Conidiophores with the main axis indurate above, the lateral branches reduced and basidium-like. 2. *Basidiophora.*

Conidiophores with the main axis not indurate above, the lateral branches developed normally.

Conidiophores fugaceous, stout, sparingly branched; oöspores permanently united to the walls of the oögone. 3. *Sclerospora.*

Conidiophores persistent, slender, usually freely branching; oöspores free from the walls of the oögone.

Branches of the condiophore apically obtuse. 4. *Rhysotheca.*

Branches of the conidiophore apically acute. 5. *Pseudoperonospora.*

Condiophores dichotomously branched, the branches arising at right angles to the main axis, successively shorter; conidia geiminating by a germ-tube. PERONOSPOREAE.

1. PHYTOPHTHORA de Bary, Jour. Roy. Agr. Soc. England II. 12: 240. 1876

Mycelium much-branched, hyaline; conidiophores arising singly or in groups from the stomata, or breaking through the epidermis, branched or apparently simple, with irregular thickenings below the conidia, which are borne apically in a scorpoid cyme; conidia oval, papillate; zoöspores oval, biciliate, escaping by the rupture of the papilla; oöspores intramycelial, the epispore more or less ridged.

Type species, *Peronospora infestans* Casp.

Herbarium material of the species of this genus is very unsatisfactory for study, as the conidiophores form a very dense covering to the host, and being quite flaccid and often very long they form at maturity a dense felt in which the individual conidiophores are effectively obscured. This is especially true of *P. infestans*, while some of the foreign species are not difficult to study.

Key to the species

Conidia usually only one, rarely two, borne at the apex of an aborted cyme; conidiophore simple or branched below.

Host Fabaceae. 1. *P. Phaseoli.*

Host Araceae. 2. *P. Colocasiae.*

Conidia numerous in a simple or compound cyme.

Conidia sessile or long-stalked in a simple cyme.

Conidia small, about 35 μ. 3. *P. Nicotianae.*

Conidia large, 50μ, or more. 4. *P. Cactorum.*

Conidia sessile in a compound cyme.

Host Solanaceae. 5. *P. infestans.*

Host Ranunculaceae. 6. *P. Thalictri.*

1. PHYTOPHTHORA PHASEOLI Thaxter, Bot. Gaz. 14: 274. 1889

The present species differs rather markedly from the other American species of the genus in the method of branching of the conidiophores, but in other respects they are quite similar. The conidiophores are very long, simple, or more commonly branched at the base, and bear a single apical conidium, below which are several swellings of the conidiophore which indicate the typical cymosely branched conidiophore upon which the majority of conidia have failed to develop. This species, first described by Dr. Thaxter, has attracted the attention of various mycologists, among them Dr. Clinton, who has recently published a very complete discussion of this destructive parasite of the lima bean.* His article is accompanied by illustrations of the oöspores and a complete bibliography of the species.

ON FABACEAE:

Phaseolus lunatus L., Connecticut, *Clinton* (Fungi Columb. *1949*), *Rorer* (Funghi Par. Piant. Colt. *351*), *Thaxter* (Econ. Fungi *9*, N. Am. Fungi *2707*); Delaware, *Jackson 1554*.

TYPE LOCALITY: New Haven, Connecticut, on *Phaseolus lunatus* L.

DISTRIBUTION: Connecticut to Maryland. Also in European Russia.

ICONES: Rep. Conn. Agr. Exp. Sta. **1900**: *pl. 3. f. 29–37;* **1905**: *pl. 20–22;* Bull. N. J. Agr. Exp. Sta. **151**: 19. *f. 6.*

2. PHYTOPHTHORA COLOCASIAE Racib. Parasit. Algen u. Pilze Javas **1**: 9. 1900

This species, which is very closely related to *P. Phaseoli*, is said, by its author, to be very abundant on the taro, *Colocasia antiquorum*, throughout Java, but apparently not damaging the host. The fungus is to be expected in other tropical countries in which the host is cultivated.

3. PHYTOPHTHORA NICOTIANAE Van Breda de Haan, Meded. Lands Plant. **15**: 41. 1896

The present species, which is illustrated and described in great detail by its author, is a serious tobacco pest in the East Indies and may appear elsewhere at any time.

4. PHYTOPHTHORA CACTORUM (Lebert & Cohn) Schröter, in Cohn, Krypt. Fl. Schles. 3^1: 274. 1886

Peronospora Cactorum Lebert & Cohn, Beitr. Biol. Pflanz. 1^1: 56. 1870.

*Ann. Rep. Conn. Agr. Exp. Sta. **1905**: 278–303. *pl. 20–22.* 1906.

Phytophthora omnivora de Bary, Bot. Zeit. **39**: 584, 619. *pl. 5. f. 33–41.* 1881.

This species has long been a scourge in Europe on account of its attacks upon seedlings and succulents, its hosts including representatives of fifteen families ranging from *Pinaceae* to *Scrophulariaceae*. Until quite recently this species was not reported from other countries, its first record from foreign quarters being in connection with a serious outbreak of a pod-rot of cacao in the island of Trinidad.* Material was sent to Massee, who identified one of the fungi concerned as *Phytophthora omnivora* de Bary. His description † is of a popular nature and would apply equally well to any one of several groups of fungi, while his figures are unmistakably of a species of *Phytophthora* of the same type as the present one. The conidia are somewhat more elongate and attenuate than usual. This, taken with the habitat, suggests that the pod-rot of the cacao may be caused by a distinct but closely related species, but no definite statement can be made without first examining fresh material. Since the first report of the outbreak of the disease, it has been reported from various other localities in the West Indies, South America, Asia and Africa. The history, distribution and nature of the disease are fully discussed by Howard.‡ The species is also included by Freeman in his Minnesota Plant Diseases § as a pest in seed-beds.

5. PHYTOPHTHORA INFESTANS (Mont.) de Bary, Jour. Roy. Agr. Soc. England II. **12**: 240. 1876

Botrytis infestans Mont. Mém. Inst. France **1845**: 313. 1845.

Peronospora infestans Casp. in Rabenh. Herb. Viv. Myc. I. *1879.* 1854.

As one of our worst plant diseases is caused by the present species its distribution is rather well worked out. While the fungus is not so prevalent, except in localities where the potato is cultivated in large commercial quantities, the range of both appears to be coextensive. It is, however, much more destructive in the

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* Hart, Bull. Trinidad Bot. Gard. **3**: 167–169. Ja 1899.

† Kew Bull. Misc. Inf. **1899**: 1–6. *plate.* 1899.

‡ West Indian Bull. **2**: 190–211. 1901.

§ Page 382. 1905.

northern than in the southern states, as it requires a cool, moist atmosphere in which to develop to the best advantage. Besides the potato, which is its chief host, the fungus attacks numerous other species of the genus *Solanum* as well as members of various other genera of *Solanaceae*.

ON SOLANACEAE:

Solanum tuberosum L., Connecticut, *Clinton* (Fungi Columb. *1839*); Illinois, *Burrill, Seymour* (N. Am. Fungi *2204*); Iowa, *Blackwood, Buchanan, Holway, Pammel;* New York, *Ellis* (Fungi Carol. 5: *92*), *Whetzel;* Tennessee, *Scribner* (Econ. Fungi *447*); Vermont, *Jones;* Wisconsin, *Pammel, Trelease.*

Lycopersicon Lycopersicon (L.) Karst., Delaware, *Smith* (Fungi Columb. *2138*); South Carolina, *Ravenel* (Myc. Univ. *926*).

TYPE LOCALITY: France, on *Solanum tuberosum* L.

DISTRIBUTION: Eastern Canada to California and Florida. Also in South America, Europe, Asia, Africa, and Australia.

ICONES: Bot. Zeit. 5: *pl. 6. f. 1–6;* Bull. Bussey Inst. 1: 319. *fig.*; Bull. Ill. Lab. Nat. Hist. 1[1]: *pl. 2. f. 8–10;* Frank, Lehrb. Bot. 2: 114. *f. 321;* Rep. U. S. Dep. Agr. 1888: *Veg. Path. pl. 1, 2;* Rep. Maine Agr. Exp. Sta. 1889: 172. *f. 1–10;* Rep. Vt. Agr. Exp. Sta. 1890: 132. *fig.;* Rep. N. J. Board Agr. 17: *pl. 4;* v. Tubeuf, Pflanzenkrankheiten 142. *f. 31;* Bull. Calif. Agr. Exp. Sta. 175: *f. 3, 6–8;* Berlese, Icon. Fung. Phyc. *pl. 8.*

6. **Phytophthora Thalictri** Wilson & Davis

Hypophyllous, the infested area suborbicular or irregular in outline, appearing somewhat glaucous; epiphyllous discoloration very dark, almost black, sometimes with a distinct brownish margin; conidiophores fasciculate from the stomata, continuous, lax and somewhat flexuose, rather scattered on the infested area and not forming a dense felt, 300–400 × 5–7 μ, bearing usually 1 or 2 branches, subconidial swellings narrowly conical, less than twice as thick as the branch; conidia elliptic, apically papillate, 20–27 × 13–17 μ; oöspores unknown.

Type collected by Dr. J. J. Davis, June 20, 1907, in Kenosha County, Wisconsin, on *Thalictrum purpurascens* L.

Distinguished from *P. infestans* by the more pronounced discoloration of the infested area and the less disastrous effect on the host; the shorter and more slender conidiophores which form a sparse covering to the infested area instead of forming a dense felt as in the other American species, and which are more persistent than is common in the genus; the slightly smaller and more elongate conidia. The material collected by Dr. Davis was all on a single plant of the host which is rather common in that region. Specimens of the type collection are in the herbaria of Dr. Davis, of the New York Botanical Garden, and of the author.

2. BASIDIOPHORA Roze & Cornu, Ann. Sci. Nat. V. 11: 84. 1869

Mycelium much-branched; conidiophores clavate, the apex an enlarged indurate axis upon which short, simple, cylindric lateral branches are borne alternately; conidia ovate to globose-ovate, smooth, hyaline, apically papillate, breaking away with a portion of the branch attached; zoöspores biciliate, monoplanal; oöspores produced in the tissues of the host in company with the conidiophores; epispore yellowish-brown, more or less irregularly ridged.

Type species, *Basidiophora entospora* Roze & Cornu.

The species of this genus are easily recognized by the clavate conidiophore with its short cylindric fertile branches. The only approach to this type of branching among the other members of the tribe is in the monotypic Japanese genus *Kawakamia* Miyabe, which is described as having the conidiophores "simple or sometimes branched without any order, generally only once and that not from the base of the conidium, slender and provided generally at the tip with a short pedicel-cell, which is more slender than the conidiophore," which is "swollen at base, and gradually tapering toward the tip."*

Key to the species

Conidiophores tall, reaching 300μ; conidia ovate; oöspores with prominent ridges. 1. *B. entospora*.
Conidiophores short, not over 100μ; conidia globose-ovate; oöspores with very obscure ridges. 2. *B. Kellermanii*.

1. BASIDIOPHORA ENTOSPORA Roze & Cornu, Ann. Sci. Nat. V. 11: 84. 1869

Peronospora entospora Berk. & Br. Grevillea 1: 20. 1872.

* Bot. Mag. Tokyo 17: (306). 1903.

Peronospora simplex Peck, Ann. Rep. N. Y. State Mus. Nat. Hist. **31**: 45. 1879.

Plasmopara entospora Schröt. in Cohn, Krypt. Fl. Schles. **3**^{1}: 237. 1886.

Hypophyllous, forming angular areas 1–8 mm. across, bounded by the veins of the leaf; conidiophores arising from the stomata, singly or in groups, hyaline, 150–300 × 8–20 μ, apically much enlarged, 17–25 μ, lateral branches 5–20, about 6–10 × 2 μ; conidia ovate, 20–36 × 10–20 μ; oöspore light yellowish-brown, 40–50 μ; epispore conspicuously ridged.

ON CARDUACEAE:

Aster Novae-Angliae L., Indiana, *Wilson;* Wisconsin, *Trelease* (N. Am. Fungi *1405*).

Aster oblongifolius Nutt., Nebraska, **Bates* (Fungi Columb. *1950*).

Erigeron philadelphicus L., Louisiana, *Langlois 1669.*

Erigeron ramosus (Walt.) B. S. P., Illinois, *Earle, Waite.*

Leptilon canadense (L.) Britton, Missouri, **Pammel.*

Solidago rigida L., Illinois. * *Seymour* (N. Am. Fungi *1405b*, Fungi Europ. *3277*).

Reported also from our limits on *Aster sagittifolius* Willd. and *Rudbeckia fulgida* Ait.

TYPE LOCALITY: France, on *Leptilon canadense* (L.) Britton.

DISTRIBUTION: New York to Wisconsin, Nebraska, Texas, and Alabama. Also in Europe and South America.

ICONES: Ann. Sci. Nat. V. **11**: *pl. 4;* Rabenh. Krypt. Fl. ed. 2. **1**^{4}: 424. *f. 68;* Berlese, Icon. Fung. Phyc. *pl. 7.*

2. Basidiophora Kellermanii (Ellis & Halsted).

Peronospora Kellermanii Ellis & Halsted "*pro tem.*"; Ellis & Everh. N. Am. Fungi *2201.* 1889. (Hyponym.)

Plasmopara sp. Swingle, Trans. Kan. Acad. Sci. **11**: 74. 1889.

Plasmopara Kellermanii Swingle; Sacc. Syll. Fung. **9**: 342. 1891.

Hypophyllous, forming angular discolored patches which often cover a large portion of the leaf; conidiophores arising from the stomata, singly or in groups, very short, hyaline, 25–100 × 8–10 μ, apically much enlarged, about 15–20 μ; lateral branches 4–7, short, 5–8 × 2 μ; conidia globose-ovate, 20–22 × 18–20 μ; oöspores yellowish-brown, obscurely ridged, 30–40 μ.

This species has an interesting history, and, while known for some years, it has never been fully described. That it is abundant in those localities where it occurs is evidenced not only by the quotation below, but by the additional fact that in three instances material has been collected in sufficient quantity for distribution in exsiccati. The original collection was distributed in North American Fungi *2201*, where it received its first name. A description was drawn at the same time by Dr. Halsted, to whom the material was submitted for determination, but this is still unpublished. Swingle's note on the species forms the basis of the diagnosis in Saccardo's *Sylloge Fungorum* and is as follows:

"This species has not yet been published, but seems to be a *Plasmopara* allied to *P. entospora*, from which it differs in having shorter fasciculate conidiophores and almost sessile conidia, which are smaller than in some forms of *P. entospora*. It is a very abundant and curious species, as yet little understood."

In addition to these points of difference attention should be called to the more globular conidia, the darker oöspores with their less conspicuously ridged epispore, and the larger infested area with more pronounced discoloration of the host in the present species than in the former.

ON AMBROSIACEAE:

Iva xanthiifolia Nutt., Kansas, **Bartholomew* (Fungi Columb. *1841*), **Kellerman* (N. Am. Fungi *2201*); Nebraska, **Pammel*, **Sheldon;* North Dakota, **Seaver;* South Dakota, **Griffiths* (W. Am. Fungi *191*); Wyoming, **Pammel & Stanton.*

TYPE LOCALITY: Manhattan, Kan., on *Iva xanthiifolia* Nutt.

DISTRIBUTION: North Dakota and Wyoming to Kansas.

ICON: Freeman, Minn. Pl. Diseases 111. *f. 45*.

3. SCLEROSPORA Schröter; de Bary, Bot. Zeit. 39: 621. 1881

Peronospora § *Sclerospora* Schröter, Hedwigia **18**: 86. 1879.

Mycelium much branched, with small vesicular haustoria; conidiophores erect, solitary or in groups of 2–3, fugaceous, low and stocky, sparsely branched, the branches also stocky; conidia elliptic or globose-elliptic, hyaline, smooth; oöspores intramycelial, the epispore brown, irregularly wrinkled, permanently united to the persistent wall of the oögonium.

Type species, *Protomyces graminicola* Sacc.

Key to the species

Oöspore small, 26–36 μ; epispore not pronouncedly opaque; host, *Chaetochloa*. 1. *S. graminicola*.
Oöspore large, 28–45 μ; epispore very opaque; host, *Chloris*. 2. *S. Farlowii*.

1. SCLEROSPORA GRAMINICOLA (Sacc.) Schröter, in Cohn, Krypt. Fl. Schles. 3^1: 236. 1886

Protomyces graminicola Sacc. Nuovo Giorn. Bot. Ital. **8**: 172. 1876.

Peronospora graminicola Schröter, in Zopf & Sydow, Myc. March. *9*. 1881.

Peronospora graminicola Setariae-italicae Traverso, Bull. Soc. Bot. Ital. **1902**: 168. *f. 1–3*. 1902.

Infesting leaves and inflorescence, causing marked distortion of the latter and, in the case of oöspores, the rapid disintegration of the former; conidiophores 100 × 10–12 μ; conidia 20 × 15–18 μ: oögone-wall thick, 4–12 μ, at maturity 30–60 μ diam., reddish-brown; oöspore pale-brown, 26–36 μ.

The conidiophores of this species are very stout and quite unlike those of any other American species of the order. Their very ephemeral character has caused them to be overlooked by collectors, while the reddish-brown color given to the leaves by the oöspores renders them rather conspicuous objects. As a result herbarium material of this species is rich in oöspores while the conidia are rare. The variety on *Chaetochloa italica* is described as having much larger oöspores than does the typical form, but an examination of American as well as authentic foreign material upon this host failed to show any constant or appreciable difference between the material upon this and upon the other hosts of the species.

ON POACEAE:

Chaetochloa italica (L.) Scribn., Iowa, * *Halsted*; Michigan, *Wheeler*; Wisconsin, * *Pammel*.

Chaetochloa viridis (L.) Scribn., Iowa, *Carver 13*, * *Halsted* (N. Am. Fungi *1803a*), * *Hitchcock*, * *Pammel* (Econ.

Fungi *64*); Minnesota, * *Pammel;* Nebraska, * *Bates* (Fungi Columb. *1776*): South Dakota, * *Griffiths* (W. Am. Fungi *8*); Wisconsin, *Trelease* (N. Am. Fungi *1803b*).

TYPE LOCALITY: Selva, Italy, on *Chaetochloa verticillata* (L.) Scribn.

DISTRIBUTION: Vermont to South Dakota and Kansas. Also in Europe and Asia.

ICONES: Bot. Gaz. **11**: *pl. 8;* Rabenh. Krypt. Fl. ed. 2. **1**[4]: 438. *f. 71;* Fl. Nebr. **1**: *pl. 16. f. 4;* Berlese, Icon. Fung. Phyc. *pl. 9. f. 1;* Bull. Soc. Bot. Ital. **1902**: 169. *f. 1–3*; Bot. Mag. Tokyo **11**: *pl. 2.*

2. SCLEROSPORA FARLOWII Griffiths, Bull. Torrey Club 34: 207. 1907

Infected areas on the leaf-sheaths, rarely on the leaf-blades, irregular in outline, usually elongate, brownish with a darker border, up to 10 mm. or more in length; conidiophores unknown; oöspores globose, 28–45 μ; epispore slightly wrinkled, very opaque, reddish-brown, often appearing almost black.

Through the courtesy of Dr. Griffiths, material from the type locality was available for examination. This species is very distinct from *S. graminicola*, from which it differs in the slightly larger and more opaque oöspore with its lighter and smoother epispore. The disintegrating influence of the fungus upon the host is also absent in the present species, while in *S. graminicola* this is very pronounced.

ON POACEAE:

Chloris elegans H. B. K., Arizona, *Griffiths.*

TYPE LOCALITY: Cochise, Arizona, on *Chloris elegans* H. B. K.

DISTRIBUTION: Arizona and Sonora.

Species inquirendae

Three additional species, of which the conidiophores are unknown, have been referred to this genus. The oöspores differ from those of *S. graminicola* in their lighter color, the thinner epispore, the difficulty of freeing them from the tissues of the host in which they are imbedded, and the failure of the affected leaves to liberate the oöspores by the rapid disintegration of the tissues of the host. That these species are members of the present order is doubtful; and if they are, it is still more improbable that they are congeneric with the American species.

S. Magnusiana Sorokin, Rev. Myc. **11**: 143. 1889. On *Equisetum* sp., in the region of the southern Ural Mountains of Russia.

S. macrospora Sacc. Hedwigia **29**: 155. 1890. On *Alopecurus* sp. in Australia, and *Triticum vulgare* L., in Europe.

S. Kriegeriana Magnus, Verh. Deutsch. Naturf. **67**: 100. 1895. On *Phalaris arundinacea* L., in Europe.

4. **RHYSOTHECA** gen. nov.

Peronospora § *Zoosporatoparae* de Bary, Ann. Sci. Nat. IV. **20**: 105. 1863.

Mycelium branching; haustoria simple; condiophores erect, solitary or fasciculate, projecting through the stomata of the host, monopodially branched, the branches usually arising at right angles to the main axis, as do also the secondary branches, at least never appearing truly dichotomous, the ultimate branches apically obtuse; conidia globose to ovoid, hyaline, germinating directly by zoöspores; oöspores yellowish-brown, the epispore variously wrinkled, sometimes appearing somewhat reticulate; oögonium persistent but free from the oöspore. (Etymology, ῥυσός, wrinkled, θήκη, casket.)

Type species, *Peronospora viticola* (B. & C.) Casp.

To this genus belong the greater number of species which are usually referred to *Plasmopara*. That they are closely related to the preceding genera is evidenced by the habit of branching of the conidiophores and the germination of the conidia by zoöspores. *Plasmopara, sensu stricto*, has conidiophores with the ultimate branchlets apically obtuse as in the present genus, but with the general method of branching more nearly dichotomous than monopodial, and with the conidia germinating in a decidedly anomolous manner. The membrane breaks as in the present genus and the entire protoplasmic content escapes in a mass, forming a non-motile plasma from which a germ-tube is produced. That this is not the typical method of germination either for the *Rhysotheceae* or the *Peronosporeae* is evident, and unless the formation of a plasma be construed as the equivalent of zoöspore-formation the genus cannot stand under the present tribe. That the method of germination is more nearly analogous to that of the *Peronosporeae* is the view held by the present author. The genus *Rhysotheca* is therefore the most highly developed and the typical genus of the group of genera the conidia of which germinates by zoöspores, while *Plasmopara* stands in the same relation to *Peronospora* as does *Pseudoperonospora* to *Rhysotheca*.

Key to the species

Conidiophores low, averaging 300 μ or less, 2–3 times branched, the branches short.	1. *R. Geranii.*
Conidiophores tall, averaging over 300 μ, 2–5, usually 4 or 5, times branched, the branches long.	
Ultimate branchlets elongate, cylindric.	
Primary branches short, densely branched.	2. *R. Umbelliferarum.*
Primary branches elongate, lax.	
Conidiophores 3-4 times branched.	
Conidia small, about 15 × 17 μ.	3. *R. Epilobii.*
Conidia large, about 27 × 35 μ.	4. *R. Heliocarpi.*
Conidiophores 4–5 times branched, very lax.	5. *R. obducens.*
Ultimate branchlets more or less conic.	
Ultimate branchlets broadly truncate.	
Secondary branchlets very short.	6. *R. Halstedii.*
Secondary branchlets lax.	
Secondary branchlets sparingly branched.	
Conidia about 12 × 15 μ.	7. *R. australis.*
Conidia about 15 × 18 μ.	8. *R. illinoensis.*
Secondary branchlets much branched; conidia about 14 × 22 μ.	9. *R. viticola.*
Ultimate branchlets narrowly truncate.	
Conidia elliptic, about 15–20 μ long.	
Conidiophores 2–4 times branched.	10. *R. Viburni.*
Conidiophores 3–5 times branched.	11. *R. ribicola.*
Conidia globose-elliptic, about 18–30 μ long.	12. *R. Gonolobi.*

1. Rhysotheca Geranii (Peck)

Peronospora Geranii Peck, Rep. N. Y. State Mus. Nat. Hist. **28**: 63. 1876.

Peronospora nivea Geranii Farlow; Ellis, N. Am. Fungi *218*. 1879.

Plasmopara Geranii Berl. & De-Toni, in Sacc. Syll. Fung. **7**: 248. 1888.

Hypophyllous; infected areas conspicuous, definite in outline, or often covering the entire leaf, white-downy; conidiophores fasciculate, monopodially 2–3 times branched, the branches short and with the exception of the lowest rarely with well developed secondary branches, 90–350 × 9–12 μ; conidia obovoid, basally papillate, hyaline, 18–25 × 12–15 μ; oöspores surrounded by periplasm at maturity, 25–35 μ; oögone persistent, wrinkled, yellowish-brown, as is also the epispore.

In Europe two other members of the order occur upon species of *Geranium*, but so far they have not been recorded from America nor has the present species been found abroad. The material issued under this name by Allescher and Schnabel in their Fungi Bavarici *555* is *Plasmopara pusilla*, a much smaller species with almost simple conidiophores. Neither of these species is as large as *Peronospora conglomerata* Fuckel. The mycelium, according to Dr. Halsted,* is perennial.

ON GERANIACEAE:

Geranium carolinianum L., Alabama, *Carver 150, Earle, Underwood;* Georgia, *Underwood 2242a;* Illinois, *Earle, Pammel, *Seymour* (Fungi Europ. *3176*, N. Am. Fungi *1404*); Indiana, *Arthur, Underwood* (Econ. Fungi *A3*, Indiana Fl. *100*); Mississippi, *Tracy;* Missouri, *Galloway, Pammel, Trelease;* New Jersey, *Ellis, Fairchild;* North Carolina, *Stevens.*

Geranium dissectum L., Mississippi, *Tracy* (Fungi Columb. *405*, on "*Geranium carolinianum*").

Geranium maculatum L., District of Columbia, *Galloway 1357;* Indiana, *Olive;* Massachusetts, *Farlow* (N. Am. Fungi *218*); New York, *Jackson 1154, Thom;* Ontario, *Dearness* (Fungi Columb. *2048*); West Virginia, *Sheldon;* Wisconsin, *Davis, Pammel.*

Geranium pusillum L., Louisiana, *Langlois 942;* South Carolina, *Rolfs 1689.*

? *Geranium Richardsonii* Fisch. & Traut., Wyoming, *Pammel & Stanton.*

This species has also been reported from our limits on *Geranium Robertianum* L.

TYPE LOCALITY: North Greenbush, N. Y., on *Geranium maculatum* L.

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* Bot. Gaz. 15: 321. 1890; 16: 338. 1891.

DISTRIBUTION: Massachusetts to Wyoming, Texas, and Georgia.

ICON: Berlese, Icon. Fung. Phyc. *pl. 12.*

2. **Rhysotheca Umbelliferarum** (Caspary)

Botrytis nivea Mart.; Unger, Exanth. 171. 1833. Not *B. nivea* Mart. 1817.

Botrytis macrospora Ditmar; Unger, Exanth. 173. 1833. Not *B. macrospora* Ditmar 1817.

Peronospora macrocarpa Rabenh. Herb. Viv. Myc. I. *1172.* 1846. Not *P. macrocarpa* Corda 1842.

Peronospora nivea Unger, Bot. Zeit. **5**: 314. 1847. Not *Botrytis nivea* Mart. 1817.

Peronospora macrospora Unger, Bot. Zeit. **5**: 315. 1847. Not *Botrytis macrospora* Ditmar 1817.

Peronospora Conii Tul. Compt. Rend. Acad. Paris **38**: 1103. 1854. (Nomen nudum.)

Peronospora Umbelliferarum Caspary, Monatsb. K. Preuss. Akad. Wiss. **1855**: —(23). 1855.

Plasmopara nivea Schröt. in Cohn, Krypt. Fl. Schles. **3**^{1}: 237. 1886. Not *Botrytis nivea* Mart. 1817.

This species is included by Harkness and Moore in their *Pacific Coast Fungi* as having been collected in the region of San Rafael, Calif., on an undetermined species of *Umbelliferae.* Since then no new record of the species in North America has appeared. That the fungus is rather widely distributed on our continent is not impossible as it infests a wide range of Umbelliferous hosts, several of which are either wild or cultivated in various parts of America. A good illustration of the species is given by Berlese.*

3. **Rhysotheca Epilobii** (Otth)

Peronospora Epilobii Otth, Bern. Mitth. **1868**: 63. 1868.

Plasmopara Epilobii Schröt. in Cohn, Krypt. Fl. Schles. **3**^{1}: 238. 1886.

This species is rather widely distributed in Europe on various species of *Epilobium,* but so far has not been recorded from America. It is illustrated by Berlese.†

*Icon. Fung. Phyc. *pl. 18.*

†Icon. Fung. Phyc. *pl. 14.*

4. **Rhysotheca Heliocarpi** (Lagerh.)

Plasmopara Heliocarpi Lagerh.; Pat. & Lagerh. Bull. Soc. Myc. France **8**: 123. 1892.

This species is known only from the type locality in Ecuador, where it occurs on the leaves of *Heliocarpus americanus* L. According to Dr. Rose * the host name as given in the original description has been applied very loosely to various members of the Tiliaceous genus *Heliocarpus*, the species of which are widely distributed in tropical America. It is, therefore, not improbable that the fungus is of more than local occurrence and that it infests several hosts.

5. **Rhysotheca obducens** (Schröt.)

Peronospora obducens Schröt. Hedwigia **16**: 129. 1877.

Plasmopara obducens Schröt. in Cohn, Krypt. Fl. Schles. **3**[1]: 238. 1886.

Peronospora Impatientis Ellis & Everh. Proc. Acad. Nat. Sci. Phila. **1891**: 86. 1891.

Plasmopara Impatientis Berlese, Icon. Fung. Phyc. 15. 1898.

Hypophyllous, usually on the cotyledons, the affected area irregular in outline, following the veins, or covering the entire surface of the leaf, white-cottony; conidiophores fasciculate, 2–4 from a stoma, slender, 300–500 × 7–12 μ, flexuosely branched, the branches usually 4–5 times branched, ultimate branchlets about 6–9 μ long; conidia broadly ellipsoid, 12–14 × 12–21 μ; oöspores light yellowish-brown, 25–30 μ; epispore slightly wrinkled, or smooth; oögone 40–50 μ.

In his monograph Berlese recognizes both *Plasmopara obducens* and *P. Impatientis* as valid species, due apparently to a misinterpretation of the original description of the latter species. In this the height of the unbranched portion only of the conidiophore is given. Otherwise the descriptions of the two species tally as closely as could be expected. Nor is this resemblance accidental, as the type of *Peronospora Impatientis* shows no perceptible points of difference from European material of *P. obducens* which was determined by Schröter himself.

* Cont. U. S. Nat. Herb. **8**: 315. 1905.

ON BALSAMINACEAE:

Impatiens aurea Muhl., Alabama, *Earle & Underwood;* Indiana, *Arthur*; Iowa, *Holway.*

Impatiens biflora Walt., Connecticut, *Underwood 2981*; Delaware, *Commons* (type of *Peronospora Impatientis* Ellis & Everh.) *Jackson 1572;* District of Columbia, *Williams;* Indiana, *Olive, Underwood, Wilson;* Massachusetts, *Farlow, Halsted & Farlow* (N. Am. Fungi *207*), *Seymour* (Econ. Fungi *A7a*, on "*Impatiens* sp."), *Trelease;* Michigan, *Merrow* (Econ. Fungi *A7b*, on "*Impatiens* sp."); New York, *Dudley & Underwood;* Wisconsin, *Davis, Pammel.*

Impatiens sp., West Virginia, *Sheldon.*

TYPE LOCALITY: Rastatt, Germany, on *Impatiens Nolitangere* L.

DISTRIBUTION: Vermont to Minnesota, southward to Alabama. Also in Europe.

ICON: Berlese, Icon. Fung. Phyc. *pl. 15.*

6. **Rhysotheca Halstedii** (Farl.)

Peronospora Halstedii Farl.; Ellis, N. Am. Fungi *209.* 1879. (Hyponym); Proc. Am. Acad. **18**: 72. 1883.

Peronospora Halstedii Ambrosiae Ellis, N. Am. Fungi *210.* 1879. (Hyponym.)

Plasmopara Halstedii Berl. & De-Toni, in Sacc. Syll. Fung. **7**: 242. 1888.

Hypophyllous, on cotyledons and leaves, the affected area small, 1–3 mm., or extending over the entire leaf; conidiophores fasciculate, slender, 300–750 μ, 3–5 times branched, ultimate branchlets 8–15 μ long, verticillate below the apex of the branching axis which is frequently swollen and ganglion-like; conidia oval or elliptic, 18–30 × 14–25 μ; oöspores 30–32 μ; epispore yellowish-brown, somewhat wrinkled.

This is the most unsatisfactory species of a difficult genus. The conidiophores are very variable, especially in the laxity of their branches and the development of the ganglion-like swelling from which the ultimate branchlets arise. Several forms are clearly distinguishable and are apparently valid species, but further search has invariably brought to light intermediate forms connecting the extremes with the typical form and with other forms. Until an exhaustive study of a much greater quantity of material, both conidial and oösporic, is possible than is at present at hand, segregation of this species had best not be attempted. The extreme forms are found on *Eupatorium*, with but few branches with the ganglion-like structure, and on *Helianthus*, where the converse is true.

ON AMBROSIACEAE:

Ambrosia artemisiaefolia L., Iowa, *Arthur*, *Hitchcock*; Massachusetts, *Farlow* (N. Am. Fungi *210*); Missouri, *Demetrio*; Wisconsin, *Pammel*.

Ambrosia psilostachya DC., Kansas, *Bartholomew* (Fungi Columb. *1563*).

Ambrosia trifida L., Kansas, *Kellerman* (N. Am. Fungi *1403d*); New York, *Jackson 1129*; Missouri, *Pammel*.

ON CARDUACEAE:

Bidens cernua L., Vermont, *Grout*.

Bidens frondosa L., Alabama, *Carver 173*; Illinois, *? Pammel*; Indiana, *Wilson*; Iowa, *Arthur*, *Bessey*, *Hitchcock*; Kansas, *Swingle 963*; Michigan, *Merrow* (Econ. Fungi *298*); Mississippi, *Tracy*; Nebraska, *Bates* (Fungi Columb. *2257*); Ontario, *Dearness*; Wisconsin, *Davis*, *Pammel*.

Bidens laevis (L.) B. S. P., Iowa, *Bessey*.

Erechtites hieracifolia (L.) Raf., Illinois, *Waite*; New Jersey, *Halsted* (Econ. Fungi *308 a*); Massachusetts, coll. ign. (Econ. Fungi *308 b*); Wisconsin, *Davis*.

Erigeron annuus (L.) Pers., Wisconsin, *Davis* (as *E. Philadelphicus* Willd.).

Eupatorium ageratoides L. f., Wisconsin, *Pammel*.

Eupatorium purpureum L., Iowa, *Bessey* (N. Am. Fungi *209*); Michigan, *Merrow*.

Gnaphalium spathulatum Lam., Mississippi, *Earle*.

Gnaphalium purpureum L., Alabama, *Atkinson* (Econ. Fungi *314*).

Helianthus annuus L., District of Columbia, *Scribner*; Indiana, *Arthur*, *Thomas*; Ohio, *Kellerman* (Ohio Fungi *68*, on "*Vitis* sp.," later corrected); Ontario, *Dearness* (Fungi Columb. *132*); Wisconsin, *Pammel*.

Helianthus divaricatus L., Wisconsin, *Pammel*, *Trelease*.

Helianthus doronicoides Lam., Iowa, *Arthur;* Kansas, *Kellerman* (Fungi Europ. *3278*, N. Am. Fungi *1403 c*).

Helianthus grosseserratus Martens, Iowa, *Hitchcock, Macbride;* Nebraska, *Sheldon.*

Helianthus hirsutus Raf., Missouri, *Pammel.*

Helianthus Maximiliani Schrad., Iowa, **Pammel.*

Helianthus occidentalis Riddell, Wisconsin, *Pammel.*

Helianthus scaberrimus Ell., Nebraska, *Bates* (Fungi Columb. *2139*).

Helianthus strumosus L., Minnesota, *Arthur;* Wisconsin, *Davis.*

Helianthus tuberosus L., Pennsylvania, *Ellis* (N. Am. Fungi *1403 a*); Wisconsin, *Farlow, Pammel.*

Helianthus sp., New York, *Thom;* Missouri, *Galloway* (on "*Vernonia noveboracensis*"); Wisconsin, *Davis.*

Rudbeckia laciniata L., Nebraska, *Sheldon;* North Dakota, *Seymour;* Wisconsin, *Davis, Pammel.*

Rudbeckia triloba L., Illinois, *Hart.*

Silphium integrifolium Michx., Kansas, *Kellerman* (Fungi Europ. *3279*); Nebraska, *Sheldon;* Wisconsin, *Davis, Pammel.*

Silphium laciniatum L., Iowa, *Arthur.*

Silphium perfoliatum L., Iowa, *Bessey;* Minnesota, *Pammel;* Missouri, *Pammel;* Nebraska, *Sheldon;* Wisconsin, *Davis, Tracy.*

Silphium terebinthinaceum Jacq., Illinois, *Pammel;* Wisconsin, *Davis, Pammel, Trelease* (N. Am. Fungi *1403 b*).

Verbesina encelioides (Cav.) A. Gray, New Mexico, *F. S. & E. S. Earle 172.*

The following additional hosts are reported from our limits: *Artemisia ludoviciana* Nutt., *Bidens comosa* (A. Gray) Wiegand, *B. connata* Muhl., *Centaurea* sp., *Helianthus trachaelifolius* Willd., *Iva xanthiifolia* (Fres.) Nutt., *Madia sativa* Molina, *Silphium trifoliatum* L., *Solidago canadensis* L., *S. Riddellii* Frank, *Vernonia Baldwinii* Torr., *V. noveboracensis* (L.) Michx., and *Xanthium canadensis* Mill. Of these two are somewhat doubtful, as it is quite probable that the record of *Iva* as a host refers to *Basidiophora Kellermanii,* while a part of the material which served as the basis for the citation of *Vernonia noveboracensis* as a host has been examined and instead of that species the host is some *Helianthus*, but as the leaves seen were all very young it is impossible to determine the species.

TYPE LOCALITY: Jamaica Plain, Massachusetts, on *Eupatorium purpureum* L.

DISTRIBUTION: Vermont to North Dakota, California, and Alabama. Also in Europe.

ICONES: Fl. Nebr. **1**: *pl. 16. f. 5;* Berlese, Icon. Fung. Phyc. *pl. 20.*

7. **Rhysotheca australis** (Speg.)

Peronospora australis Speg. Anal. Soc. Ci. Argent. **12**: 36. 1881.
Peronospora sicyicola Trel.; Farlow, Bot. Gaz. 8: 331. 1883.
Plasmopara australis Swing. Trans. Kan. Acad. Sci. **11**: 72. 1889.

Hypophyllous, the infected area amphigenously discolored, of variable size and shape, bounded by leaf-veins; conidiophores fasciculate, arising from the stomata of the host, 500–650 × 9–11 μ, with 5–7 main branches, the branches monopodially 3–4 times branched, the ultimate branchlets 10–14 μ long; conidia widely ellipsoid, 14–17 × 10–13 μ; mature oöspores unknown.

This species is very distinct in habit as well as in other important characters from *Pseudoperonospora cubensis*, with which European mycologists have sometimes confused it. The mature oöspores are unknown, but the immature ones are described as almost hyaline and with a smooth epispore, 30–40 μ.*

ON CUCURBITACEAE:

Micrampelis lobata (Michx.) A. Gray, Kansas, *Bartholomew* (Fungi Columb. *2334*).

Sicyos angulatus L., Illinois, *Clinton, Pammel, Seymour* (Econ. Fungi *42*, Fungi Europ. *3276b*); Indiana, *Olive, Wilson*; Kansas, *Kellerman* (Fungi Europ. *3276a*); Missouri, *Galloway;* Nebraska, *Bartholomew* (Fungi Columb. *2556*); New York, *Jackson 1150, Thom;* Ohio, *Kellerman* (Ohio Fungi *147*); Ontario, *Dearness;* Wisconsin, *Pammel, Trelease* (Fungi Gallici *3421*, N. Am. Fungi *1416*).

TYPE LOCALITY: Recoleta, Argentina, on *Cyclanthera Hystrix* Arn.

* Swingle, *l. c.*

DISTRIBUTION: Massachusetts to Ontario, Wisconsin, Kansas, and Ohio. Also in South America.

ICONES: Rep. Mass. State Agr. Exp. Sta. 8: *pl. 2. f. 15, 16*; Rev. Myc. **22**: *pl. 203. f. 10, 11*; Berlese. Icon. Fung. Phyc. *pl. 16*.

8. **Rhysotheca illinoensis** (Farl.)

Peronospora illinoensis Farl. Bot. Gaz. 8: 332. 1883.

Hypophyllous; infected area irregular in outline, up to 10 mm., densely cottony, epiphyllous discoloration slight or none; conidiophores fasciculate, about 500 × 10 μ, with 2–4 main branches which are 2–4 times laxly branched, the ultimate branchlets 10–12 μ long, subacute; conidia elliptic, 15–18 × 17–20 μ; oöspores unknown.

This species is known only from the collections of Professor Seymour at Camp Point and Quincy, Illinois. The inconspicuous habit of the fungus and the wide distribution of the host make it very probable that the species will be found to have a much wider range than now known. European botanists have excluded the species from the genus.* Through the kindness of the authorities of the University of Illinois I have been permitted to examine material of the species. It is nearest to *R. australis*, but with much more irregularly branched and more flexuose conidiophores, which at first sight suggest those of *Pseudoperonospora Celtidis.*

ON URTICACEAE:

Parietaria pennsylvanica L., Illinois, *Seymour 5302, 5354, 5355*.

TYPE LOCALITY: Southern Illinois, on *Parietaria pennsylvanica* L.

DISTRIBUTION: Illinois.

9. **Rhysotheca viticola** (B. & C.)

Botrytis viticola B. & C.; Berkeley, Jour. Hort. Soc. Lond. **6**: 289. 1851. (Hyponym.)

Botrytis vitis-viticola B. & C.; Taylor, Ann. Rep. U. S. Dep. Agr. **1871**: 110. 1872. (Hyponym.)

Peronospora viticola Caspary, Monatsb. K. Preuss. Akad. Wiss. **1855**: 331. 1855. (Hyponym); de Bary, Ann. Sci. Nat. IV. **20**: 125. 1863.

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* A. Fischer; Rabenh. Krypt. Fl. ed. 2. 4^1: 485. 1892. — Berlese, Icon. Fung. Phyc. 41. 1898.

Plasmopara viticola Berl. & De-Toni, in Sacc. Syll. Fung. **7**: 338. 1888.

Hypophyllous, caulicolous, or on young fruits, covering the host with a white downy growth, or causing a brown rot of the fruit without producing aerial hyphae; conidiophores fasciculate, 250–850 × 5–8 μ, 4–5 times branched, the ultimate branchlets about 8 μ long; conidia elliptic-ovate, very variable in size, 9–12 × 12–30 μ; oöspores 30–35 μ; epispore brown, wrinkled, or almost smooth: oögone thin-walled, hyaline or light yellowish-brown.

This is one of the worst fungous pests of the vineyard. It was first collected in the United States by Schweinitz in 1834, and referred to *Botrytis cana* Link. Later Ravenel, Curtiss, and others sent material from South Carolina and New England to Berkeley and de Bary. The first published account of the species which has come to our notice is by Berkeley, who, in publishing a translation of one of Léveillé's papers upon the *Oidium* of the vine, remarks that "a true *Botrytis* of the same section with *Botrytis infestans** but far more beautiful, and highly developed, occurs in South Carolina on vine leaves. I have not, however, heard that it is injurious. My specimens, which were gathered by Mr. Ravenel, and have been named *B. viticola* Berk. and Curt., occurred on *Vitis aestivalis*, and, I believe, on some other species."†

In more recent years mycologists of this and other countries have experienced a decided change of opinion as to the injurious character of the disease. Berlese ‡ estimates that 75 per cent. of the crop is destroyed in the northern states by this disease. That this is as extreme a view as the one previously quoted is not improbable, yet that great injury, especially to some varieties, is due to this fungus is certain. The most destructive form is that which occurs on the fruits as a brown rot.

ON VITACEAE:

Parthenocissus quinquefolia (L.) Planch., Alabama, *Underwood;* Minnesota, *Farlow* (N. Am. Fungi *1402*, on "*Ampelopsis quinquefolia*"), *Seymour;* New York *Jackson, 1124.*

**Phytophthora infestans* (Mont.) de Bary.

† Jour. Hort. Soc. London **6**: 289, note. 1851.

‡ Riv. Pat. Veg. **9**: 102. 1902.

Parthenocissus tricuspidata (Sieb. & Zucc.) Planch., New Jersey, *Halsted* (N. Am. Fungi *2427 b*, on "*Ampelopsis Ritchii*," error for the horticultural name *A. Veitchii*).

Vitis aestivalis Michx., Indiana, *Arthur;* Massachusetts, *Grout;* South Carolina, *Ravenel* (Fungi Am. Exs. *61*; Myc. Univ. *617*, on "*V. vinifera*" but subsequently corrected; Fungi Carol. 5: *90*).

Vitis bicolor Le Conte, New York, *Long.*

Vitis californica Benth., California, *Harkness* (N. Am. Fungi *2247a*).

Vitis cinerea Engelm., Illinois, *Pammel.*

Vitis cordifolia Michx., Indiana, *Olive;* Illinois, *Earle, Hart, Waite;* Missouri, *Jaeger, Trelease;* New York, *Underwood;* Ohio, *Aiken* (Phyc. Prot. *122*); Wisconsin, *Pammel.*

Vitis labrusca L., Connecticut, *Sheldon;* District of Columbia, *Scribner, Williams;* Iowa, *Buchanan, Griffin, Pammel, Stewart, Rolfs, Macbride;* Kansas, *Kellerman* (Funghi Par. Piant. Colt. *102*, on "*Vitis Concord*"; Roum. Fungi Sel. Exs. *5517*, on "*Vitis* cultive var. (*Concord*)"); Massachusetts, *Farlow* (N. Am. Fungi *208*, on "*Vitis* cult."), *Seymour* (Econ. Fungi *3*, on "*Vitis* sp. cult."), *Underwood;* New York, *Blodgett;* Ohio, *Kellerman* (Ohio Fungi *169a*, on "*Vitis* sp. cult."); Pennsylvania, *Ellis;* Wisconsin, *Henry, Pammel, Trelease, Underwood.*

Vitis rotundifolia Michx., Michigan, *Merrow* (Econ. Fungi *3a*, on "*Vitis* sp.").

Vitis vulpina L., Iowa, *Arthur, Hitchcock;* Kansas, *Bartholomew* (Fungi Columb. *2345*); New York, *Jackson 1120, Stevens* (Fungi Columb. *545*, on "*Vitis riparia*"); Ohio, *Kellerman* (Ohio Fungi *169b*); West Virginia, *Sheldon;* Wisconsin, *Clinton, Pammel.*

An additional host, *Vitis vinifera* L., is reported from North America.

TYPE LOCALITY: South Carolina, on *Vitis aestivalis* Michx.

DISTRIBUTION: Coextensive with the grape (*Vitis* spp.) throughout the world.

ICONES: Rep. U. S. Dep. Agr. 1871: *pl. 4;* Bull. Bussey Inst. 1: *pl. 2. f. 1, pl. 3. f. 2–8;* Bull. Ill. Lab. Nat. Hist, 1[1]: *Par. Fungi pl. 2. f. 6, 7;* Rep. U. S. Dep. Agr. 1886: *Mycol. pl. 1;* Berlese, Icon. Fung. Phyc. *pl. 17, 18.*

10. **Rhysotheca Viburni** (Peck)

Plasmopara Viburni Peck, Rep. N. Y. State Mus. Nat. Hist. 43: 74. 1890.

Hypophyllous, affected areas irregular in outline, 3–10 mm. in diam., marginal or following the larger veins, sparingly white-downy, epiphyllous discoloration none to dark reddish-brown or chocolate-colored; conidiophores fasciculate, sparingly 2–3, rarely 4 times branched, 300–600 × 6–8 μ, ultimate branchlets 6–8 μ; conidia broadly elliptic, rarely globose, 15–30 × 12–15 μ, or larger; oöspores unknown.

The present species and the two following ones form a distinct group, and are very closely related; all of them are poorly understood and by no means common in collections. The present species is especially close to *R. ribicola*, from which it differs in its taller conidiophores, its sparser covering and more pronounced discoloration of the host.

ON CAPRIFOLIACEAE:

Viburnum acerifolium L., District of Columbia, *Waite;* West Virginia, *Waite.*

Viburnum dentatum L., New York, *Peck* (cotype), *Thom.*

Viburnum nudum L., Alabama, *Earle* (Phyc. Prot. *81*).

Viburnum Opulus L., Maryland, *Fairchild.*

Viburnum pubescens (Ait.) Pursh, West Virginia, *Waite 721.*

TYPE LOCALITY: Baiting Hollow Station, Long Island, N. Y., on *Viburnum dentatum* L.

DISTRIBUTION: Central New York to Alabama.

11. **Rhysotheca ribicola** (Schröt.)

Peronospora ribicola Schröt., Jahrb. Schles. Ges. Vaterl. Kult. 1883: 139. 1883.

Plasmopara ribicola Schröt. in Cohn, Krypt. Fl. Schles. 3[1]: 238. 1886.

Hypophyllous, infected area usually near the main veins, irregular in outline, up to 15 mm., loosely downy, epiphyllous discoloration light and usually not pronounced; conidiophores fasciculate, 200–400 × 7–9 μ, 3–5 times branched, ultimate branchlets 4–8 μ long; conidia elliptic to globose-elliptic, 14–22 × 10–14 μ; oöspores unknown.

This is one of the rarest species of the genus. It is distinguishable from the preceding species by its more conspicuous habit of growth, the smaller conidiophores, and the less pronounced discoloration of the host.

ON GROSSULARIACEAE:

Ribes albinervum Michx., Wisconsin, *Davis* (Fungi Columb. *1753*, on "*Ribes rubrum subglandulosum* Maxim.").

Ribes divaricatum Dougl., Washington, *Piper 2957*.

Ribes hirtellum Michx., Wisconsin, *Davis* (on "*Ribes oxycanthoides* L.").

Ribes prostratum L'Her., Wisconsin, *Davis*.

Ribes rotundifolium Michx., West Virginia, *Sheldon*.

TYPE LOCALITY, Liegnitz, Germany, on *Ribes rubrum* L.

DISTRIBUTION: West Virginia to Washington. Also in Europe.

12. **Rhysotheca Gonolobi** (Lagerh.)

Peronospora Gonolobi Lagerh. Jour. Myc. **7**: 49. 1891.
Plasmopara Gonolobi Swingle, Jour. Myc. **7**: 119. 1892.
Plasmopara Vincetoxici Ellis & Everh. Jour. Myc. **8**: 70. 1902.

Hypophyllous, infected area about 2–5 mm. bounded by the veins, rather well covered with conidiophores, epiphyllous discoloration light-brown; conidiophores fasciculate, 300–600 × 8–10 μ, 4–6 times branched, ultimate branchlets 6–10 μ long; conidia globose-elliptic, rarely elliptic, 16–25 × 13–24 μ, or even larger; "oöspores globose, brown, about 20 μ diam."

The type material of *Peronospora Gonolobi* was collected by Dr. J. H. Mellichamp and sent to Dr. Farlow, who distributed the collection for *Pucinia Gonolobi* Rav., the predominating parasite on the material, and so far as some of the specimens are concerned the only one. Among these latter is the one in the Ellis herbarium. It was, however, possible to determine positively the species of the host which was cited by Lagerheim as *Gonolobus* sp. but which is in reality *Vincetoxicum hirsutum*. The host of *Plasmopara Vincetoxici* is also the same species. This discovery led to the conclusion that the two species were the same, a conclusion which has since been borne out by an examination of authentic material of the earlier species. The present species is easily distinguished from either of the two preceding ones by its larger conidia and more complexly branched conidiophores.

ON ASCLEPIADACEAE:

Vincetoxicum hirsutum (Michx.) Britton, Alabama, *Carver 932*. (Type of *Plasmopara Vincetoxici*.)

Vincetoxicum suberosum (L.) Britton, Florida, *McCulloch*.

An additional host, *V. gonocarpos* Walt., is also recorded.

TYPE LOCALITY: Blufton, South Carolina, on *Gonolobus* sp. (= *Vincetoxicum hirsutum* (Michx.) Britton).

DISTRIBUTION: Maryland to Florida and Mississippi.

5. PSEUDOPERONOSPORA Rostew. Ann. Inst. Agron. Moscou 9: 47. Ja 1903. — Flora 92: 422. O 1903

Plasmopara § *Peronoplasmopara* Berl. Riv. Pat. Veg. 9: 122. 1901.

Peronoplasmopara Clinton, Rep. Conn. State Agr. Exp. Sta. 29: 234. 1905.

Mycelium intracellular, branching, haustoria small, usually simple; conidiophores pseudo-monopodially branched, the primary branches arising, as a rule, at acute angles, the ultimate branchlets acute; conidia typically colored, rarely hyaline, elliptic in outline, conspiciously papillate both apically and basally; oöspores thin-walled, smooth or roughened; oögone thin-walled.

Type species, *Peronospora cubensis* B. & C.

The present genus is the most anomalous of the tribe, combining as it does certain characteristics of the present and succeeding tribes. The conidia germinate, as in all species of the *Rysotheceae*, by zoöspores, while the colored conidia suggest a close relationship with *Peronospora*. This is further augmented by the apically acute conidiophores, the method of branching of which is intermediate between the typical method of the two tribes in question.

The close relationship of the two species to each other and their problematical taxonomic position was pointed out by Waite at the time he described the second one.* He, however, allowed them to remain in the genus *Peronospora*. The next step was

* Jour. Myc. 7: 105. 1892.

taken by Berlese, who formed for them a subgenus under the old genus *Plasmopara*, which he characterized as having the conidiophores of *Peronospora* and the conidia of *Plasmopara*, *i. e. Rhysotheca* of the present treatment of the group. The final step was taken by Rostewzew who made an extensive study of *P. cubensis*, the results of which appeared in an elaborate paper which was published first in Russian and later in German. He concluded that this species represented a distinct genus intermediate between *Peronospora* and *Plasmopara*, *sensu* Schröter. He called the genus *Pseudoperonospora*, choosing this name, as he tells us, rather than *Pseudoplasmopara* as *Peronospora* antedates *Plasmopara*. Later Dr. Clinton made an extended study of the species in America, publishing an admirable paper upon his researches. Unfortunately, at least from a nomenclatural standpoint, he rejected the earlier generic name in favor of Berlese's subgeneric name, and still more unfortunately he has been followed in this by other American mycologists. The name proposed by Rostewzew has more than two years priority over the elevation of Berlese's subgenus to generic rank, and is therefore the rightful name of the genus.

Key to the species

Conidiophores 3–4 times branched.	1. *P. cubensis*.
Condiophores 4–5 times branched.	2. *P. Celtidis*.

1. PSEUDOPERONOSPORA CUBENSIS (B. & C.) Rostew. Ann. Inst. Agron. Moscou **9**: 47. Ja 1903. — Flora **92**: 422. O 1903

Peronospora cubensis B. & C. Jour. Linn. Soc. Bot. **10**: 363. 1868.

Plasmopara cubensis Humphrey, Rep. Mass. State Agr. Exp. Sta. **8**: 212. 1891.

Peronoplasmopara cubensis Clinton, Rep. Conn. Agr. Exp. Sta. **1904**: 335. 1905.

Hypophyllous, or rarely amphigenous; discoloration of the host yellowish, rather definite in outline, affected area apparently unoccupied or with a sparse marginal growth; condiophores 1–2, rarely more, from a stoma, 180–400 × 5–9 μ, 3–4, rarely 2–5, times branched, the ultimate branchlets recurved, apically acute, 5–20 μ long; conidia gray, brownish or smoky, ovoid to ellipsoid, papillate, 20–40 × 14–25 μ; oöspores spherical, yellowish, watery-papillate, 30–43 μ, maturing in the decaying leaves.

This is one of the most important pests of the truck farmer. Its adaptibility to almost any cultivated species of *Cucurbitaceae* and the comparative immunity of the native species, especially in the more northern states, makes it a pest which is most destructive in regions where Cucurbitaceous vegetables are cultivated in commercial quantities. Its favorite hosts appear to be the cucumber and melon. It has been suggested that the fungus spreads from south to north each season, and in proof of this theory are cited the perennial character of the mycelium in Florida and the records of the distribution of the pest in the southern and eastern states in recent years.* It has also been suggested that hot-house culture of the hosts assists in scattering the disease, at least in the immediate vicinity. It is not impossible that both these factors enter into the distribution of the fungus, while the researches of Rostewzew, who found the immature oöspores in the partially decayed leaves of infested vines, tend to establish the probability that oöspore-production also plays a most important part in the persistency of the pest in infested areas. By the first two means suggested, the distribution of the fungus would of necessity be confined to those regions which could be reached by summer migration and in which hot-house cucurbits were produced. The third method of passing the winter, in addition to the first two, accounts for the occurrence and persistence of the disease in places which, according to the two preceding theories, should be immune from the pest. The problem presented is one of great scientific interest and of a not inconsiderable financial importance to certain sections of the country.

ON CUCURBITACEAE:

Bryonopsis lacunosa erythrocarpa Naud., Ohio, *Selby*.
Citrullus vulgaris Schrad., Louisiana, *Langlois 1122*.
Coccinia indica Wright & Arn., Ohio, *Selby*.
Cucumis angulatus Forsk., Ohio, *Selby*.
Cucumis Melo L., Ohio, *Selby*.
Cucumis odoratissimus Moench, Ohio, *Selby*.

* Bull. S. Car. Agr. Exp. Sta. 116: 7. 1905.

Cucumis sativus L., Florida, *Hume 24*; Massachusetts, *Humphrey*; New Jersey, *Halsted* (N. Am. Fungi *2426a*; Econ. Fungi *41*), *Stevens*; Maryland, *Dorsett*; Ohio, *Selby* (Phyc. Prot. *119*); West Virginia, *Sheldon*.

? *Cucurbita maxima* Duch., New Jersey, *Halsted* (N. Am. Fungi *2426b*).

Cucurbita ovifera L., Ohio, *Duvel*.

Cucurbita Pepo L., Ohio, *Duvel*.

Lagenaria vulgaris Ser., Ohio, *Duvel*.

Micrampelis lobata (Michx.) Greene, Ohio, *Selby*.

Momordica balsamina L., Iowa, *Arthur*.

Mukia scabrella Arn., Ohio, *Duvel*.

The following additional hosts are reported from within our limits: *Cucumis Anguria* L., *Melothria scabra* Naud., *Momordica charantia* L., *Sicyos angulatus* L., *Trichosanthes colubrina* Jacq.

TYPE LOCALITY: Cuba, on some unidentified species of *Cucurbitaceae*.

DISTRIBUTION: New Hampshire to Minnesota, Texas, Florida, and Cuba. Also in South America, Europe, Asia, and Africa.

ICONES: Riv. Pat. Veg. **9**: 125. *f. 21*; Rep. Mass. State Agr. Exp. Sta. **8**: *pl. 2. f. 11–14*; Bull. Ohio Agr. Exp. Sta. 89: *pl. 1*; Rep. Fla. Agr. Exp. Sta. **1899–00**: *pl. 1*; Rev. Myc. **22**: *pl. 203. f. 7–9*; Rep. Conn. Agr. Exp. Sta. **1904**: *pl. 31*.

2. **Pseudoperonospora Celtidis** (Waite)

Peronospora Celtidis Waite, Jour. Myc. **7**: 105. 1892.

Plasmopara Celtidis Berlese, Icon. Fung. Phyc. 16. 1898.

Peronoplasmopara Celtidis Clinton, Rep. Conn. Agr. Exp. Sta. **1904**: 334. 1905.

Hypophyllous, infected areas brownish, limited by the veins, from less than 1 mm. up to covering a large portion of the leaf; epiphyllous discoloration purple with a more or less pronounced yellowish margin; conidiophores scattered, 200–320 × 6–8 μ, 4–5 times branched, the ultimate branchlets straight or slightly recurved, about 5–8 μ long; conidia elliptic, 12–26 × 20–40 μ, smoky or somewhat purplish; oöspores in the leaves, 26–45 μ; epispore thin, yellowish-brown, irregularly thickened; oögone persistent, thin-walled, smooth.

This species is remarkable as the only member of the order which infests a tree, although a few species occur on shrubs. Perhaps this unusual habitat accounts for the rarity of the species in herbaria.

ON ULMACEAE:

Celtis occidentalis L., District of Columbia,* *Waite 556, 557*.

TYPE LOCALITY: Washington D. C., on *Celtis occidentalis* L.

DISTRIBUTION: Maryland and District of Columbia.

ICON: Jour. Myc. 7: *pl. 17. f. 1–16.*

NEW YORK BOTANICAL GARDEN.

Studies on the Rocky Mountain flora — XVIII

Per Axel Rydberg

Homalobus divergens (Blankinship) Rydb.

Astragalus divergens Blankinship, Mont. Agric. Coll. Sci. Stud. Bot. **1**: 73. 1905.

Homalobus camporum Rydb. Bull. Torrey Club **32**: 666. 1906.

When I described *Homalobus camporum* I overlooked the facts that the same species had already been published by Prof. Blankinship and that he had even cited the type number of my type. He had described the pod, however, as having a stipe, something that I cannot find in any specimens at hand.

Homalobus humilis sp. nov.

Perennial with a cespitose caudex; stems 2–10 cm. long, grayish-strigose, decumbent or spreading; stipules ovate, scarious, 2–3 mm. long; leaves 2–6 cm. long; leaflets 11–15, oblong, 3–6 mm. long, about 2 mm. wide, grayish-strigose beneath, glabrate above; peduncles 2–8 cm. long; raceme short, 1–2 cm. long, 3–8-flowered; calyx strigose with black hairs; tube campanulate, 1.5–2 mm. long; teeth triangular or triangular-subulate, 1–1.5 mm. long; corolla purple, 7–8 mm. long; legume about 1.5 cm. long, 3 mm. wide, widest near the abruptly acute apex, tapering towards the base, the upper suture nearly straight, the lower strongly arched at the apex.

This species most resembles *H. divergens* (Blankinship) Rydb. in habit, but differs in the shape of the legumes, the darker corollas, and in the less canescent leaves, which are glabrate above. It grows on high arid mountain tops at an altitude of nearly 3,000 m.

Utah: Mountain north of Bullion Creek, near Marysvale, 1905, *Rydberg & Carlton 7147* (type); Delano Peak, 1905, *nos. 1219* and *1219 a.*

Homalobus microcarpus sp. nov.

Homalobus campestris Rydb. Bull. Agr. Exp. Sta. Col. **100**: 209, in part. 1906. Not *H. campestris* Nutt.

Homalobus camporum Rydb. *loc. cit.*, in part.

Perennial with a cespitose caudex; stems decumbent, about 1 dm. high, strigose; leaves 5–8 cm. long; stipules ovate, scarious, 2–3 mm. long; leaflets 9–15, elliptic to linear, 5–15 mm. long, 1–3 mm. wide, glabrous above, sparingly strigose beneath; peduncles 4–6 cm. long; racemes short, 3–8-flowered; calyx strigose with black hairs; tube campanulate, about 2 mm. long; teeth about 1 mm. long, subulate; pod sessile, strigose, straight, 12–18 mm. long, 3 mm. wide.

This species is intermediate between *H. oblongifolius* Rydb. and *H. divergens* (Blankinship) Rydb. Baker's specimens from North Park were referred to the latter, which the present species resembles in general habit and the pod; but it is a greener plant, the leaflets being glabrous above and only slightly strigose beneath. The smaller size, and the smaller pod of a different shape, separate it from *H. oblongifolius.*

COLORADO: East slope of Rabbit Ear Range, 1894 (type distributed from the State Agricultural College of Colorado, collector not given); Forks of Poudre and Big South, 1894; North Park, 1897, *C. F. Baker;* Steamboat Springs, 1903, *Osterhout 2774.*

Homalobus paucijugus sp. nov.

Perennial with a cespitose caudex, bushy; stems 1–2 dm. high, sparingly strigose; leaves numerous, 5–10 cm. long; leaflets 1–5, the lateral ones lanceolate to linear-subulate, 1 cm. or less long, glabrous above, sparingly strigose beneath, or none; the terminal one 1–2 cm. long, linear or linear-oblanceolate, gradually tapering into the rachis; stipules scarious, ovate, 2–3 mm. long; peduncles 3–6 cm. long; racemes short, 3–6-flowered; calyx strigose with black hairs; tube campanulate, about 2 mm. long; teeth subulate, fully 1 mm. long; legume 12–15 mm. long, 2 mm. wide, straight, strigose.

This species resembles *H. decurrens* in the peculiar terminal leaflet, but differs in the few small and narrow lateral leaflets, the small size of the plant, the small flowers and the small pod. It grows at an altitude of nearly 3000 m.

UTAH: Big Cottonwood Cañon, in sheltered places near the summit of the divide between Lake Solitude and Twin Lakes, 1905, *A. O. Garrett 1580.*

The species confused with *H. tenellus* and usually included in it may be distinguished by the following characters:

Legume glabrous.
  Stipe rarely exceeding the tube of the calyx; leaves usually spreading in age; leaflets oblong to oval, obtuse and mucronate. *H. dispar.*
  Stipe of the mature legume usually exceeding the calyx-teeth; leaves strongly ascending; leaflets narrowly linear to linear-oblong, mostly acute.
    Stipe 3–4 mm. long; leaflets linear or linear-oblong; stem usually conspicuously strigose; calyx-teeth half as long as the tube. *H. tenellus.*
    Stipe 5–7 mm. long; leaflets narrowly linear; stem glabrous or nearly so; calyx-teeth usually nearly equaling the tube. *H. stipitatus.*
Legume strigose. *H. strigulosus.*

HOMALOBUS DISPAR Nutt.; T. & G. Fl. N. Am. **1**: 350. 1838.

Orobus dispar Nutt. Gen. **2**: 95. 1818.

This is much less common and has a more restricted range than *H. tenellus.* The range of *H. dispar* includes the extreme western portion of Nebraska, Wyoming, northern Colorado and northeastern Utah, while that of *H. tenellus* extends from Saskatchewan to Nebraska, Colorado, Utah, and the Yukon Territory.

Homalobus stipitatus sp. nov.

Somewhat cespitose perennial; stems slender, 3–4 dm. high, erect, branched, sparingly strigose or glabrate, leafy; leaves strongly ascending, 4–6 cm. long; stipules lance-subulate; leaflets 9–15, narrowly linear, 1–2 cm. long, 1–2.5 mm. wide, glabrous or sparingly strigose beneath; peduncles about 1 cm. long; racemes lax, 2–10 cm. long, 5–20-flowered; calyx strigose; tube campanulate, about 1.5 mm. long; teeth subulate, about as long; corolla ochroleucous, 8–10 mm. long; legume glabrous, stipitate, flat; body oblong, about 1 cm. long, 3 mm. wide, acute, gradually tapering into the stipe, which is 5–7 mm. long.

This species is related to *H. tenellus* (Pursh) Britton [*Astragalus multiflorus* (Pursh) A. Gray], but is a more slender and more glabrate plant, with narrower leaflets and longer stipe. It belongs to the prairie region east of the range occupied by *H. tenellus.*

NORTH DAKOTA: "Upper Missouri" [from the data given in Nicollet's report, on the hills somewhere between Fort Pierre and Devil's Lake], 1839, *Geyer* (type in herb. Columbia University); Valley City, 1897, *L. L. Perrine.*

MINNESOTA: Lake Belmont, Otter Tail Co., 1892, *E. P. Sheldon.*

SASKATCHEWAN: 1858, *E. Bourgeau 4.*

Homalobus strigulosus sp. nov.

Cespitose perennial; stems erect or ascending, branched, 1–3 dm. high, strigulose; stipules short, ovate; leaves 3–4 cm. long; leaflets linear, acute, 8–12 mm. long, 1–2 mm. wide, thick, glabrous above, strigose beneath; peduncles 1 cm. or less; raceme lax, 1.5–3 cm. long, 4–7-flowered; bracts minute, subulate; calyx strigulose; tube campanulate, 1.5 mm. long; teeth subulate, less than 1 mm. long; corolla ochroleucous, about 6 mm. long; pod strigose, shining, stipitate; body oblong, 7–8 mm. long, 3 mm. wide, rather gradually contracted into the stipe, which is about 3 mm. long.

This is closely related to *H. tenellus*, but differs in the smaller flowers and the smaller and hairy pod. It grows at an altitude from 1800–3000 m.

NEVADA: East Humboldt Mountains, 1860, *S. Watson 283* (type).

UTAH: P. V. Junction, Wasatch Mountains, 1883, *M. E. Jones* (mixed with *H. tenellus*).

Diholcos micranthus sp. nov.

Somewhat cespitose perennial; stems erect or ascending, sparingly strigose or glabrate, 2–4 dm. high; stipules ovate, about 5 mm. long; leaves 4–6 cm. long; leaflets 17–25, linear or lance-oblong, acute at both ends, 7–20 mm. long, glabrous above, strigose beneath; peduncles 4–7 cm. long; racemes many-flowered, 3–7 cm. long; calyx strigose; tube campanulate, slightly gibbous, 2–2.5 mm. long; teeth subulate-filiform, 1–2 mm. long, the upper somewhat shorter; corolla 6–7 mm. long, ochroleucous; pod strigose, obsoletely if at all cross-ribbed; stipe 3–4 mm. long; body scarcely 1 cm. long, 3 mm. wide, very acute.

This species is related to *D. Haydenianus* (A. Gray) Rydb. [*Astragalus Haydenianus* A. Gray], differing in the smaller flowers and fruit, the more acute leaflets, the narrower calyx-lobes, and especially the almost total lack of cross-ribs on the more acute legumes. *D. micranthus* was included in *D. Haydenianus* in my Flora of Colorado.

COLORADO: La Veta, 1896, *C. L. Shear 3569* (type); Gunnison, 1896, *Clements 100*; Ridgeway, 1895, *Tweedy 228*; Rio Blanco, south of Pagosa, 1883, *B. H. Smith.*

Kentrophyta minima sp. nov.

Perennial with a woody root and cespitose caudex, forming cushions 1 dm. in diameter; herbaceous stems 1–2 cm. high;

leaves 5–8 mm. long; stipules scarious, lanceolate, 1–3 mm. long, more or less united; leaflets 5–9, linear-lanceolate, conduplicate, pungent, 3–4 mm. long, finely strigose; flowers usually solitary, subsessile; calyx strigose; tube 1–1.5 mm. long, campanulate; teeth subulate, scarcely 1 mm. long; corolla ochroleucous, about 3 mm. long; keel tipped with purple; pod ovoid, rather turgid, acute, 3 mm. long.

This is related to **K. tegetaria** (S. Wats) Rydb. [*Astragalus tegetarius* S. Wats.] and *K. Wolfii* Rydb. From the former it differs in the subsessile flowers and the shorter calyx-lobes; *K. tegetaria* has 1–3-flowered racemes, exceeding the leaves in length and calyx-lobes which are longer than the tube. From *K. Wolfii*, it differs in the appressed pubescence, the smaller flowers and the shorter legume. It is an alpine species growing at an altitude of 2800–3100 m.

YELLOWSTONE NATIONAL PARK: August 1884, *Tweedy 83* (herb. Columbia Univ.).

Aragallus patens sp. nov.

Acaulescent perennial; leaves spreading or ascending, 5–10 cm. long; leaflets 9–17, elliptic or oblong, acutish at both ends, 1–2 cm. long, 4–6 mm. wide, somewhat silvery with closely appressed hairs; scape 1–1.5 dm. high, strigose with short silky hairs; raceme short, 3–7 cm. long; bracts linear-lanceolate to lanceolate, 5–8 mm. long; flowers usually spreading; calyx sparingly appressed-silky with short hairs, often somewhat tinged with purple above, 5–6 mm. long, 3 mm. wide; teeth subulate, the upper 2 mm., the lower 3 mm. long; corolla dark bluish-purple, about 15 mm. long; banner narrow; wings broad, slightly emarginate, the upper lobes narrow and acutish; keel with a very dark purple spot, and a short, porrect tip; legume ascending-spreading, thin-coriaceous, nearly straight, less than 2 cm. long, 4 mm. thick, long-acuminate, minutely strigose, half 2-celled.

This is related to *A. Lambertii* and *A. sericeus*. From the former it differs in the shorter and broader leaflets and the more spreading leaves; from the latter in being greener, less hairy, and having narrower bracts and calyx-tube and darker flowers, and from both in the smaller size, thinner and more spreading legumes and smaller flowers.

COLORADO: Plains and foothills near Boulder, 1902, *F. Tweedy 5164* (type); between Sunshine and Ward, *no. 5165;* Eldora to

Baltimore, *no. 5634;* Sargents 1901, *C. F. Baker 344;* Cimarron, *no. 277.*

WYOMING: Laramie Plains, 1903, *Goodding 1422;* Centennial, 1900, *Aven Nelson 7680.*

NEBRASKA: Hay Springs, 1901, *MacDougal 44.*

Aragallus angustatus sp. nov.

Acaulescent perennial; leaves spreading or ascending, 6–10 cm. long; leaflets 7–13, narrowly linear-lanceolate to narrowly linear, 1–2 cm. long, 2–4 mm. wide, sparingly strigose; scape about 1 dm. high, sparingly strigose; raceme 3–5 cm. long; bracts lanceolate, about 5 mm. long; calyx finely silky-strigose; tube 5–6 mm. long; teeth subulate, about 2 mm. long; corolla purple, 15 mm. long or less; banner rather broad; wings broad and slightly emarginate; keel with a very dark blue-purple spot and a very short porrect tip; legume ovoid, less than 1.5 cm. long, coriaceous, 3.5 mm. thick, rather abruptly contracted into a spreading beak, minutely strigose, half 2-celled.

This resembles, somewhat, a low, narrow-leaved *A. Lambertii*, but differs in the more spreading leaves, and smaller, more spreading flowers, and especially by the short pod, with an abrupt spreading beak. The specimen designated as the type has the best developed fruit.

NEBRASKA: Hills, Rush Creek, 1891, *Rydberg 82c* (fruit, type in herb. Columbia Univ.); prairies, Banner Co., *no. 82a*, in part (fruit); hills, Banner Co., *no. 82b* (flowers); Hay Springs, 1901, *MacDougal 64b* (flowers).

ARAGALLUS BLANKINSHIPII A. Nelson

Prof. J. W. Blankinship * writes:

"*Oxytropis Besseyi* (Rydberg); *Aragallus Besseyi* Rydberg, Flora 250 is *A. Blankinshipii* Nelson, Erythea, 7: 58. The types of both were collected within a few miles of each other. The fruiting specimens of Nelson were pathogenic, infected with uredo, causing the ovary to remain undeveloped and an abnormal calyx, the legume in the species usually exceeding the calyx; otherwise they are identical."

This statement is only partly correct. Professor Blankinship some time ago sent us specimens of *Aragallus Blankinshipii* from

* Mont. Agr. College Sci. Stud. Bot. 1: 80. 1905.

the type collection. The flowering specimen is identical with my *A. Besseyi*, but the fruiting specimen is not. The flowering specimen has long linear-subulate calyx lobes, 4 mm. long, and linear-lanceolate, acute bracts, while in the fruiting specimen the calyx-lobes are almost triangular and about half as long and the bracts lance-oblong and obtuse. If the fruit of the type sheet is infected by uredo, there is no evidence of it in the duplicate here at the Botanical Garden. The trouble is that *Aragallus Blankinshipii* was described from flowering specimens of one species (*A. Besseyi*) and fruiting specimens of another. They are both well known to me. I intended to describe the second species in the Flora of Montana when in the meantime Professor Nelson's article in Erythea appeared. I had no authentic specimens of his new species. As I knew of no species answering to Professor Nelson's description of *A. Blankinshipii*, never suspecting it to be a composite one, and knowing one agreeing fairly with his description of *A. collinus* except as to the color of the corolla, I referred the specimens of my supposed new species to this. The New York Botanical Garden has since received authentic specimens of both *A. Blankinshipii* and *A. collinus* and I have been able to correct my mistake. The specimens referred to *A. collinus* in my Flora of Montana are specifically the same as the fruiting specimens of *A. Blankinshipii*. Mr. Gooding has also collected good fruiting specimens in Wyoming at Alcona, Natrona County, in 1901 (*no. 147*). These were determined as *A. Blankinshipii*.

This species is closely related to *A. nanus*, differing mostly in the erect stiff scape and more elongated spike. *A. Besseyi*, together with *A. argophyllus*, forms a small group more related to *A. Lambertii*.

I adopt the name *A. Blankinshipii* for this species, represented by the fruiting specimens of the original description for the following reasons: (1) Prof. Nelson has laid most stress on the structure of the pod, associating *A. Blankinshipii* with *A. collinus*, *A. multiceps*, *A. Lagopus* and *A. nanus*, to which this species is related; (2) The characters of the fruit in the genus *Aragallus* are more reliable then those of the flowers to show the actual relationship; (3) The species represented by the flowering specimens has already received a name. The synonymy of the two species is as follows:

ARAGALLUS BLANKINSHIPII A. Nelson Erythea **7**: 58 (fruiting specimens). 1899.

Aragallus collinus Rydb. Mem. N. Y. Bot. Garden. **1**: 254. 1900. Not *A. collinus* A. Nelson 1899.

ARAGALLUS BESSEYI Rydb. Mem. N. Y. Bot. Garden **1**: 250. 1900.

Oxytropis argentata Pursh Fl. Am. Sept. 473. 1814. Not *O. argentata* Persoon.

Aragallus Blankinshipii A. Nelson. Erythea, **7**: 58 (flowering specimens). 1899.

Aragallus monticolus A. Nelson, Erythea **7**: 62, in part. 1899. Not *Oxytropis monticola* A. Gray.

Oxytropis Besseyi Blankinship, Mont. Agr. Coll. Sci. Stud. Bot. **1**: 80. 1905.

Aragallus atropurpureus sp. nov.

Acaulescent perennial; leaves numerous, 3–7 dm. long; leaflets oval to oblong, canescently silky-villous, 5–15 mm. long, 3–5 mm. wide, obtuse or acute; scape 6–10 cm. long, loosely villous; raceme short and headlike; 2–3 cm. long; bracts linear-subulate, 5–10 mm. long; calyx dark, villous with mixed black and white hairs; tube 5 mm. long, 3 mm. wide; teeth black-hairy, subulate, 4 mm. long; coralla dark-purple, about 15 mm. long; wings deeply emarginate; keel with a rather long ascending tip; legume ovoid, less than 1.5 cm. long, 15 mm. thick, abruptly acuminate with a spreading beak, villous, partly black-hairy, thin, half 2-celled.

In pubescence and leaf-form, this species most resembles *A. sericeus*, but it is a much smaller plant, has only half 2-celled, shorter and more curved pod. It is easily distinguished from all the other purple-flowered species of the *A. Lambertii* group by the black-hairy calyx and long calyx-teeth.

WYOMING: Headwaters of Tongue River, Big Horn Mountains, 1898, *F. Tweedy 125* (type, in flower); *no. 126* (in fruit).

Hedysarum utahense sp. nov.

Perennial with a rootstock; stem 4–6 dm. high, finely strigose, stipules triangular, acuminate, 5–8 mm. long; leaves –15 cm. long; leaflets 11–17, elliptic, oval or oblong, usually rounded at both ends, 1–3 cm. long, 5–10 mm. wide, glabrous above, finely cinereous-strigose or more glabrate beneath; peduncles about 1 dm. long; raceme 4–10 cm. or in fruit even 2 dm. long; bracts ovate to lanceolate, scarious; calyx cinereous-strigose; tube nearly 3 mm. long; teeth lance-subulate, 5 mm. long, attenuate; corolla rose-purple; banner 15–18 mm. long; keel 18–20 mm.; loments minutely strigose; internodes 2–5, 6–8 mm. long, 5–6 mm. wide; nodes narrow, 2.5 mm. or less.

This is related to the subarctic *H. Mackenzii*, from which it differs in the denser pubescence on its calyx, its broader calyx-teeth, its fewer and larger internodes of the loment, its taller habit, broader bracts and lighter and redder flowers. It grows on hillsides at an altitude of 1400–2000 m.

UTAH: Vicinity of Salt Lake City, 1883, *Leonard 55* (type); 1900, *Stokes;* 1869, *Watson 294;* near Ogden, *Coulter; Stansbury;* Wahsatch Mountains, 1888, *Dr. Eccles.*

Lathyrus brachycalyx sp. nov.

Perennial with a creeping rootstock; stem simple or slightly branched, 1.5–3 dm. high, usually finely pubescent, sharply 4-angled; stipules semi-sagittate, 5–10 mm. long, 1.5–3 mm. wide, pubescent; rachis 2–5 cm. long, somewhat winged; leaflets 2–5 pairs, linear-oblong or oblanceolate, firm, strongly veined, finely pubescent, acute at both ends, 1–3 cm. long, 2–8 mm. wide; tendrils of the lower leaves reduced to mere tips, those of the upper leaves better developed, but usually simple; peduncles 5–10 cm. long; raceme short, 2–6-flowered; calyx puberulent; tube 4–5 mm. long; upper teeth broadly triangular, scarcely 2 mm. long, the rest lance-subulate, the lowest one 3 mm., rarely 4 mm. long; corolla purple, 2–2.5 cm. long; legume glabrous, 3–4 cm. long, 7 mm. wide.

This species has been confused with *L. decapetalus* and is closely related to it. It differs in the much shorter calyx-tube and calyx-teeth, the broader, more upturned banner, the more pubescent foliage and less well developed tendrils. It grows on hillsides and in cañons and washes at an altitude of 1400–2500 m.

UTAH: City Creek Cañon, 1883, *F. E. Leonard 101* (type), *20* and *29;* 1900, *S. G. Stokes;* 1880, *M. E. Jones 1700;* near Salt Lake City, 1904, *Garrett 998;* 1905, *Rydberg 6162;* Mt. Majestic, *Garrett 1656;* Mount Nebo, 1902, *Goodding 1105;* Wahsatch Mountains, 1869, *S. Watson 295.*

Capnoides hastatum sp. nov.

Glabrous green perennial, 1–1.5 m. high, branched above; leaves 2–4 dm. long, thrice pinnatifid; ultimate divisions elliptic or oval, 1–2 cm. long, mucronate; racemes 1 dm. long or more; bracts oblanceolate, about 1 cm. long; pedicels about 3 mm. long; sepals narrowly hastate with broad often toothed, divergent basal lobes, about 2 mm. long; corolla with the spur 15–18 mm. long, salmon-pink; hood scarcely crested.

This species is closely related to *C. Cusickii* (S. Wats.) Heller, but differs in the smaller corolla, less crested hood and the sepals which are hastate instead of reniform and laciniate.

IDAHO: Lolo Creek, 1902, *C. V. Piper 4057* (type in herb. N. Y. Bot. Garden).

Capnoides brachycarpum sp. nov.

Glabrous and glaucous perennial with thick root; stem 3–6 dm. high, branched above; leaves 2–3 dm. long, thrice pinnatifid; ultimate divisions lanceolate or lance-elliptic, 2–3 cm. long, 5–12 mm. wide; racemes 1–2 dm. long, the upper often branched; bracts linear-subulate, about 5 mm. long; pedicels ascending, about 5 mm. long; sepals ovate, acute, 2–3 mm. long with toothed auricles at the base; corolla, including the spur, about 15 mm. long, yellowish, the inner petals tipped with purple or brown; spur about the length of the body of the petals, horizontal; crest of the hood obsolete; pod horizontal or reflexed, obovoid, about 1 cm. long and 6 mm. wide.

This species was included in the original description of *Corydalis Brandegei* S. Wats., but the type of the latter and all Colorado specimens can easily be distinguished by the green, scarcely glaucous foliage, the broader oval or obovate mucronate divisions of the leaves, the broader and obtuse sepals, the longer corolla, which is fully 2 cm. long and has an almost erect spur, and the fruit, which is fully 1.5 cm. long but scarcely more than 4 mm. thick. *C. brachycarpum* grows along streams at an altitude of nearly 3000 m.

UTAH: Alta, 1879, *M. E. Jones 1197* (type in herb. N. Y. Bot. Gard.); 1905, *Rydberg 6848;* Silver Lake, American Fork Cañon, 1895, *M. E. Jones;* Wahsatch Mountains, 1884, *Leonard 175.*

Lepidium Crandallii sp. nov.

L. Jonesii Rydb. Bull. Ag. Ex. Sta. Colo. **100**: 152, in part. 1906.
L. Eastwoodiae Rydb. *l. c.* in part.

Perennial; stems several, branched and leafy throughout, glabrous or puberulent above, 3–5 dm. high; basal leaves and lower stem-leaves pinnatifid, 5–7 cm. long, glabrous, with oblanceolate or oblong, entire or slightly toothed divisions; upper stem-leaves, especially those of the branches, oblanceolate or linear, entire or toothed; sepals oblong, nearly 2 mm. long, white-margined; petals clawed, about 3 mm. long, white, their blades obovate; stamens 6; fruiting racemes 5–10 cm. long; pedicels divergent; pods oval or ovate, about 4 mm. long, glabrous, slightly wing-margined above; style 1 mm. long, about twice as long as the wing-margin.

This species is related to the two species to which it has been referred and to *L. allyssoides.* From the latter and *L. Eastwoodiae* it differs in the more commonly dissected stem-leaves, the broader and shorter segments of the leaves and the comparatively longer style. From *L. Jonesii* it differs in the broader leaf-segments, thinner leaves, and more branched habit. From *L. scopulorum* it differs in the less woody base, the branched and leafy stem, thinner leaves and shorter styles.

COLORADO: Palisades, May 14, 1898, *Crandall 131* (type in herb. N. Y. Bot. Gard.); Glenwood Springs, 1902, *Osterhout 2599;*

Lepidium brachybotryum sp. nov.

Biennial or perennial with a tap-root; stem 2–3 dm. high, branched, puberulent throughout; basal leaves puberulent, bipinnatifid, about 5 cm. long, with elliptic or obovate lobes; stem-leaves oblanceolate, pinnatifid or toothed; sepals oblong, about 1 mm. long, white-margined; petals white, clawed, 2 mm. long, their blades broadly obovate; stamens 6; fruiting racemes short, 2–5 cm. long; pedicels divergent, 5–7 mm. long; pod rounded-ovate, 3 mm. long, 2.5 mm. wide, wing-margined above; styles less than 0.5 mm. long, scarcely exceeding the wing-margins.

This is related to *L. montanum* but differs in the short style, more rounded pods, and short racemes. It grows on sage-brush flats.

UTAH: Juab, 1902, *Goodding 1075* (type in herb. N. Y. Bot. Gard.); Wasatch County, near Midway, *Carlton & Garrett 6728* (poor specimen doubtfully referred here).

√ **Lepidium Fletcheri** sp. nov.

Annual or biennial; stem erect, 3–5 dm. high, puberulent with short cylindric spreading hairs, branched above with ascending branches; leaves narrow, pinnatifid with linear divisions or saliently toothed, 2–5 cm. long, puberulent; those of the inflorescence linear and entire; sepals oblong, scarcely 1 mm. long, green, with white margins; petals none; stamens usually 2, scarcely exceeding the sepals; fruiting racemes 3–5 cm. long; pedicels 4 mm., terete; pod glabrous, scarcely 3 mm. long, obovate in outline, glabrous, strongly wing-margined above; lobes of the wings nearly 0.5 mm., triangular-ovate, acutish or obtuse; seed 1 mm. long, brown, wingless.

This species is related to *L. densiflorum* and *L. ruderale*, but differs from both in the deeper, more open notch of the pod and the prominent lobes of the wing. From the former it differs also in the smaller pod and the narrow divisions of the leaves and from the latter in the leaves, of which none, apparently, are bipinnatifid. In the fruit it resembles *L. Bourgeauanum* Thelling, but differs in the simple erect habit and in the pinnatifid leaves.

MANITOBA: Roadsides, Winnipeg, 1905, *J. Fletcher* (type in herb. N. Y. Bot. Gard.); apparently also

SASKATCHEWAN: Cherryfield, 1906, *Macoun & Herriot 69881.*

THELYPODIUM Endl.

This genus as treated in the Synoptical Flora represents at least half a dozen different types of plants. Whether they should be regarded as one or more genera depends upon the individual tastes and inclinations of the botanist treating them. Dr. Greene, in splitting up the genus *Streptanthus*, expressed the opinion that either these two genera, *Stanfordia* and *Caulanthus*, should be united into one, or else *Streptanthus* should be divided into several. The writer agrees so far with Dr. Greene and thinks that *Thelypodium* and *Caulanthus* should be treated the same way. He has not been able to follow Dr. Greene in his segregation, however, partly because he does not know well enough the West American species treated by Dr. Greene, and partly because his opinions differ considerably in some cases. One of these cases will be given below.

Thelypodium was established by Endlicher, and based wholly on *Pachypodium* Nutt.* A generic diagnosis was given but no species were cited. In Walpers' Repertorium (1 : 172), the genus was again taken up and the three species of *Pachypodium* found in Torrey and Gray's Flora, were taken up in the same order as these. Hence *Thelypodium* is a mere substitute for *Pachypodium*, which name had been used for another genus, and the type of the latter genus is the type of the former. The three species of *Pachypodium* are the following, given in the order in which they appear: *P. laciniatum*, *P. integrifolium*, *P. sagittatum*. The last of the three need not be considered, for in Torrey and Gray's Flora it is regarded as doubtfully belonging to the same genus as the preceding and perhaps belonging to a section of *Arabis*. The type of *Pachypodium* Nutt., and hence of *Thelypodium* Endl., must then be either *P. laciniatum* or *P. integrifolium*. There is nothing that points directly to either of the two, but everything favors the former. It is not only the first species mentioned, but it is also the only one previously known and figured. It was first described as *Macropodium laciniatum*. Hooker compared it with the original *M. nivale*, gave figures for both and emphasized the differences between the two, the oblong anthers and the long, slender pubescent stipe of *M. nivale* and the linear anthers and the short, stout stipe of *M. laciniatum*. Nuttall remarked "evidently not a *Macropodium*." It is evident that he selected the name *Pachypodium* from the short, stout stipe.

If *Macropodium laciniatum* Hook. is regarded as the type of *Thelypodium* Endlicher, and the writer can not regard it otherwise, the closest relatives of it we find in *T. utahense* Rydb. and the groups of *Thelypodia* on which Dr. Greene based his genus *Guillenia*. It is hard to see how *Thelypodium lasiophyllum* Greene, the type of the latter genus, can be generically distinct from *T. laciniatum* (Hook.) Endl. Every character pointed out by Dr. Greene for his *Guillenia* agrees with the latter and is even found in Hooker's description. It will be admitted that there are some habitual differences, by which *T. laciniatum* is isolated from *Guillenia*, but *T. utahense*, originally named *T. laciniatum*, has the habit of that genus, while the flower and fruit are essentially those of *T. lasiophyllum*.

* T. & G. Fl. N. Am. 1 : 96. 1838.

Dr. Greene evidently intended to include in *Guillenia*, *Arabis longirostris* or *Streptanthus longirostris*, but in enumerating the species of his new genus he has no *G. longirostris.* He has one *G. rostrata* based on *Arabis rostrata* S. Wats., a name the publication of which I have been unable to find. *Arabis longirostris* is hardly congeneric with *Telypodium lasiophyllum*, however. It has the flat pod of *Streptanthus*, but the short anthers, merely cordate at the base, and not spirally curved, place it as very doubtfully belonging to any of the Streptanthoid genera.

The second species of *Pachypodium* in Torrey and Gray's Flora, now usually known as *Thelypodium integrifolium* (Nutt) Endl., is so different in habit, that the writer has always found it hard to regard it as congeneric with the rest, but the differences in the structure of the flower and of the pod externally are so slight that a segregation based on habit alone would not be desirable. There is however, a character in the pod, unique to this species and two or three segregates from it and making them stand isolated from all the other Thelypodioid plants, viz., the strong and broad midrib of the septum of the pod. There is no distinct midvein in any of the typical *Thelypodia.*

A species closely resembling *T. integrifolium* in habit, foliage and flowers, is *T. linearifolium* or *Iodanthus* or *Streptanthus linearifolius*, but it lacks the rib on the septum. Besides it has two characters not found in the other *Thelypodia.* Two of the rather firm and purple sepals are strongly saccate at the base and the stigma is conical, not truncate nor 2-lobed as in the other species. It could be referred to *Hesperis*, which it resembles especially in the flowers, if it were not for the stipitate, terete pod and the curved anthers, which characters are strongly thelypodioid.

In describing the subgenus *Euthelypodium* in the Synoptical Flora, Dr. Robinson gives *T. elegans* Jones as an exception having a 2-lobed stigma with the lobes expanding over the septum. In the whole tribe the stigma is either undivided or else the lobes are expanded over the valves. This exceptional character is most pronounced in the species mentioned above, but it is also found in less degree in *T. aureum* Eastw. and *T. Bakeri* Greene. Mr. George Osterhout, of New Windsor, Colorado, who has collected a specimen of *T. elegans*, has written on the label: "near to

Streptanthus wyomingensis A. Nelson but probably rather a *Thelypodium*." This note made the writer compare the latter species. When *S. wyomingensis* was first described, it was thought that it was the closest relative of *S. maculatus* Nutt., the only original *Streptanthus*, but a closer comparison now has shown that the pod is not flat as in *Streptanthus* and the lobes of the stigma are turned the wrong way. Its relationship is with the three *Thelypodia* just mentioned above, with which it also agrees in habit.

Two other species of *Thelypodium* are said by Dr. Robinson to have the lobes of the stigma placed in the same way, viz.: *T. micranthum* and *T. longifolium*, but here that character is scarcely noticeable. There are other characters in which they disagree with the other *Thelypodia*. The branched or stellate pubescence is unique in the whole tribe and should place them according to the classification used in Engler & Prantl's Pflanzenfamilien in another grand division of the family. The stamens and the pods are, however, more or less thelypodioid. In both species the flowers are more or less irregular, the lower sepals being longer (this is best shown in *T. longifolium*) and there is scarcely any distinction between claw and blade in the petals.

The most interesting of the *Thelypodia* is perhaps *T. Wrightii*. In the pod, the texture of sepals and petals, the form of the latter, etc., this is close to the typical *Thelypodia*. The habit is not so essentially different either, but the sepals are spreading-reflexed and early deciduous as in *Stanleya* and the glands at the base of the stamens and the thickening of the pedicel, both so conspicuous in most thelypodioid plants, are here inconspicuous. The plant could not be included in *Stanleya*, on account of the short stipe, the different habit and the structure of the petals.

The genera may be distinguished as follows:

- Sepals equal or nearly so; hairs simple or none.
  - Sepals erect or ascending in anthesis.
    - Stigma distinctly lobed, its lobes expanded over the septum. — *Thelypodiopsis*.
    - Stigma entire or, if indistinctly lobed, the lobes expanded over the valves.
      - Stigma truncate; sepals scarcely gibbous at the base.
        - Septum of the pod without a distinct midrib. — *Thelypodium*.
        - Septum of the pod with a strong midrib. — *Pleurophragma*.
      - Stigma conical; the outer sepals gibbous at the base. — *Hesperidanthus*.
  - Sepals strongly spreading or reflexed in anthesis, soon deciduous. — *Stanleyella*.

Sepals unequal, the lower longer; hairs, at least some of them, stellate or branched, *Heterothrix*.

THELYPODIOPSIS gen. nov.

Biennials with rather thick and glaucous foliage and glabrous except the lower part of the stem. Basal leaves spatulate or oblanceolate, more or less toothed, with winged petioles; stem-leaves auriculate-clasping with rounded auricles. Sepals thin, erect or ascending, not gibbous, more or less petaloid, linear or oblong. Petals more or less clawed, white or purplish or in one species yellow. Filaments distinct, slender, filiform or subulate; anthers long, linear, sagittate at the base, soon spirally curved. Pod slender, terete, more or less torulose, usually with short stipe and style; stigma 2-lobed, the lobes expanded over the septum; cotyledons obliquely incumbent.

The first species of this genus as well as of the following new genera is regarded as the type.

Stipe very short, less than 1 mm. long or almost none; petals white or tinged with purple.
  Style 2 mm. or nearly so.
    Pod 7–9 cm. long. *T. elegans.*
    Pod about 4 cm. long. *T. Bakeri.*
  Style less than 1 mm. long; pod 5–7 cm. long. *T. wyomingensis.*
Stipe 2–5 mm. long; petals and sepals yellow. *T. aurea.*

Thelypodiopsis elegans (M. E. Jones).

Thelypodium elegans M. E. Jones, Zoe **4**: 265. 1893.

Thelypodiopsis Bakeri (Greene).

Thelypodium Bakeri Greene, Pl. Baker. **3**: 8. 1901.

Thelypodiopsis wyomingensis (A. Nelson).

Streptanthus wyomingensis A. Nelson, Bull. Torrey Club **26**: 126. 1899.

Thelypodiopsis aurea (Eastw.).

Thelypodium aureum Eastw. Zoe **2**: 227. 1891.

Thelypodium Palmeri sp. nov.

Biennial or perennial with a tap-root; stem 3–5 dm. high, sparingly hirsute below, glabrous above; basal leaves oblanceolate or spatulate, 2–4 cm. long, more or less hirsute beneath, especially on the veins; stem-leaves sagittate, 2–4 cm. long, glabrous or nearly so; inflorescence usually branched with ascending branches; pedicels nearly erect, 5–8 mm. long; sepals oblong, 3–4 mm. long; petals 5–6 mm. long, white or rose; claw about 3 mm. long; blade spatulate or oblanceolate; pod about 2–5 cm. long, 1 mm. wide.

This species has been confused with *T. sagittatum* (Nutt.) Endl., but differs in the smaller and narrower petals, nearly erect pedicels and narrow pod.

SOUTHERN UTAH: 1877, *E. Palmer 25* (type in herb. Columbia Univ.).

Thelypodium leptosepalum sp. nov.

Annual or biennial, glabrous throughout; stem 4–6 dm. high, branched; leaves thin, glabrous, 6–10 cm. long, lyrate-pinnatifid with lanceolate divergent lobes; flowering pedicels about 3 mm. long; sepals lance-subulate, 6 mm. long, 1–1.5 mm. wide at the base, white; petals narrowly linear-oblanceolate, almost strap-shaped, with scarcely any distinction between blade and claw, 8 mm. long, 0.5 mm. wide or less; filaments filiform, about 1 cm. long when well developed; anthers linear, sagittate at the base, soon curled.

This is closely related to *T. laciniatum* (Hook.) Endl., but differs in the narrow tapering instead of oblong sepals. It grows at an altitude of 450–600 m. on rocky banks.

IDAHO: Lewiston, Nez Perces County, 1896, *A. A. & E. Gertrude Heller 3022* (type in herb. Columbia Univ.); Valley of Peter Creek, Nez Perces County, 1892, *Sandberg, MacDougal & Heller 122*.

PLEUROPHRAGMA gen. nov.

Tall glabrous perennials or biennials with paniculate inflorescence and thick entire leaves. Basal leaves oblanceolate or spatulate; stem-leaves linear-lanceolate, sessile but not clasping. Sepals ascending, thin, more or less petaloid. Petals white or purplish with slender claws. Filaments distinct, subulate, white, somewhat dilated below and with conspicuous glands at their bases; anthers linear, sagittate at the base, curved. Receptacle dilated. Pod slender, terete, torulose, tapering at both ends into a short stipe below and a short slender style above; stigma minute, entire; septum with a strong midrib.

Pleurophragma integrifolium (Nutt.)

Pachypodium integrifolium Nutt.; T. & G. Fl. N. Am. 1: 96. 1838.

Thelypodium integrifolium Endl.; Walp. Rep. 1: 172. 1842.

Pleurophragma gracilipes (Robinson)

Thelypodium integrifolium gracilipes Robinson, Syn. Fl. 1[1] 176. 1895.

Pleurophragma platypodum sp. nov.

Glabrous perennial with a tap-root; stem simple up to the inflorescence, 1–2 m. high; basal leaves spatulate, 5–10 cm. long, entire; stem-leaves 3–6 cm. long, linear-lanceolate or oblanceolate, dark-green, thick; inflorescence paniculate; racemes dense, at first corymbiform, in fruit about 1 dm. long; sepals oblong, yellowish- or greenish-white, 4 mm. long; petals white, clawed, 6–7 mm. long; blades spatulate; pedicels in fruit about 3 mm. long, divergent or somewhat reflexed, dilated and flattened at the base, pod 1.5–2 cm. long, 1–1.5 mm. thick, torulose; stipe 1–2 mm. long; style short.

This is related to *Pleurophragma integrifolium* (*Thelypodium integrifolium* Endl.), but differs in the shorter inflorescence, the shorter pedicels, broadened at the base, the shorter pod with longer stipe and shorter style.

UTAH: Moab, 1891, *M. E. Jones* (labeled *Thelypodium Wrightii*, type in herb. N. Y. Bot. Garden).

ARIZONA: 1876, *E. Palmer.*

To this genus belongs also *Thelypodium lilacinum* Greene, Pl. Baker. 3: 9. 1901, if distinct from *T. integrifolium.* The only specimens at hand differ from that only in the stronger purple color of calyx and corolla. They are without fruit, which, however, may furnish distinctive characters.

HESPERIDANTHUS (B. L. Robinson) Rydb., gen. nov.

Thelypodium § *Hesperidanthus* B. L. Robinson, Syn. Fl. 1[1]: 174. 1895.

Erect, slender, glabrous perennials, with pale foliage; corymbosely branched above. Basal leaves obovate, toothed; stem-leaves linear, entire. Sepals rather firm, erect; the outer strongly saccate at the base. Petals purple, with obovate blades. Anthers linear, sagittate at the base, strongly curved. Stigma conical or ovate, neither truncate nor 2-lobed. Pod terete, linear, short-stipitate.

Hesperidanthus linearifolius (A. Gray).

Streptanthus linearifolius A. Gray, Pl. Fendl. 7. 1849.

Iodanthus or *Pachypodium linearifolium* A. Gray, Proc. Am. Acad. 6: 187. 1863.

Thelypodium linearifolium S. Wats. Bot. King's Expl. 25. 1871.

STANLEYELLA gen. nov.

Tall branched biennials. Leaves thin, the lower ones lyrately pinnatifid, the upper entire. Sepals thin, petaloid, white, oblong or linear, spreading or even reflexed in anthesis. Petals white, with oblanceolate or spatulate blades gradually tapering into a short claw. Filaments distinct, filiform; anthers linear, sagittate at the base, soon more or less spirally recurved. Pod slender, terete with short stipe and short style; stigma small, truncate or nearly so; cotyledons incumbent and somewhat conduplicate.

Stanleyella Wrightii (A. Gray)

Thelypodium Wrightii A. Gray. Pl. Wright. **1**: 7. 1852.

HETEROTHRIX (B. L. Robinson) Rydb., gen. nov.

Thelypodium § *Heterothrix* B. L. Robinson, Syn. Fl. $\mathbf{1}^1$: 178. 1895.

Slender biennials, more or less pubescent at least below with stellate or branched hairs. Basal leaves oblanceolate, more or less toothed; stem-leaves lance-linear or linear, entire. Racemes elongated, slender. Calyx more or less oblique, the lower sepals being longer than the upper, all ascending, rather firm and more or less purplish. Petals oblanceolate or spatulate, indistinctly or broadly clawed. Filaments subulate, broad at the base, distinct, scarcely exserted; anthers linear, sagittate at the base, spirally curved. Pod slender, terete, sessile; stigma minute, entire or slightly lobed, the lobes expanding over the septum; cotyledons obliquely incumbent.

Heterothrix longifolia (Benth.)

Streptanthus longifolius Benth. Pl. Hartw. 10. 1839.

Thelypodium longifolium S. Wats. Bot. King's Expl. 25. 1871.

Heterothrix micrantha (A. Gray)

Streptanthus micranthus A. Gray Pl. Fendl. 7. 1849.

Thelypodium micranthum S. Wats. Proc. Am. Acad. **17**: 321. 1882.

CHLOROCRAMBE gen. nov.

Perennial glabrous herbs; stem simple at least up to the inflorescence. Racemes lax with slender horizontal or reflexed pedicels. Leaves thin, petioled, with usually hastate blades. Sepals greenish, ascending. Petals greenish-white, with short claws and lanceolate dentate blades. Anthers sagittate at the base, linear-oblong, at last curved, greenish. Pod slender, somewhat torulose, short-stipitate and short-styled; stigma minute, entire.

The plant referred here has been included in *Caulanthus*, but the type of that genus, *C. crassicaulis*, and its allies have an urn-shaped, more or less closed calyx; linear, oblong, or spatulate petals, which have practically no claws, are thin and membranous except the upper third or fourth, which is thicker, brownish or purplish, curved and crisp; and a conspicuous, two-cleft stigma.

Chlorocrambe hastata (S. Wats.) Rydb.

Caulanthus hastatus S. Wats. Bot. King's Expl. 28. 1871.

Sophia magna sp. nov.

Annual; stem branched, 5–10 dm. high, sparingly stellate-puberulent or glabrous, stout; basal leaves twice to thrice pinnatifid, 1–2 dm. long, nearly glabrous; segments obovate, often toothed; stem-leaves similar but with narrower segments; sepals yellow, 2 mm. long, oblong; petals spatulate, nearly 3 mm. long, rather light-yellow; pedicels in fruit 15–20 mm. long, ascending; pod glabrous, more or less clavate, 12–15 mm. long, 1.5–2 mm. thick; seeds more or less in two rows.

This species is related to *S. intermedia* and *S filipes*, but differs from both in the broad segments of the basal leaves. In habit it therefore resembles *S. incisa*, but has an evidently clavate pod. It has the conspicuous flowers of *S. filipes*, but the terminal segment of the leaves is not elongated. It was first mistaken for *S. brachycarpa*; but the style is evident although short. It grown on river-bluffs at an attitude of 1500–2500 m.

COLORADO: North of La Veta, 1900, *Rydberg & Vreeland 6163* (type in herb. N. Y. Bot. Gard.); South of La Veta, *6162*; Plains near Denver, *6164*.

Sophia Nelsonii sp. nov.

Slender annual; stems 2–4 dm. high, slightly stellate or glabrate; leaves pinnatifid or bipinnatifid with linear or oblong divisions, slightly stellate or glabrate; sepals oblong, 1 mm. long; petals light-yellow, spatulate, 1.5 mm. long; fruiting pedicels ascending, 4–6 mm. long; pods clavate, 5–8 mm. long, glabrous, slightly over 1 mm. thick; style minute.

This species is probably nearest related to *S. intermedia*, but differs in the shorter pod and pedicels and the smaller flowers. From *S. pinnata* it differs in being nearly glabrous and by the shorter pedicels and the erect pods. It grows on gravelly flats, sandy plains and rocky hills, at an attitude of 1300–2000 m.

WYOMING : Wraith Falls, Yellowstone Park, 1899, *Aven Nelson &Elias Nelson 5710* (type in herb. N. Y. Bot. Gard.); Green River. 1895, *Rydberg*; Fort Steele, 1901, *Tweedy 4479* and *4480* (?),

UTAH : Salt Lake City, 1884, *Leonard 212*.

Arabis oreophila sp. nov.

Arabis Drummondii alpina S. Wats. Bot. King's Expl. 17, in part. 1871.

Perennial with a more or less branched caudex; stems 1–2 dm. high; basal leaves numerous, broadly oblanceolate or spatulate, stellate-pubescent; stem-leaves rather few, lanceolate, slightly auriculate-clasping; sepals oblong, 3–4 mm. long, margined with purplish, obtuse, glabrous; petals 7–8 mm. long, yellowish-white below, upper portion rose or purplish; pedicels 4–10 mm. long, erect or ascending; pods glabrous, 3–6 cm. long, slightly arcuate, 2 mm. wide, acute, but beak obsolete; seeds in 2-rows, winged above and on one side.

This species is nearest related to *A. Lyallii* S. Wats., and was included therein, but differs in the broader and shorter basal leaves, which are decidedly stellate, and in the pod which lacks a distinct beak. It grows on the higher mountains at an altitude of 2500–3500 m.

UTAH : Divide between Big Cotton-wood Cañon and Heber Valley, 1905, *Rydberg & Carlton 6678* (type in herb. N. Y. Bot. Garden, flowers and young fruit); Alta, 1879, *Jones 1248* (fr.); Uintas, 1869, *Watson 75* (fl.)

WYOMING : Union Peak, 1894, *A. Nelson 1007* (fl.); upper Buffalo Fork, 1899, *C. C. Curtis*.

MONTANA : Old Hollowtop, 1897, *Rydberg & Bessey* (fl.).

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE
(1907)

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Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions their kindness will be appreciated.

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Abrams, L. R. Studies on the flora of Southern California — II. Bull. Torrey Club **34**: 263–265. 10 Jl 1907.

Includes new species in *Chamaebatia*, *Xanthoxalis*, *Malvastrum*, and *Gutierrhezia*.

Bailey, W. W. Lianes. Am. Bot. **12**: 75–77. My 1907.

Bailey, W. W. Wayside flowers. Am. Bot. **12**: 101–103. Je 1907.

Benedict, R. C. Notes on some ferns collected near Orange, New Jersey. Torreya **7**: 136–138. 19 Jl 1907.

Bergen, J. Y. Some ecological observations on the Naples flora. Plant World **10**: 157–161. Jl 1907.

Berger, A. *Pilocereus euphorbioides* Rümpl. Monats. Kakteenk. **17**: 87–91. 15 Je 1907. [Illust.]

Blanchard, W. H. A round-leaved red raspberry. Torreya **7**: 139, 140. 19 Jl 1907.

Rubus Egglestonii sp. nov., native of Vermont.

Brainerd, E. The older types of North American violets.— I. Rhodora **9**: 93–98. 29 Je 1907.

Burlingame, L. L. The sporangium of the *Ophioglossales*. Bot. Gaz. **44**: 34–56. *pl. 3, 4.* 20 Jl 1907.

Campbell, D. H. Studies on the *Ophioglossaceae*. Ann. Jard. Bot. Buitenzorg II. **6**: 138–194. *pl. 9–19.* 1907.

Chamberlain, E. B. *Catharinaea MacMillani.* Rhodora **9**: 98–100. *pl. 74.* 29 Je 1907.

Clute, W. N. *Collinsia verna.* Am. Bot. **12**: 73, 74. My 1907. [Illust.]

Clute, W. N. Our bird's nest fungi. Am. Bot. **12**: 79–81. My 1907.

Cook, M. T. The embryology of *Rhizophora Mangle.* Bull. Torrey Club **34**: 271–277. *pl. 22, 23.* 26 Jl 1907.

Crockett, A. L. *Catharinea crispa* in Maine. Bryologist **10**: 74. 5 Jl 1907.

Cushman, J. A. A synopsis of the New England species of *Pleurotaenium.* Rhodora **9**: 101–106. *pl. 75.* 29 Je 1907.

Dobbin, F. An afternoon in the Helderbergs. Am. Bot. **12**: 78, 79. My 1907.

Dunham, E. M. *Polytrichum gracile* in Maine. Bryologist **10**: 75. 5 Jl 1907. [Illust.]

Edwards, S. C. Why and how to begin study of fungi. Am. Bot. **12**: 97–100. Je 1907. [Illust.]

Fernald, M. L. *Streptopus oreopolus* a possible hybrid. Rhodora **9**: 106, 107. 29 Je 1907.

Fink, B. Further notes on cladonias. XI. *Cladonia pyxidata* and *Cladonia pityrea.* Bryologist **10**: 57–60. *pl. 7.* 5 Jl 1907.

Foslie, M. Algologiske notiser III. Kgl. Norske Vidensk. Selskr. Skr. **1906**^{8}: 1–34. 1907.

Includes new American species in *Lithothamnion* (2), and *Lithophyllum* (4), also other American references.

Foslie, M. Antarctic and subantarctic *Corallinaceae.* Wissensch. Ergeb. Schwed. Südpolar-Exped. 1901–1903 **4**^{5}: 1–16. *pl. 1, 2.* 1907.

Fritsch, F. E. The subaërial and freshwater algal flora of the tropics. Ann. Bot. **21**: 235–275. Ap 1907.

Based mainly upon Old World observations.

Gager, C. S. The breathing of plants. Jour. N. Y. Bot. Gard. **8**: 143–156. Jl 1907.

Gates, R. R. Hybridization and germ cells of *Oenothera* mutants. Bot. Gaz. **44**: 1–21. *f. 1–3.* 20 Jl 1907.

Guillet, C. Fungi from the Kawartha Lakes (and a few from Toronto) including several new species. Ottawa Nat. **23**: 57–60. 31 Jl 1907.

Several species named as new but not described.

Gürke, M. *Echinocactus gladiatus* Pfeiff. und *E. hastatus* Hopff. Monats. Kakteenk. **17**: 81–86. 15 Je 1907.

Natives of Mexico.

Gürke, M. *Echinocereus Kunzei* Gürke n. sp. Monats. Kakteenk. **17**: 103, 104. 15 Jl 1907.

Native of Arizona.

Harris, C. W. Lichens of the Adirondack League Club tract. Bryologist **10**: 64–66. 5 Jl 1907.

Harshberger, J. W. Observations on the formation of algal paper. Torreya **7**: 141, 142. 19 Jl 1907.

Hemsley, W. B. *Stewartia Malachodendron.* Curt. Bot. Mag. IV. **3**: *pl. 8145.* Jl 1907.

Native of eastern North America.

Hill, A. W. A revision of the geophilous species of *Peperomia*, with some additional notes on their morphology and seedling structure. Ann. Bot. **21**: 139–160. *pl. 15.* Ap 1907.

Includes descriptions of 7 new species, natives of tropical America.

Hill, E. J. The validity of some species of *Fissidens.* Bryologist **10**: 67–74. *pl. 9.* 5 Jl 1907.

Hillier, J. M. Guayule rubber. (*Parthenium argentatum* A. Gray.) Kew Bull. Misc. Inf. **1907**: 285–294. Jl 1907.

Native of Mexico and Texas.

Holm, T. Morphological and anatomical studies of the vegetative organs of *Rhexia.* Bot. Gaz. **44**: 22–33. *pl. 1, 2.* 20 Jl 1907.

House, H. D. Notes on southern violets — II. Torreya **7**: 133–136. *f. 4.* 19 Jl 1907.

Includes *Viola oconensis* sp. nov., a native of South Carolina.

Hutchinson, J. *Montanoa mollissima.* Curt. Bot. Mag. IV. **3**: *pl. 8143.* Jl 1907.

Native of Mexico.

Kirby, A. M. Daffodils, narcissus, and how to grow them as hardy plants and for cut flowers, with a guide to the best varieties. 1–235. *pl. 1–32.* New York, 1907.

Kirkwood, J. E. Some features of pollen-formation in the *Cucurbitaceae.* Bull. Torrey Club **34**: 221–242. *pl. 17–21.* 10 Jl 1907.

Knowlton, F. H. Description of a collection of Kootanie plants from the Great Falls coal field of Montana. Smithsonian Misc. Coll. **50**: 105–128. *pl. 11–14.* 27 Je 1907.

Includes new species in *Cladophlebis, Acrostichopteris, Dryopteris, Adiantum, Oleandra*, and *Protorhipis.*

Knox, A. A. The relation of fasciation to injury in the evening primroses. Plant World **10**: 145–151. *f. 29.* Jl 1907.

Kupfer, E. Studies in plant regeneration. Mem. Torrey Club **12**: 195–241. *f. 1–13.* 10 Je 1907.

Lawson, A. A. The gametophytes and embryo of the *Cupressineae* with special reference to *Libocedrus decurrens.* Ann. Bot. **21**: 281–301. *pl. 24–26.* Ap 1907.

Mackenzie, K. K. The range of *Vaccinium virgatum.* Torreya **7**: 144, 145. 19 Jl 1907.

Malme, G. O. A. Några anteckningar om *Victoria* Lindl., särskildt om *Victoria Cruziana* D'Orb. Act. Hort. Berg. 4^5: 1–16. *pl. 1–4.* 1907.

Natives of South America.

Mottier, D. M. The development of the heterotypic chromosomes in pollen mother-cells. Ann. Bot. **21**: 309–347. *pl. 27, 28.* Jl 1907.

Murrill, W. A. Leaf blight of the plane-tree. Jour. N. Y. Bot. Gard. **8**: 157–161. *f. 21, 22.* Jl 1907.

Nash, G. V. An attractive Philippine shrub in flower. Jour. N. Y. Bot. Gard. **8**: 161–163. *f. 23.* Jl 1907.

Nash, G. V. Structure and classification of orchids. Jour. Hort. Soc. N. Y. **1**: 24–26. Je 1907.

Nash, G. V. Useful or economic plants. Jour. Hort. Soc. N. Y. **1**: 33–35. Je 1907.

O'Mara, P. Sports. Jour. Hort. Soc. N. Y. **1**: 39–43. Je 1907.

Powell, G. T. The value of selection in the propagation of trees and plants. Jour. Hort. Soc. N. Y. **1**: 36–38. Je 1907.

Purpus, J. A. *Cereus Thurberi* Engelm. Monats. Kakteenk. **17**: 107. 15 Jl 1907. [Illust.]

Native of Mexico and Arizona.

Purpus, J. A. Neue, von Rose beschriebene Kakteen aus Mexico. Monats. Kakteenk. **17**: 91–93. 15 Je 1907.

Quehl, L. Varietäten der *Mamillaria strobiliformis* Scheer. Monats. Kakteenk. **17**: 86, 87. 15 Je 1907.

Natives of Mexico.

Rolfe, R. A. *Odontoglossum Leeanum.* Curt. Bot. Mag. IV. **3**: *pl. 8142.* Jl 1907.

Native of Colombia.

Rolfs, F. M. Die back of the peach trees (*Valsa leucostoma* Pers.). Science II. **26**: 87–89. 19 Jl 1907.

Rose, J. N. Additional notes on Mexican plants of the genus *Ribes*. Smithsonian Misc. Coll. **50**: 32. 1 My 1907.
Ribes madrense Coville & Rose sp. nov.

Rose, J. N. *Cactus Maxonii*, a new cactus from Guatemala. Smithsonian Misc. Coll. **50**: 63, 64. *pl. 6.* 15 Je 1907.

Rose, J. N. & Painter, J. H. *Morkillia*, a new name for the genus *Chitonia*; with description of a new species. Smithsonian Misc. Coll. **50**: 33, 34. 1 My 1907.
Includes description of *Morkillia acuminata* Rose & Painter sp. nov., native of Mexico.

Rydberg, P. A. Linnaeus and American botany. Science II. **26**: 65–71. 19 Jl 1907.

Sargent, C. S. The black-fruited *Crataegus* of western North America. Bot. Gaz. **44**: 64–66. 20 Jl 1907.

Schreiner, O. & Reed, H. S. The production of deleterious excretions by roots. Bull. Torrey Club **34**: 279–303. *f. 1.* 26 Jl 1907.

Shear, C. L. New species of fungi. Bull. Torrey Club **34**: 305–317. 26 Jl 1907.
New species described in *Ozonium*, *Sporotrichum*, *Cladosporium*, *Helminthosporium Phyllosticta*, *Sphaeronema*, *Septoria*, *Sporonema* (2), *Plagiorhabdus* gen. nov. (2), *Leptothyrium*, *Rhabdospora*, *Ceuthospora*, *Bothrodiscus* gen. nov., *Anthostomella*, *Acanthorhynchus* gen. nov., *Gloeosporium*, *Guignardia*, and *Ustilago*.

Sheldon, J. L. The taxonomy of a leaf-spot fungus of the apple and other fruit-trees. Torreya **7**: 142, 143. 19 Jl 1907.

Smith, K. P. Pennsylvania wild flowers. Am. Bot. **12**: 115, 116. Je 1907.

Stapf, O. A new rubber tree: Palo amarillo. (*Euphorbia fulva* Stapf; syn. *E. elastica* Altamirano and Rose, not of Jumelle.) Kew Bull. Misc. Inf. **1907**: 294–296. Jl 1907.
Native of Mexico.

Stapf, O. *Phyllodoce Breweri*. Curt. Bot. Mag. IV. **3**: *pl. 8146.* Jl 1907.
Native of California.

Stejneger, L. The origin of the so-called Atlantic animals and plants of western Norway. Smithsonian Misc. Coll. **48**: 458–513. *pl. 67–70.* 4 My 1907.

Stokey, A. G. The roots of *Lycopodium pithyoides*. Bot. Gaz. **44**: 57–63. *pl. 5, 6 + f. 1.* 20 Jl 1907.

Thériot, I. *Grimmia Dupreti* n. sp. Bryologist **10**: 62–64. *pl. 8.* 5 Jl 1907.
Native of Quebec.

Underwood, L. M. American ferns–VIII. A preliminary review of the North American *Gleicheniaceae.* Bull. Torrey Club **34**: 243–262. *f. 1, 2.* 10 Jl 1907.

Includes descriptions of 4 new species of *Dicranopteris.*

White, J. Atlas of Canada. 1–14. *pl. 1–83.* Ottawa, "1906" [1907].

Includes maps showing distribution of forests and forest trees.

Wittrock, V. B. *Linnaea borealis* L. Species polymorpha et polychroma. *Linnaea borealis* L. En mångformig Art. Act. Hort. Berg. 4^1: 1–187. *pl. 1–13* + *f. 1–18.* 1907.

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Vol. 4, No. 2; not furnished separately:

Small, John Kunkel & Vail, Anna Murray. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 93–201, *plates 75–82.* 18 N 1893–17 Ap 1894.

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Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

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Banker, Howard James. A contribution to a revision of the North American *Hydnaceae*. Pages 99–194. 13 Je 1906.

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VOL. 34 SEPTEMBER, 1907 NO. 9

BULLETIN

OF THE

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CONTENTS

The genus Antrophyum—I. Synopsis of subgenera, and the American species. . . . . RALPH CURTISS BENEDICT 445

New western species of Gymnosporangium and Roestelia. FRANK DUNN KERN 459

Some Philippine Polyporaceae . . . . . WILLIAM ALPHONSO MURRILL 465

INDEX TO AMERICAN BOTANICAL LITERATURE. 483

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The genus Antrophyum — I. Synopsis of subgenera, and the American species

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The genus *Antrophyum*, as known at present, comprises more than thirty species of wide distribution in the tropics. Of this number, nine are confined to America, ranging from Mexico and Cuba on the north to Bolivia and southeastern Brazil on the south. The Old World species range from eastern Polynesia to Japan and China, south to New Guinea, the Mascarene Islands and Madagascar, and across Africa to the island of Fernando Po on the west coast.

The genus was established in 1824 by Kaulfuss,* who named six species, but recognized three more in a footnote. Three of the nine were American. The first species to be figured was the Old World *A. reticulatum* (Forster) Kaulfuss,† which may be considered as the type of the genus. Only one of the nine, the American *A. lanceolatum*, was known to Linnaeus.

The nine original species had been described under the Linnaean genus, *Hemionitis*, with which, however, they have very little affinity. They are probably more closely related to *Loxogramme* Presl. Blume recognized this when he classified several species properly belonging to the latter genus under *Antrophyum*,‡ and Presl placed one species of *Antrophyum* with *Loxogramme*.§

When the present work was commenced, it was intended to include the entire genus, but the material at hand was not suffi-

* Enum. Fil. 197. 1824.

† Schkuhr, Crypt. Gewäch. 6. *pl. 6.* 1805.

‡ Flora Jav. Fil. 84–87. *pl. 36, 37.* 1828.

§ Tent. 215. 1836.

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ciently complete for an exhaustive study of all the species, and in this paper only the American species are treated extensively. Complete descriptions of all the species can not be given without comparative study of the types in the European herbaria. Further field work is also necessary.

The herbarium of the New York Botanical Garden has furnished most of the material studied, but loans from the Eaton Herbarium and from the U. S. National Herbarium have been of great assistance, and hearty thanks are hereby tendered Professor Evans and Mr. Maxon for their aid. To Dr. Christ also, thanks are due for a loan of type material of one of his species.

ANTROPHYUM Kaulf. Enum. Fil. 197. 1824

Plants epiphytic or on rock (rarely in soil); rhizomes rather stout, short-creeping or suberect, usually clothed with a dense mass of fuzzy roots, together with the bases of old fronds; apical buds and stipe-bases covered with delicate deciduous clathrate scales whose cell-walls may be smooth or papillose; fronds cespitose, glabrous, membranous, coriaceous, or fleshy, sessile or with alate stipes; costas complete or vestigial, the secondary venation reticulate, without included veinlets, of long costal areolae and shorter, frequently divergent lateral ones, which may be closed along the margin, or open in free veinlets: sporangia in either simple or branching lines mostly along the longitudinal veins, free or more or less interconnected, or completely reticulated and on all the veins (in mature fronds), superficial or immersed in grooves; indusia wanting; paraphyses of various shapes may be mixed with the sporangia.

Various methods have been used to divide the genus into groups. Those based on gross foliar or soral differences alone have not been successful, as they have included in the same sections species which differed in fundamental characters such as spore-form. At the suggestion and aided by the advice of Dr. Underwood, to whom sincere thanks are due, the writer has endeavored to find out whether microscopic characters would furnish adequate means of separation. The results have been extremely satisfactory. Part of the scheme given below is based on that used by Fée in his monograph of the genus,* but it is very much modified and extended, and the characters are chosen so as to show

* Mém. Foug. 4: 39–52. 1852.

natural relationships. By a combination of the characters of soriation and spore-form, separation into four subgenera is readily made. The use of microscopic characters may be carried still further. The Asiatic species are easily divided into groups and to some extent, into species according to the shape of the soral paraphyses. By this means certain species, otherwise easily confused, may be separated without difficulty.

Four of the five African species, which possess several well-marked distinctive characters, have been separated as a new subgenus, **Antrophyopsis.*** The only other African species known, *A. immersum*, seems to belong rather with the type section.

The terms "diplanate" and "triplanate" have been used for the spores instead of the usual "reniform" and "sphaero-tetrahedral" as being of more exact significance, since they relate not to mere variable form but to systems of spore-cleavage.

Synopsis of subgenera

Soriation in mature fronds completely reticulated, superficial or slightly raised; spores diplanate; paraphyses present; costa vestigial, marginal veinlets free to the edge of the frond; stipe-scale cell-walls papillose (all?).

§ **Antrophyopsis** (African) *

Soriation of simple or branched lines which may be more or less interconnected but never completely reticulated, superficial or immersed in grooves; spores diplanate or triplanate, paraphyses present or absent; costa complete or vestigial, marginal veinlets usually anastomosing with the anterior veinlets to form closed areolae; stipe-scale cell-walls smooth.

Spores diplanate, paraphyses pyriform; costa complete.

§ SCOLIOSORUS (American)

Spores triplanate.

Sporangia in three or four long grooves on each side of the complete costa and parallel to it; paraphyses wanting. § POLYTAENIUM (American)

Sporangia, except in the three narrowest forms, in branched lines, more or less connected; paraphyses present or absent; costa complete or vestigial.

§ EUANTROPHYUM

Paraphyses wanting; costa complete or nearly so.

Costata (American)

Paraphyses present; costa vestigial. *Ecostata* (Old World)

The American section of the genus *Antrophyum* comprises nine species separable into three subgenera as noted in the group synopsis, according to (1) soriation, and (2) spore-form. All are alike in having a complete or nearly complete costa, a character distinguishing them from all the Old World forms, some of which,

* Type, *A. Boryanum* (Willd.) Spr.

however, approach this condition. A still more sharply distinctive character, if *A. ensiforme* be excluded, is the absence of paraphyses, which are found in all the Old World species.

On the basis of this character together with spore-form, *A. ensiforme* Hooker with diplanate spores may be separated from the others which lack paraphyses and have triplanate spores. Moore's genus *Scoliosorus* was based on this species, but on the strength of a non-existing character inferred from Hooker's incomplete description. The characters here given, however, and a slight but decided difference in soriation are sufficient to separate it at least as a subgenus.

Using soriation as a basis, Desvaux in 1827 established a new genus, *Polytaenium*, with *A. lineatum* as type. The sporangia in this species are in three or four long straight deep grooves on each side of the costa, and parallel to it, an arrangement considerably different from the normal American type which consists of series of divergent branching lines, superficial or only slightly immersed. In some of the broadest forms of *A. lineatum*, however, the type of soriation approaches the normal, and on the whole, the similarities seem greater than the differences, which are satisfied by recognition as a subgenus.

The remainder of the species belong to the costate section of *Euantrophyum*. After we eliminate *A. lanceolatum*, which is easily distinguishable, six species remain, two of which are described here for the first time, and one other which has never been accepted. These three are based on material originally identified as *A. subsessile* Kunze (*A. brasilianum* (Desv.) C. Chr.), but such reference is not justified. The six species form a group of coördinate forms, no one of which is entitled to stand as representative of the others. If *A. discoideum*, for example, be refused recognition, then logically *A. cayennense* which has always been recognized must also be referred to *A. brasilianum*. The fact that in the most superficial and easily determined character, outline, *A. discoideum* resembles *A. brasilianum* more closely, is not a sufficient reason for denying its validity. In reality it is less closely related to the latter fern than is *A. cayennense*, which shows its affinity in a coriaceous texture and closed marginal areolae, and sometimes even in outline.

Reasons of value equal to those just given for recognizing *A. discoideum* can be given for the admission of the other species treated here. Indeed, further field work may show that two or three other variant forms to which reference is made under the species concerned, are also entitled to specific rank.

The American species may be separated as follows:

Spores diplanate; paraphyses pyriform (*Scoliosorus*). 1. *A. ensiforme.*
Spores triplanate; paraphyses wanting.
  Sporangia in long simple grooves parallel to costa (*Polytaenium*). 2. *A. lineatum.*
  Sporangia not in long simple grooves (*Euantrophyum*).
    Areolar axes longitudinal. 3. *A. lanceolatum.*
    Areolar axes divergent.
      Soral lines slightly sunken; marginal venation mostly closed in short areolae with few free veinlets.
        Fronds coriaceous, margins reflexed.
          Fronds oblanceolate, rather thick, opaque. 4. *A. brasilianum.*
          Fronds elliptic, thin, translucent. 5. *A. cayennense.*
        Fronds not coriaceous, margins flat; fronds oblong, long-acute. 6. *A. Dussianum.*
      Soral lines superficial; marginal venation of open free veinlets.
        Fronds broadly oblanceolate, short-stiped, thick. 7. *A. Jenmani.*
        Fronds elliptic-lanceolate, sessile. 8. *A. anetioides.*
        Fronds oblong or oblanceolate, subsessile, thin. 9. *A. discoideum.*

1. ANTROPHYUM ENSIFORME Hook.; Benth. Pl. Hartweg. 73. 1841. (Type from Mt. Totontepeque, Mexico.)

Antrophyum falcatum Mart. & Gal. Mém. Foug. Mex. 49. *pl. 12.* 1842.

Antrophyum carnosum Liebm. Vid. Selsk. Skr. V. **1**: 161. 1849.

Antrophyum Galeottii Fée, Mém. Foug. **4**: 51. *pl. 5. f. 4.* 1852.

Scoliosorus ensiformis Moore, Ind. Fil. xxix. 1857.

Dictyogramme ensiformis Trev. Atti Ist. Ven. V. **3**: 592. 1877.

Spores diplanate, paraphyses pyriform, brown or yellow, on slender pedicels of various lengths which may arise singly or in clusters from a thickened basal cell; sporangia in simple or usually only once-forked, oblique, free, superficial lines along each side of the frond; fronds narrowly oblong, often curved, tapering very gradually below to a sessile base, less gradually above to a narrowly acute apex, thin, rather flaccid, 17 × 1.1–50 × 2.7 cm. margins reflexed, slightly repand; areolae in branching rows divergent from the complete costa, open along the margin; costa and areolation superficially indistinct.

Mexico to Costa Rica.

Antrophyum ensiforme occupies a rather anomalous position in the genus. Moore in 1857 made it the basis of a new genus, *Scoliosorus*, giving the following reasons based on Hooker's description and figure. "This plant having neither netted veins nor netted sori, cannot possibly belong to *Antrophyum*." His misapprehension regarding the venation was due to the fact that in the original description no evidence of a secondary venation was shown. But a distinct difference in soriation really exists. In *Euantrophyum*, the soriation consists of series of lines which usually branch several times, and may anastomose considerably. In immature fronds or in the narrowest specimens, the lines may be simple, but the relationship is obvious. In *Scoliosorus*, the soral lines are simple or usually only once-forked, and at a glance appear different from the normal type, although probably derived from it.

Another distinctive character is found in the paraphyses which are present in no other American species. These, however, do not differ essentially from one type found on some of the Old World species and may be indicative of a paraphysate ancestry for all the present species.

The character of greatest differential value known at present is found in the diplanate spores which entitle the species at least to rank as a subgenus. Judging from external characters, anatomical differences exist as well which would further distinguish it from the typical species.

2. ANTROPHYUM LINEATUM (Sw.) Kaulf. Enum. Fil. 199. 1824.
Hemionitis lineata Sw. Prodr. 129. 1788. (Type from Jamaica.)
Vittaria lanceolata Sw. Gesell. Naturf. Freund. Neue Schr. 2: 133. *pl. 7. f. 2.* 1799.
Polytaenium laceolatum Desv. Prodr. 174. 1827.
Loxogramme lineata Presl, Tent. 215. 1836.
Polytaenium lineatum J. Sm. Jour. Bot. Hook. 4: 68. 1841.

Spores triplanate; paraphyses wanting; sporangia in three or four long grooves on each side of and parallel to the costa, rarely interconnected: fronds linear-lanceolate, 43×1 cm. and 43×1.5 cm. (maximum), long-tapering, sessile, membranous; areolae long and narrow, axes longitudinal, cross-veinlets transvese ; venation indistinct.

West Indies and Mexico, south to Bolivia. Altitude : 500–1000 meters.

This is the most widely distributed of all the American species of *Antrophyum*. It is easily distinguished from *A. lanceolatum*, with which it is often associated, by its long straight soral grooves. In the broadest fronds, besides the longitudinal grooves, a series of short divergent ones may occur along each margin. One frond was seen which was intermediate between *A. lanceolatum* and *A. lineatum* in soriation and general appearance.

It is frequently referred to as a close relative of *Vittaria*, but it is really no more closely related than other species of *Antrophyum*. The only point of similarity is found in the deep soral grooves, which are, however, of little importance in determining the relationship as compared with the venation. In *Vittaria* this consists of a costa and two submarginal veins formed by the interlocking of pinnate branches from the axial vein. In *Antrophyum*, the venation consists of a primary costa, and a secondary system of reticulated veins of uniform size. In the narrow species of *Vittaria*, the pinnate veins are almost indistinguishable, and the venation apparently consists of three primary veins. *Antrophyum lineatum* seems to be in the process of developing a system of several longitudinal veins connected by secondary cross-veinlets, apparently in a manner similar to that in which the narrow species of *Vittaria* have evolved from the broader forms, but related to *Vittaria* only through some ancestral form of both. The process seems to take place by the gradual suppression of the transverse veins, first by a loss of fertility followed by a diminution in size. *A. lanceolatum* represents an earlier stage of the same process. In it the soral lines are mainly on the longitudinal veins, but not to such an extent as in the related species. If they were immersed the resemblance would appear much stronger.

3. ANTROPHYUM LANCEOLATUM (L.) Kaulf. Enum. Fil. 198. 1824.
Hemionitis lanceolata L. Sp. Pl. 1077. 1753. (Type from Jamaica.)
Dictyogramme lanceolata Trev. Atti Ist. Ven. V. **3** : 592. 1877.
Antrophyum Feei Schaffner ; Fée, Mém. Foug. **7** : 42. *pl. 22. f. 1.* 1857. (Type from Mexico.)

Spores triplanate ; paraphyses wanting ; sporangia in crooked superficial mostly longitudinal lines ; fronds linear-lanceolate, 23 × 1–55 × 1.7 cm., usually broadest a little above the middle, sessile, membranous ; costas percurrent ; margins repand ; areolae in rows parallel to the costa, usually pointed.

West Indies and Mexico to northern South America.

This species is one of the commonest and also most easily distinguishable of the genus. Only one other, *A. lineatum*, resembles it closely, and differences in soriation as well as less-marked differences in outline and in the texture of the living plant serve at once to distinguish the two.

In Mexico and Honduras true *A. lanceolatum* is replaced by the form *A. Féei*, which may prove distinct. It has fronds elliptic-lanceolate, 9 × 0.9–19 × 1.4 cm.; smaller and relatively much broader than the type form. Its best claim to recognition lies in the uniform way in which these characters are maintained, combined with its localization in Mexico and Honduras to the exclusion of the related form, which is, however, found not far away in Costa Rica. But if it is a good species, Dominica must be included in its range, since material in the herbarium of the N. Y. Botanical Garden from this island cannot be separated from that collected in Mexico.

4. ANTROPHYUM BRASILIANUM (Desv.) C. Chr. Ind. Fil. 59. 1905.

Hemionitis brasilianum Desv. Prod. 216. 1827. (Type from Brazil.)

Antrophyum subsessile Kunze, Anal. Pter. 29. *pl. 19. f. 1.* 1837. (Type from Peru.)

Antrophyum spathulatum Fée, Mém. Foug. **4**: 46. *pl. 4. f. 6.* 1852. (Type from Colombia.)

Spores triplanate ; paraphyses wanting ; sporangia in simple or branching lines, divergent from near the costa toward the margin : fronds oblanceolate or oblong, 19 × 1.7–30 × 3.5 cm., narrowed very gradually below, subsessile or with margined stipe of indeterminate length, short-acuminate, young fronds acute ; epidermis glossy, wrinkled ; margins thin and sharp, reflexed ; areolae divergent from the costa, rather distinct on the back of frond ; marginal areolae closed, small, costa percurrent, prominent below.

BOLIVIA : Isapuri, *Williams 1354 ;* Tumupasa, *Williams 1353 ;* San José, *Williams 1352.* BRAZIL : Ilheos, *Martius* (Herb.

Fl. Bras. *369.*) VENEZUELA: Tovar, *Fendler 305* (in part). COSTA RICA: Turrialba, *Maxon 180, 152; Wercklé.* GUATEMALA: Alta Verapaz, *Von Tuerckheim 8059.*

Owing to the uncertainty regarding Desvaux's type, the positive application of this name is at present impossible, but there seems to be little doubt but that it should replace *A. subsessile* Kunze. The two descriptions agree closely and Kunze himself admitted that they might refer to the same plant.*

A. spathulatum Fée is apparently nothing but an abnormally obtuse form which is not very unusual.

5. ANTROPHYUM CAYENNENSE (Desv.) Sprengel, Syst. **4**: 67. 1827.

Hemionitis cajennensis Desvaux, Berl. Mag. **5**: 311. 1811. (Type from French Guiana.)

Spores triplanate; paraphyses wanting; sporangia in branching, divergent, slightly sunken lines: frond elliptic, acute or acuminate, thin coriaceous, translucent; costa percurrent; margin reflexed; stipes 2–8 cm. long, blades 13 × 2.3–23 × 5 cm.; areolae divergent from the costa, marginal areolae closed, small.

BRITISH GUIANA: 1897, *Jenman.* TRINIDAD: Herb. Bot. Gard. Trin. *346, 1263; Fendler 151.*

The identity of *A. cayennense* is rather doubtful. Desvaux in 1811 described *Hemionitis cajennensis* from French Guiana, but his material was lost sight of and his description would fit either of two species now known from that locality. Kunze, however, arbitrarily applied this name to the form here described. The nomenclature can be definitely settled only by examination of Desvaux's original material.

The species which superficially resembles it most is *A. Jenmani,* from which, however, it differs largely in texture and marginal venation. The herbarium specimens examined had nearly all bleached out to a light color. Those of *A. Jenmani* are all dark-brown. *A. cayennense* has a further distinctive character in its stipe-scales which have much longer setae than any other of the American species.

6. **Antrophyum Dussianum** sp. nov.

Spores triplanate; sporangia in simple or branching slightly sunken lines, divergent from near the costa to-

* Anal. Pter. 30.

ward the margin: fronds usually narrowly oblong, 20 × 2–40 × 3.4 cm., tapered gradually both ways, broader a little above the middle, long-acute (young fronds acute), subsessile, membranous, thin, dark-brown when dried; margin flat or slightly reflexed; areolation rather indistinct; areolae divergent from the costa; marginal venation of small closed areolae and some free veinlets; costa superficially distinct to the apex but not prominent.

Guadeloupe, *Père Duss 4226* (type). Also Martinique, *Duss 1549*; Dominica, *Lloyd 918*; Trinidad, *Fendler 151 B* (in Eaton herb.); Haïti, *Nash 1358*; Cuba, *Eggers 5269*, *Wright 775*.

Under this species is included all the West Indian *A. subsessile* so-called except that from Jamaica, which is placed with *A. discoideum*. It resembles *A. lanceolatum*, and seems to form a connection between this plant and the broader species of the genus. It is further distinguished from *A. brasilianum* by its less coriaceous texture and thinner frond, by the presence of rather numerous free veinlets along the margin, and by its less spatulate outline. From *A. discoideum* it is distinguishable by its sunken soral lines; its free veinlets are not punctate at the tips and do not occur regularly as in the latter form.

Two variant forms are included. That from Cuba, *Eggers 5269*, *Wright 775*, is narrower than the type material, 26 × 2.1–40 × 2.5 cm., and more coriaceous. That from Haïti, *Nash 1358*, is broader and more oblanceolate and acuminate, 25 × 3.5 cm. All three forms are alike in having the stipe-scales very long-attenuate, much more so than in any other American species.

7. **Antrophyum Jenmani** sp. nov.

Sporangia and spores not seen; soral lines apparently as in *A. brasilianum* and the other American species of *Euantrophyum*: fronds broadly elliptic to broadly oblanceolate, 19.5 × 4.5–28 × 7 cm., slightly acuminate, thick, flaccid, friable when dry, opaque; margins slightly reflexed; stipes thick, 2–5 cm. long; costa disappearing near the apex; areolation rather indistinct; areolae narrow, sometimes broad in young fronds, in branching rows which reach at the margin a wide angle of divergence from the costa; marginal areolae open.

BRITISH GUIANA: Potaro River, *Jenman* (type; det. *A. subsessile*); Demerara, Mt. Ragwa, *Jenman* (det. as above). GUIANA: *Leprieur 109* (U. S. Nat. Herb.).

Jenman refers to this plant as large *A. subsessile*,* but it is really one of the most distinct in the group, and it is hard to see how he could confuse it with the small thin form which occurs in Jamaica. It is the largest American species in the genus and is easily recognizable by its open marginal areolae, and its flaccid texture.

8. ANTROPHYUM ANETIOIDES Christ, Bull. Herb. Boiss. II. **5**: 12. 1905. (Type from Costa Rica.)

Spores triplanate; paraphyses wanting; sporangia in simple or branching, more or less connected, superficial lines divergent from the axis; fronds elliptic-lanceolate, 15 × 2.5–18 × 3.5 cm., acute (often blunted), rather thin, flaccid, friable when dry, opaque, sessile; margins very slightly reflexed; costa usually disappearing before the upper third, and scarcely visible even by transmitted light near the apex; areolation rather distinct; areolae divergent at a narrow angle from the axis; marginal areolae open.

COSTA RICA: Las Vueltas, *A. Tonduz 12757.*

Thanks to Dr. Christ's kindness in loaning me authentic material of this species, I have had opportunity to examine it at first hand and to compare it point by point with the related species. It differs from *A. brasilianum*, as he says, in texture and outline. In two other characters it is also easily distinguishable from this species, in its open marginal areolae, and indistinct costa. In its costal characters it is particularly interesting as suggesting a transition between the New and Old World species of this genus. In the species of the latter region, a costa is present usually only in the stipe or lower part of the frond. In the lamina, as a whole, or at least in the upper part, it becomes indistinguishable or can be traced only as a vein no larger than any other in the general network of the leaf. This is practically what happens in *A. anetioides.* The costa is nowhere prominent, and a little above the middle of the frond it can be distinguished only by transmitted light, while towards the apex it becomes no larger than the lateral veins.

9. ANTROPHYUM DISCOIDEUM Kunze, Bot. Zeit. **6**: 702. 1848. (Type from Colombia, *Karsten.*)

Spores triplanate; paraphyses wanting; sporangia in simple wavy or branching superficial lines, sometimes considerably con-

* Bull. Dept. Bot. Jam. II. **4**: 211. 1897.

nected, divergent from near the costa toward the margin; fronds elongate-oblong, 26 × 4 cm., 35 × 4 cm., 39 × 3.4 cm., narrowed very gradually below to a subsessile base, less gradually above to an acute apex (young fronds rounded or obtuse), membranous, firm; epidermis smooth and dull; margins flat, thin, slightly repand; areolation rather distinct; areolae divergent from the costa; marginal areolae open, ends of free veinlets enlarged and usually darkened; costa disappearing toward the apex, and visible only by transmitted light.

Colombia and Venezuela to Bolivia; Jamaica (?). Alt. 1800–2300 meters.

BOLIVIA: Santa Barbara, *Williams 1355*. VENEZUELA: Manoa, Lower Orinoco, *Rusby & Squires 371*; without definite locality, *Fendler 305*, in part (Eaton Herbarium).

Kunze's description is as follows: *A. fronde lineari-lanceolata, ensiformi-curvata, acuminata, bas longe attenuata in stipitem decurrente, tenuiter marginata, costata; venis obscuris, areolis erectis; soris immersis, flexuosis, interruptis, nec basin, nec apicem, nec marginem attingentibus.*

It will be seen that the two descriptions differ in two characters, outline and soriation. Kunze has "*lineari-lanceolata*" as compared with my "elongate-oblong," and "*soris immersis*" instead of "superficial." The difficulty regarding the first point is removed by a further reference to the form in his discussion of the species. He speaks of it as less spatulate than *A. brasilianum*. This would make it correspond to the description given here. In the other case, it is probable that the facts were misinterpreted. Soral lines which are not at all immersed, may appear so because of a blackening of the line of attachment. But, whatever the name eventually adopted for this species, it is distinct from *A. brasilianum*, with which it has always been confused.

The best distinctive character is found in the marginal venation, which in this species consists of free veinlets, the ends of which are thickened and usually blackened or brown. In good material these ends appear as a line of dots around the leaf about one and a half millimeters inside the thin margin. The dull smooth surface and the very thin tissue also serve to differentiate it from *A. brasilianum*, which has a wrinkled and rather glossy surface, and a thicker leaf.

The material of *A. subsessile* so-called from Jamaica seems to belong here, but its form is not typical. It is much shorter and usually more oblanceolate and less acute, but it shows to a marked degree the line of dots along the ends of the veinlets. The range in size is shown by the following specimens:

Underwood 1370. 21.5 × 2.5 cm.

Jenman, coll. in 1876. 18 × 3 cm.

Species inquirenda

ANTROPHYUM DESVAUXII Moore, Ind. Fil. 80. 1858.

Hemionitis gigantea Desv. Prodr. 216. 1827. (Type from St. Thomas, West Indies.)

Frondibus ecostatis, late lanceolatis, acutis, basi in stipitem late compressum dilatatis; lineolis dense reticulatis superficialibus. Habitat in insula Sancti-Thomae Antillarum. 2 ped. et ultra; 4 *poll. lata.* (Desvaux.)

The description agrees with that of Bory's *Antrophyum giganteum*, from the Mascarene Islands. The characters and dimensions given fit that species exactly. The following quotation from De Candolle's "Phytographie" may throw some light on the confusion. Speaking of Desvaux's herbarium, the writer says (page 408), "*Les omissions ou indications fausses de pays et la similitude de certains échantillons avec ceux du Muséum rendent cet herbier fort curieux.*" As the species under consideration could not possibly have come from the locality cited, the conclusions are obvious. The only possible explanation creditable to Desvaux, is that his material came from the African island, St. Thomas, which lies off the west coast, but this presupposes an improbable distribution for the fern, to say the least, and the accidental confusing of the two continents is not very likely.

Species excludenda

ANTROPHYUM MINIMUM Baker, Ann. Bot. **5**: 488. 1891. (Type from Costa Rica.) = **Hecistopteris minima** (Baker).

Soon after I began to study this species, I came to the conclusion that it belonged with *Vittaria* because of (1) the diplanate spores and the peculiarly shaped paraphyses, which are identical in form and size with those of *Vittaria costata* Kunze, (2) the venation, which is that of a very young leaf of *Vittaria lineata* as figured in a paper on the life-history of that species by E. G. Britton and A. Taylor.* But further study showed me that it was certainly congeneric with *Hecistopteris pumila* (Spr.) J. Smith, which possesses similar paraphyses and spores, and, as shown by Goebel, † has a vittarioid prothallium. The only distinction, except in form, is found in the venation, free-forking in *H. pumila*, and pinnate-anastomosing in *H. minima*. Dr. Christ has described another species, *H. Werckleana* ‡ (*Antrophyum Werckleanum* §), which seems to be intermediate in form between the other two, and may show a transitional type of venation. In the material of *H. minima* examined (*Endres*), one frond was found showing a forked tip. The sori are not sunken as stated by Baker in his description, but entirely superficial and in other respects like those of *H. pumila*. Taken together, the three species form a very natural genus with affinities close to *Vittaria*.

NEW YORK BOTANICAL GARDEN.

* Mem. Torrey Club 8: 158–211. *pl. 23–31.* 1902.

† Flora 82: 67. 1896.

‡ Bull. Bois. II. 7: 265. 1907.

§ Bull. Bois. II. 5: 11. 1905.

New western species of Gymnosporangium and Roestelia

Frank Dunn Kern

Examination of a large number of specimens of *Gymnosporangium* and *Roestelia* from the Rocky Mountains has clearly shown that there exist in that region several species very unlike any now known in the eastern states or in foreign countries. Some of these western species are represented in the larger cryptogamic herbaria and are labeled with the names of other species, to which they have some slight resemblance, or are undetermined. For the most part they possess strong diagnostic characters and are easily distinguishable from the eastern species, but cultures, to supplement field observations, are necessary before the telial and aecial forms can be definitely connected. In order that the western species may be properly recognized, and for the sake of convenience in referring to the two stages independently before they are connected, the present paper characterizes six new species, three of *Gymnosporangium* and three of *Roestelia*. Studies of the western species in this group have been very materially advanced by the co-operation of Professor E. Bethel, of the East Denver High School, both through his many contributions of unusually fine specimens and through advice and assistance rendered to Professor J. C. Arthur and the writer, while on a collecting and observation trip in Colorado during the latter part of April and first part of May, this year.

Gymnosporangium Betheli sp. nov.

Telia appearing on irregular, elongated, gall-like knots varying from a few millimeters to several centimeters across, unevenly disposed, wedge-shaped, 1–1.5 mm. broad by 1–3 mm. long at the base by 3–4 mm. high, chestnut-brown, epidermal tissues raised and torn about the base; teliospores ellipsoid, 17–25 by 40–55 μ, rounded or somewhat narrowed above and below, slightly or not constricted at the septum, wall dark cinnamon-brown, varying in thickness on different spores, 1–2 μ, smooth, pedicel hyaline, cylindrical, uniform, 6–7 μ in diameter, very long, pores 2 in each cell, near the septum.

On branches of *Sabina scopulorum* (Sarg.) Rydb. (*Juniperus scopulorum* Sarg.), Boulder, Colorado, April 27, 1907, *Bethel & Kern* (type); Horsetooth Gulch, Fort Collins, Colorado, June 30, 1893, *C. F. Baker 124;* Walcott, Colorado, July, 1905, *E. Bethel,* May 2, 1907, *F. D. Kern;* Laramie Hills, Wyoming, September 13, 1899, *A. & E. Nelson 6907.* Type in the herbarium of J. C. Arthur.

This is without doubt the most injurious to the cedars of all the species. It produces gall-like knots on both small and large branches. The mycelium is perennial, but does not produce new hypertrophy within the scars of the old, but always extends to the unaffected tissues beyond or at the side. This gives the characteristic appearance of new galls beside the old galls. The tendency is for the succession of galls to break forth along the grain of the wood, thus forming an elongated area of hypertrophy. In the selection of a name the author takes the opportunity to show his appreciation of the courtesies shown by Professor Bethel in sending specimens and otherwise assisting in the study of this group, and especially of this species. Professor Bethel has made numerous collections of this species and has suggested a probable roestelia connection as a result of his excellent field observations.

Gymnosporangium durum sp. nov.

Telia appearing on firm, regular, globoid galls 0.5–5 cm. in diameter, unevenly disposed, sometimes aggregated, often separated by the scars of the sori of previous seasons, irregularly flattened, about 1–1.5 mm. broad by 1–5 mm. long at base by 3.5 mm. high, often confluent, light chestnut-brown, torn epidermal tissues not conspicuous; teliospores narrowly ellipsoid, 18–22 by 50–65 μ, narrowed at both ends, slightly constricted at the septum, wall pale cinnamon-brown, 1–1.5 μ thick, smooth, pedicel hyaline, cylindrical, uniform, 4–6 μ in diameter, very long, pores 2 in each cell, near the septum.

On branches of *Sabina utahensis* (Engelm.) Rydb. (*Juniperus californica utahensis* Engelm.), Glenwood Springs, Colorado, May 1, 1907, *F. D. Kern* (type), July, 1905, *E. Bethel;* Durango, Colorado, July 20, 1898 or '99, *Baker, Earle & Tracy,* May 24, 1907, *H. N. Wheeler,* communicated by E. Bethel; Mancos, Colorado, July 18, 1898, *Baker, Earle & Tracy.* Type in the herbarium of J. C. Arthur.

This species is characterized by the very regular, nearly globose, hard, woody gall which it produces. The mycelium is perennial for a few years or until the gall is usually several centimeters in diameter. The galls remain hanging on the trees for years. They are harder and more nearly globose than the galls produced by the eastern *G. globosum.*

Gymnosporangium inconspicuum sp. nov.

Telia usually arising between the scale-like leaves on the green branches, or rarely on the woody branches, scattered or usually aggregated and confluent, oblong, pulvinate, about 0.4–1 mm. wide by 0.5–1.5 mm. long by 0.5–1 mm. high, reddish-brown; teliospores oblong-ellipsoid, 25–29 by 55–80 μ, roundish or often acutish at apex, obtuse below, wall thin, about 1 μ, golden-yellow, smooth, pedicel hyaline, carotiform, swelling greatly next to the spore, 25–65 μ, very long, pores one in each cell, apical in the upper, near the pedicel in the lower cell.

On small branches of *Sabina utahensis* (Engelm.) Rydb. (*Juniperus californica utahensis* Engelm.), Glenwood Springs, Colorado, May 1, 1907, *Arthur & Kern.* Type in herbarium of J. C. Arthur; known only from the type locality.

As the name implies, this is a very inconspicuous species, and this fact undoubtedly accounts for its being overlooked up to the present time. The small, pulvinate sori breaking forth between the leaves soon become gelatinized and form a film over the surface of the leaves. In this condition it appears as if the spore-masses of some larger gall-form had dropped upon the leaves and clung there. In fact it was only after a great abundance had been seen that it was examined closely enough to be recognized as a genuine species. The teliospores are the largest of any of our known species. In general form they resemble *G. clavipes*, but are larger and the pedicel is swollen much more. Fruits of *Amelanchier* of the previous season, badly infested with a roestelia, were found still hanging to the trees in close proximity to the cedars abundantly bearing *G. inconspicuum* and it is strongly suspected that these forms may be different stages of the same species.

Roestelia Betheli sp. nov.

Pycnia fruiticolous and epiphyllous, numerous, gregarious, more or less crowded in irregular groups on discolored spots, punctiform, subepidermal, honey-yellow becoming blackish, flask-shaped, 130–160 μ in diameter by 100–112 μ high; ostiolar filaments 45–65 μ long.

Aecia fruticolous and hypophyllous, densely aggregated or in small groups on discolored spots, cylindrical, 0.2–0.3 mm. in diameter, 3–8 mm. high; peridium dingy-white, becoming finely lacerate above, often nearly to base, spreading, cells linear-rhomboidal in longitudinal section, 16–20 by 60–90 μ, overlapping and imbricated, outer wall thin, 1–1.5 μ, inner wall moderately thick, 4–6 μ, coarsely rugose with closely set linear ridges directed outward and downward, hygroscopic; aeciospores globoid, 18–24 by 23–30 μ, wall chestnut-brown, 2.5–3 μ thick, finely verrucose, pores several, scattered.

On fruit and leaves of *Crataegus Cerronis* A. Nels., Boulder, Colorado, September 1905, *E. Bethel* (type), August 17, 1906, *E. Bartholomew.*

On leaves of *Crataegus saligna* Greene, Wolcott, Colorado, September, 1898, *C. L. Shear 947* (in Griffiths' West Am. Fungi, *no. 333*).

This is a very vigorous species developing an unusually long peridium. It is interesting on account of its supposed relation to *Gymnosporangium Betheli*, described above. The same specific name is applied to both forms with the hope that cultures will soon establish their identity.

Roestelia Harknessiana Ellis & Ev. sp. nov.

Pycnia unknown. Aecia fruiticolous, evenly disposed, cylindrical, 0.5–0.8 mm. in diameter, 4–7 mm. long; peridium golden-brown, tough, not becoming lacerate, cells rhomboidal in longitudinal section, 58–74 by 90–112 μ, somewhat overlapping, outer wall moderately thick, 4–6 μ, smooth, inner wall thick, 15–20 μ, rather coarsely and evenly verrucose with roundish or slightly irregular papillae; aeciospores globoid, 22–26 by 26–30 μ, wall light cinnamon-brown, 2–2.5 μ thick, finely verrucose, pores several, scattered.

On *Amelanchier alnifolia* Nutt., Klamath River, California, July, 1887, collector unknown, communicated by H. W. Harkness (in Ellis & Ev. N. Am. Fungi, *no. 2714*). Type in the Ellis collection at the New York Botanical Garden.

The collection here listed was issued by Ellis & Everhart in their North American Fungi (*no. 2714*), in May, 1892, without any accompanying description. The name has since been used, but in an examination of the literature no publication with a description has been found. A Colorado collection was later issued under the same name (Ellis & Ev. Fungi Columb. *1293*, May, 1898), but it is very different both in gross and microscopical appearance and belongs with the new species proposed below. The geographical range of *R. Harknessiana* suggests a possibility of a connection with *G. Libocedri* (P. Henn.), which has the same limited distribution, but there is at present no other clue to introduce as evidence of their relationship.

Roestelia Harknessianoides sp. nov.

Pycnia fruiticolous, numerous, scattered or often more or less crowded over considerable areas, punctiform, subepidermal, honey-yellow becoming blackish, globoid, large, 160–220 μ in diameter by 150–210 μ high, ostiolar filaments 65–80 μ long.

Aecia fruticolous, scattered irregularly or crowded over the entire surface, cylindrical, 0.5–0.8 mm. in diameter, 2–4 mm. high; peridium yellowish-white, rather tough, not becoming lacerate, cells rhomboidal in longitudinal section, 45–55 by 65–100 μ, overlapping, outer wall moderately thick, 5–8 μ, smooth, inner wall very thick, 27–35 μ, moderately and closely verrucose with slightly irregular papillae; aeciospores globoid, 23–27 by 25–31 μ, wall pale-yellow, 2–2.5 μ, finely verrucose, pores obscure, scattered.

On fruit of *Amelanchier oreophila* A. Nels., Glenwood Springs, Colorado, July, 1905, *E. Bethel* (type in herbarium of J. C. Arthur).

On fruit of *Amelanchier alnifolia* Nutt. (?), Colorado, *E. Bethel* (in Ellis & Ev. Fungi 1293).

A very interesting species occurring only on the fruit. It has been confused with *R. Harknessiana* from which it differs in having shorter, lightly-colored peridia, peridial cells with a much thicker inner wall, and finer, closer markings, and spores with a lighter wall. It has a superficial resemblance and a similar habit of growth to the genuine *R. Harknessiana* and in separating it the name *Harknessianoides* has been chosen in order that it may carry with it this suggestion. This is the species mentioned above as having a possible connection with *Gymnosporangium inconspicuum*.

LAFAYETTE,
INDIANA.

Some Philippine Polyporaceae

William Alphonso Murrill

A large number of Philippine polypores have been added to the herbarium of the New York Botanical Garden during the last few years, mainly through the efforts of Mr. Robert S. Williams, who was collecting in the islands from November, 1903 to July, 1905, and to some extent from the collections of Mr. Elmer D. Merrill and Mr. A. D. E. Elmer, who sent material either to Mr. Ricker or myself for determination. A list of these additions to the herbarium is given in the following pages.

Mr. Williams collected the most of his specimens on the Lamao River and elsewhere on the slopes of Mt. Mariveles across the bay west of Manila. At Baguio, some distance to the north, he reached an elevation of 5200 feet, about 1000 feet higher than Mt. Mariveles, and found open pine woods, with much dead pine timber left by lumbermen. At Santa Cruz, on the Gulf of Davao, in Mindanao, he collected at an elevation of only a few hundred feet, and mostly in a more continuous forest than in the Lamao region. The specimens from Mr. Merrill and Mr. Elmer were collected in Luzon, Mindanao, Mindoro, Palawan, Culion, and Leyte.

A number of Philippine species which have been seen in European herbaria have as yet failed to appear in these additions, but it is hoped that the list will be complete enough in a year or two more so that a fairly full synopsis of Philippine polypores will be possible. Excursions into the interior of the larger islands will undoubtedly bring to light a considerable number of novelties, while further explorations among the smaller islands will serve more strongly to connect the native species with their relatives in Formosa, China, Japan, Malacca, Borneo, Java, Celebes, New Guinea, Australia, and the many small neighboring islands of the Pacific.

Subfamily POLYPOREAE

Coltricia cinnamomea (Jacq.) Murrill, Bull. Torrey Club **31**: 343. 1904.

Luzon: Mt. Mariveles, *Elmer 6949*.

COLTRICIA PERENNIS (L.) Murrill, Jour. Myc. **9**: 91. 1903.
Luzon: Baguio, *Williams.*

Coriolopsis aneba (Berk.) Murrill. *Polyporus anebus* Berk. Lond. Jour. Bot. **6**: 504. 1847. (Type from Ceylon.) *? Polyporus bicolor* Jungh. Fl. Crypt. Jav. **1**: [54]. 1838. (Type from Java.)
Luzon: Mt. Mariveles, *Elmer 6909.*

Coriolopsis badia (Berk.) Murrill. *Trametes badia* Berk. Lond. Jour. Bot. **1**: 151. 1842. (Type from the Philippines.) *Polystictus badius* Cooke, Grevillea **14**: 86. 1886.
Luzon: Lamao, 70 m., 115 m., 130 m., *Williams.* Culion: *Merrill 3526.* Mindanao: Santa Cruz, Gulf of Davao, *Williams.*

Coriolopsis dermatodes (Lév.) Murrill. *Trametes dermatodes* Lév. Ann. Sci. Nat. Bot. III. **2**: 196. 1844. *? Polyporus cervino-gilvus* Jungh. Fl. Crypt. Jav. **1**: [45]. *pl. 9.* 1838. (Type from Java.) *Polyporus dermatodes* Lév.; Gaud. Voy. Bonite **1**: 180. *pl. 138. f. 2.* 1846. *Polyporus Peradeniae* Berk. & Br. Jour. Linn. Soc. Bot. **14**: 51. 1885. (Type from Ceylon.)
Luzon: Lamao, 70 m., 80 m., 115 m., 130 m., *Williams;* Mt. Mariveles, *Elmer 6936, 6957.*

CORIOLOPSIS OCCIDENTALIS (Kl.) Murrill, Bull. Torrey Club **32**: 358. 1905. *Polyporus lanatus* Fr. Epicr. 490. 1838. (Type from the East Indies.) *Polyporus scorteus* Fr. Nov. Symb. 89. 1851. (Type from Pulo-Milu.)
Luzon: Lamao, 15 m., *Williams.* Culion: *Merrill 3571.* Mindanao: Santa Cruz, Gulf of Davao, *Williams.*

Coriolopsis phocinus (Berk. & Br.) Murrill. *Polyporus phocinus* Berk. & Br. Jour. Linn. Soc. Bot. **14**: 52. 1885. (Type from Ceylon.)
Luzon: Lamao, 80 m., *Williams.*

Coriolopsis semilaccata (Berk.) Murrill. *Polyporus zonalis semilaccatus* Berk. Jour. Linn. Soc. Bot. **16**: 46. 1878. (Type from Malamon.) *Fomes semilaccatus* (Berk.) Cooke, Grevillea **15**: 22. 1886.
Luzon: Bataan, *Merrill 3503;* Mt. Mariveles, *Elmer 6929, 6946;* Mt. Banahao, *Elmer 7557.*

CORIOLUS ABIETINUS (Dicks.) Quél. Ench. Fung. 175. 1886.

Luzon: Baguio, *Williams.*

CORIOLUS ATYPUS (Lév.) Pat. Tax. Hymén. 94. 1900. *Polyporus atypus* Lév. Ann. Sci. Nat. Bot. III. **2**: 184. 1844. (Type from Java.) *? Polyporus brunneolus* Berk. Lond. Jour. Bot. **3**: 187. 1844. (Type from the Philippines.) *? Polystictus Didrichsenii* Fr. Nov. Symb. 76. 1851. (Type from the island of Bora-bora.) *Trametes Aurora* Ces. Myc. Borneo 5. 1897. (Type from Borneo.)

Luzon: Lamao, 75 m., 80 m., 115 m., 500 m., *Williams;* Mt. Mariveles, *Merrill 3506, Elmer 6938, 6940, 6947, 6955, 6958;* Bataan, *Merrill 3505.* Mindoro: Baco River, *Merrill 3578.*

Coriolus cuneatiformis Murrill, sp. nov.

Pileus flabelliform, with a cuneate base, thin, dry, flexible, conchate, depressed behind, 2–3 × 3–4 × 0.1 cm.; surface subglabrous, zonate, smooth, white, with pale-avellaneous zones, sometimes avellaneous behind; margin very thin, entire, slightly deflexed when dry: context thin, white, fibrous, less than 1 mm. thick; tubes short, yellowish-white, 1 mm. long, mouths minute, circular to angular, regular, 6 to a mm., edges thin, entire, white to pale-yellowish: spores ellipsoidal, smooth, hyaline, 2.5–3 × 5–6 μ; hyphae hyaline, 3.5–5 μ; cystidia none.

Type collected on the Lamao River, Luzon, 80 m., on dead wood, December 1903, by R. S. Williams.

CORIOLUS ELONGATUS (Berk.) Pat. Tax. Hymén. 94. 1900. *Polyporus elongatus* Berk. Lond. Jour. Bot. **1**: 149. 1842. (Type from the Philippines.)

Luzon: Lamao, 500 m., 700 m., *Williams.*

Coriolus maximus (Mont.) Murrill. *Irpex maximus* Mont. Ann. Sci. Nat. II. **8**: 364. 1837. (Type from Cuba.) *Polyporus Meyenii* Kl. Nov. Act. Acad. Nat. Cur. **19**: Suppl. 236. 1843. (Type from Manila.)

Luzon: Lamao, 80 m., 115 m., *Williams;* Mt. Mariveles, *Elmer 6931;* Bataan, *Merrill 3499.*

Coriolus murinus (Lév.) Pat. Tax. Hymén. 94. 1900. *Polyporus murinus* Lév. Ann. Sci. Nat. Bot. III. **2**: 185. 1844. (Type from Java.)

Luzon: Lamao, 115 m., 130 m., *Williams.* Leyte: Palo, *Elmer 7237.*

Coriolus vernicipes (Berk.) Murrill. *Polyporus vernicipes* Berk. Jour. Linn. Soc. Bot. **16**: 50. 1878. (Type from Japan.)

Luzon: Mt. Banahao, 650 m., *Elmer 7550*.

Cycloporellus* **cichoriaceus** (Fr.) Murrill. *Polyporus intybaceus* Berk. Lond. Jour. Bot. **1**: 149. 1842. (Type from the Philippines.) Not *P. intybaceus* Fr. *Polystictus cichoriaceus* Fr. Nov. Act. Reg. Soc. Sci. Ups. III. **1**: 92. 1855. *Polyporus setiporus* Berk. Hook. Lond. Jour. Bot. **6**: 505. *pl. 20. f. 2.* 1847. (Type from Ceylon.)

Luzon: Upper Lamao, 700 m., *Williams;* Lamao, *Merrill 3528*.

Cycloporellus microcyclus (Lév.) Murrill. *Polyporus microcyclus* Lév. Ann. Sci. Nat. Bot. III. **2**: 188. 1844. (Type from Java.)

Luzon: Lamao, 115 m., *Williams;* Upper Lamao, 700 m., *Williams;* Mt. Mariveles, *Elmer 6937*. Leyte: Palo, *Elmer 7228*.

Earliella corrugata (Pers.) Murrill. *Polyporus corrugatus* Pers.; Gaud. Voy. Freyc. Bot. 172. 1826. *Polyporus fusco-badius* Pers.; Gaud. Voy. Freyc. Bot. 172. 1826. (Type from the Marianne Islands.) *Polyporus scabrosus* Pers.; Gaud. Voy. Freyc. Bot. 172. 1826. (Type from the Marianne Islands.) *? Polyporus mariannus* Pers.; Gaud. Voy. Freyc. Bot. 173. 1826. (Type from the Marianne Islands.) *Daedalea sanguinea* Kl. Linnaea **8**: 481. 1833. (Type from the East Indies.) *? Trametes bicolor* Berk. Trans. Linn. Soc. Bot. **16**: 43. 1878. (Type from the island of Aru.) *Polystictus Persoonii* Cooke, Grevillea **14**: 85. 1886. *Trametes nitida* Pat. Jour. de Bot. **4**: 17. 1890. (Type from Tonkin.)

Luzon: Mt. Mariveles, *Elmer 6921, 6935*. Leyte: Palo, *Elmer 7206, 7208*.

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* The genus *Cyclomycetella* (Bull. Torrey Club **31**: 422. 1904), based on *Boletus pavonius* Hook., becomes a synonym of *Coriolus*, since the real type of this species proves to be a member of the latter genus, rather than synonymous with *Polyporus iodinus* Mont. as generally supposed. I therefore suggest the name **Cycloporellus** for this group of species, with *Polyporus iodinus* Mont. (Ann. Sci. Nat. Bot. II. **16**: 108. 1841) as its type, and with the same diagnosis as that already published for *Cyclomycetella*.

FAVOLUS TENUIS (Hook.) Murrill, Bull. Torrey Club **32**: 100. 1905. *Polyporus bivalvis* Pers.; Gaud. Voy. Freyc. 168. 1826. (Type from Rawak.) *Hexagona orbiculata* Fr. Fung. Guin. *f. 9.* 1837. (Type from Guinea.) *Hexagona cervino-plumbea* Jungh. Crypt. Java 61. *f. 32.* 1838. (Type from Java.) *Hexagona Thwaitesii* B. & C. Proc. Am. Acad. Arts & Sci. **4**: 122. 1860. (Type from Bonin island.)

Luzon: Lamao, 70 m., 130 m., *Williams;* Mt. Mariveles, *Elmer 6927, 6934.* Leyte: Palo, *Elmer 7226.*

FAVOLUS WIGHTII (Kl.) Ricker, Philipp. Jour. Sci. **1**: Suppl. 286. 1906. *Polyporus Wightii* Kl. Linnaea **7**: 200. *pl. 10.* 1832. *Hexagona Wightii* Fr. Epicr. 496. 1838.

Pileus thin, coriaceous, flexible, umbonate-affixed, dimidiate to reniform, applanate when young, becoming deeply depressed with age, 5–10 × 7–16 × 0.2 cm., surface multizonate, marked with a few concentric ridges, pale-umbrinous and nearly glabrous when young, then chestnut-colored, with a few appressed aculeae, and finally opaque-black and clothed with conspicuous, erect or ascending, rigid, flattened, somewhat branched, black aculeae; margin very thin, isabelline, undulate or slightly lobed: context scarcely 1 mm. thick, tough, punky, fibrous; tubes 1.5 mm. long, cinereous or fulvous and glabrous within, mouths large, shallow, equally hexagonal, 1–3 mm. in diameter, cinereous or fulvous, edges thin, rarely obtuse, firm, entire.

Luzon: Mt. Mariveles, *Elmer 6913, 6919;* Lamao, 130 m., *Williams.*

Funalia philippinensis Murrill, sp. nov.

Pileus sessile, dimidiate, subimbricate, applanate above, slightly convex below, 5–10 × 10–15 × 1–2 cm.; surface slightly zonate near the margin, dark-fulvous throughout, very conspicuously clothed with rigid, branched, flattened or terete, concolorous, pointed aculeae, which partially disappear in extreme age; margin ochraceous, sterile, acute, undulate: context ferruginous, thin, punky-corky, 2–3 mm. thick; tubes 5–10 mm. long, ferruginous-fulvous within, mouths circular to hexagonal, very regular, averaging 1 mm. in diameter, edges thin, firm, entire, white when young, becoming dark-umbrinous: spores ovoid, smooth, hyaline, 3.5–4.5 μ; hyphae pale-ferruginous, 2–4 μ; cystidia none.

Type collected on the Lamao River, Luzon, 115 m., on dead wood, February, 1904, by R. S. Williams.

Funalia versatilis (Berk.) Murrill. *Trametes versatilis* Berk.

Lond. Jour. Bot. **1**: 150. 1842. (Type from the Philippines.) *Hexagonia ciliata* Kl. Nov. Act. Acad. Nat. Cur. **19**: Suppl. 235. *pl. 5. f. 1.* 1843. *Polystictus cilicioides* Fr. Nov. Symb. 87. 1851.

Luzon: Lamao, 80 m., 115 m., *Williams.* Mindanao: Santa Cruz, Gulf of Davao, *Williams.*

HAPALOPILUS GILVUS (Schw.) Murrill, Bull. Torrey Club **31**: 418. 1904. *Polyporus discipes* Berk. Hook., Lond. Jour. Bot. **6**: 499. 1847. (Type from Ceylon.) *Polyporus holosclerus* Berk. Lond. Jour. Bot. **6**: 501. 1847. (Type from Ceylon.) *Polyporus spadiceus* Berk. Ann. Mag. Nat. Hist. **3**: 388. 1839. (Type from the East Indies.) *Polyporus breviporus* Cooke, Grevillea **12**: 17. 1883. (Type from Australia.) *Polyporus aureomarginatus* P. Henn. Bot. Jahrb. **22**: 72. 1895. (Type from Kamerun.)

Luzon: Lamao, 70 m., 130 m., *Williams;* Lamao, *Merrill 3525;* Mt. Mariveles, *Elmer 6925.*

HAPALOPILUS LICNOIDES (Mont.) Murrill, Bull. Torrey Club **31**: 417. 1904.

Culion: *Merrill 3607.*

Hapalopilus subrubidus Murrill, sp. nov.

Pileus imbricate, umbonate-sessile or attached by a narrow base, dimidiate or flabelliform, conchate, thin, slightly flexible, 3–4 × 4–6 × 0.1–0.3 cm.; surface glabrous, slightly zonate, fulvous; margin thin, straight, entire or slightly undulate, reddish-brown when bruised: context ferruginous, punky-fibrous, tough, 1–2 mm. thick; tubes short, dark-lilac within, 1 mm. in length, mouths minute, slightly angular, regular, 7–8 to a mm., edges thin, entire, dark flesh-colored to fulvous: spores globose, smooth, hyaline, 3–4 μ; hyphae 2–3 μ, pale-ferruginous; cystidia none.

Type collected on Mt. Mariveles, Luzon, on dead wood, November, 1904, by A. D. E. Elmer, *no. 6912.*

HEXAGONA CUCULLATA (Mont.) Murrill, Bull. Torrey Club **31**: 332. 1904.

Mindanao: Santa Cruz, Gulf of Davao, *Williams.*

Hexagona vibecinoides (P. Henn.) Murrill. *Polyporus vibecinoides* P. Henn. Bot. Jahrb. **23**: 546. 1896. (Type from Kamerun, Africa.)

Luzon: Lamao, 70 m., *Williams.*

Inonotus Elmerianus Murrill, sp. nov.

Pileus subimbricate, sessile, dimidiate, conchate, thin, slightly flexible, $3 \times 4–5 \times 0.1–0.3$ cm.; surface finely tomentose to nearly glabrous, spongy-tomentose behind or in certain parts, very uneven, slightly zonate, ferruginous to fulvous, fuliginous at times behind; margin thin, undulate, ferruginous: context ferruginous, punky above, fibrous below, 1 mm. or less thick; tubes short, fulvous within, 0.5–1.5 mm. long, mouths very minute, regular, circular to angular, 9–11 to a mm., fulvous to umbrinous, bay when bruised, stuffed with flavous to luteous mycelium when very young, edges thin, entire: spores subglobose, smooth, pale-ferruginous, copious, 2 μ; hyphae pale-ferruginous, 3–4 μ; cystidia none.

Type collected on Mt. Mariveles, Luzon, on dead wood, November, 1904, by A. D. E. Elmer, *no. 6942.*

Microporellus subdealbatus Murrill, sp. nov.

Pileus very thin, tough, flexible, flabelliform, tapering to a short flattened stipe, which appears to be merely a continuation of the pileus, $4 \times 3 \times 0.1$ cm.; surface zonate, fibrillose to glabrous, resinous in appearance, pale-yellowish or light reddish-brown; margin very thin, sterile, lacerate, uneven: context very thin, white, fibrous, flexible; tubes short, decurrent, white within, mouths small, glistening, irregular, angular, white to slightly yellowish, 5 to a mm., edges acute, uneven, lacerate-dentate, soon becoming irpiciform: spores ovoid, smooth, hyaline, 3–4 μ; hyphae hyaline, 3–4 μ; cystidia none.

Type collected in the Province of Bataan, Luzon, on prostrate logs, October, 1903, by E. D. Merrill, *no. 3511.*

Nigroporus durus (Jungh.) Murrill. *Polyporus durus* Jungh. Fl. Crypt. Jav. **1**: [62]. 1838. (Type from Java.)

Luzon: Bataan, *Merrill 3500.*

NIGROPORUS VINOSUS Murrill, Bull. Torrey Club **32**: 361. 1905. (Type from San Domingo.)

Luzon: Lamao, 70 m., *Williams.* Leyte: Palo, *Elmer 7212.*

POLYPORUS CELEBICUS P. Henn. Monsunia **1**: 12. *pl. 1. f. 5.* 1899. (Type from Celebes.)

Luzon: Lamao, 75 m., 80 m., 130 m., *Williams.*

Polyporus coracinus Murrill, sp. nov.

Pileus suborbicular to reniform, attached by a short lateral tubercle, thin, fleshy-tough, conchate, $3–4 \times 4–5 \times 0.2$ cm., surface yellowish-white, finely tomentose, becoming glabrous and black;

margin thin, entire, concolorous: context less than 1 mm. thick, homogeneous and white to pallid, except the very thin black cuticle; tubes 1.5 mm. long, white to avellaneous within, mouths circular, regular, 4 to a mm., pallid to black, edges very obtuse, entire: spores subglobose, smooth, hyaline, 2.5–3.5 μ; hyphae 3 μ; cystidia dark-fulvous, short, ventricose, sharp-pointed, 10–25 μ, often branched or cespitose.

Type collected at Palo, Leyte, on dead sticks, January, 1906, by A. D. E. Elmer, *no. 7232*.

POLYPORUS GRAMMOCEPHALUS Berk. Lond. Jour. Bot. **1**: 148. 1842. (Type from the Philippines.)

Mindanao: Santa Cruz, Gulf of Davao, *Williams*.

Polyporus palensis Murrill, sp. nov.

Pileus flabelliform, tapering behind, shallowly depressed to infundibuliform, 2–3 × 2–3 × 0.1 cm.; surface white to fulvous, finely radiate-striate, glabrous; margin very thin, entire to undulate or lacerate, inflexed on drying: context very thin, fleshy, white, fragile when dry; tubes decurrent, less than 1 mm. long, white or slightly flesh-colored within, mouths minute, white to dull-fulvous, fragile when dry, somewhat radially elongated, 0.5 × 0.25 mm., edges lacerate-dentate, becoming almost irpiciform in appearance: spores oblong-ellipsoid, smooth, hyaline, 3–4 × 5–6 μ; hyphae smooth, hyaline, 3–4 μ; cystidia none: stipe lateral, rarely eccentric, short, tapering below, white, terete, striate above, covered with tubes below at the base, 3 mm. long, 2 mm. thick.

Type collected at Palo, Leyte, on dead sticks, January, 1906, by A. D. E. Elmer, *no. 7236*.

POLYPORUS PERULA (Beauv.) Fr. Epicr. 437. 1838. *Microporus Perula* Beauv. Fl. Owar. **1**: 12. *pl. 43*. 1805. (Type from Wari.) *Polyporus xanthopus* Fr. Obs. Myc. **2**: 255. 1818. (Type locality unknown.) *Polyporus affinis* Nees, Nov. Act. Acad. Nat. Cur. **13**[1]: *pl. 4. f. 1*. 1826. *Polyporus incomptus* Fr. Epicr. 437. 1838. (Type from Guinea.) *Polyporus polychrous* Ces. Myc. Borneo 4. 1879. (Type from Borneo.) *Polyporus carneo-niger* Berk.; Cooke, Grevillea **12**: 15. 1883. (Type from Australia.)

Luzon: Baguio, *Williams*; Bataan, *Merrill 3498, 3502, 3535*; Mt. Banahao, *Elmer, 7546, 7552, 7555*; Lamao, 70 m., 80 m., 100 m., 115 m., 700 m., *Williams*; Mt. Mariveles, *Elmer 6908, 6920, 6923, 6926*, *Merrill 3495*. Mindanao:

Santa Cruz, Gulf of Davao, *Williams.* Mindoro: Baco River, *Merrill 3582.* Palawan: Ewiig River, *Merrill 3585, 3588.* Culion: *Merrill 3605.*

POLYPORUS VIBECINUS Fr. Kongl. Vet.-Akad. Handl. Stockh. 126. 1849. (Type from Natal.)

Luzon: Lamao, 80 m., *Williams.*

PYCNOPORUS SANGUINEUS (L.) Murrill, Bull. Torrey Club **31**: 421. 1904.

Luzon: Lamao, 75 m. and 130 m., *Williams;* Province of Tarlac, *Merrill 3601.* Leyte: Palo, *Elmer 7239.* Mindanao: Santa Cruz, Gulf of Davao, *Williams.*

Rigidoporus surinamensis (Miq.) Murrill. *Polyporus surinamensis* Miq. Bull. Sci. Phys. Nat. Néerl. **1839**: 454. 1839. *Polyporus zonalis* Berk. Ann. Mag. Nat. Hist. **10**: Suppl. 375. *pl. 10. f. 5.* 1843. (Type from Ceylon.)

Luzon: Mt. Banahao, 900 m., *Elmer 7549.*

Spongipellis luzonensis Murrill, sp. nov.

Pileus thin, tough, rigid, imbricate, laterally connate, sessile, dimidiate, somewhat decurrent, conchate, 1–1.5 × 1.5–2.5 × 0.2–0.5 cm.; surface azonate, anoderm, fibrillose-tomentose, white to discolored, absorbing water; margin thin, undulate, concolorous, easily bruised, fertile, decurved when dry: context spongy-fibrous, white to pale-isabelline, about 2 mm. thick, tubes white to discolored, tough, elastic, 2–3 mm. long, mouths white to discolored, irregular, 4–6 to a mm., subglistening, edges very thin, fimbriate-dentate: spores globose, smooth, hyaline, 3–4 μ; hyphae hyaline, 5–6 μ; cystidia none.

Type collected on Mt. Mariveles, Luzon, on dead wood, November, 1904, by A. D. E. Elmer, *no. 6944.*

Trametes caespitosa Murrill, sp. nov.

Hymenophore densely imbricate, dimidiate, conchate, laterally connate, 1–2 × 2–3.5 × 0.2–0.3 cm.; surface puberulent to subglabrous, smooth, very slightly subzonate, pale-avellaneous, with a tinge of pale-purple; margin rather thick, concolorous, undulate, sharply deflexed: context white, fibrous, rigid, tough, 1–2 mm. thick; tubes white to pallid, 1–1.5 mm. long, mouths very regular, minute, circular, white to pallid, with a tinge of flesh color, 7–8 to a mm., edges rather thick, firm, tough, entire: spores smooth, hyaline, ovoid, copious, 5–6 × 7–7.5 μ; hyphae hyaline, 5–6 μ; cystidia none.

Type collected on Mt. Mariveles, Luzon, on dead wood, November, 1904, by A. D. E. Elmer, *no. 6951*.

Trametes lamaensis Murrill, sp. nov.

Pileus subcircular, narrowly attached, convex above and below, 3–4 × 3–4 × 1 cm.; surface finely puberulent, anoderm, slightly zonate or sulcate at times, white or pale-isabelline; margin rather thick, sterile, concolorous, entire: context white, subzonate, punky-corky, 7 mm. thick; tubes firm, tough, pallid, 2–3 mm. long, mouths somewhat irregular, circular to angular, 2–3 to a mm., subglistening, white to isabelline, edges rather thick, entire: spores globose, smooth, hyaline, 5–6 μ; hyphae hyaline, 4–5 μ; cystidia none.

Type collected on the Lamao River, Luzon, 130 m., on dead deciduous wood, February, 1904, by R. S. Williams.

Trametes luzonensis Murrill, sp. nov.

Pileus small, laterally connate, dimidiate, sessile, rarely encircling the twig, conchate, 1–2 × 1.5–3 × 0.2–0.4 cm.; surface smooth, anoderm, finely tomentose to subglabrous, white to very pale avellaneous, entirely without marks; margin acute, entire, deflexed when dry: context punky, white, 1–2 mm. thick; tubes white within, 1–2 mm. long, tough, mouths regular, minute, circular, 6 to a mm., edges white to slightly discolored, rather thick, entire: spores smooth, hyaline.

Type collected on Mt. Mariveles, Luzon, on dead sticks, November, 1904, by A. D. E. Elmer, *no. 6932*.

TRAMETES MÜLLERI Berk. Jour. Linn. Soc. Bot. **10**: 320. 1868. (Type from Victoria River, Australia.)

Luzon: Province of Tarlac, *Merrill 3602*.

Trametes ostreaeformis (Berk.) Murrill. *Polyporus ostreaeformis* Berk. Jour. Linn. Soc. Bot. **16**: 46. 1878. (Type from the Philippines.)

Luzon: Lamao, 600 m., *Williams*.

Trametes subacuta Murrill, sp. nov.

Pileus very large, dry, firm, slightly flexible, reniform, sessile, applanate, 10–12 × 20 × 1–2 cm.; surface narrowly zonate, finely puberulent, becoming glabrous and tuberculose behind, avellaneous or umbrinous in front, murinous behind; margin ochraceous, thin, entire, fertile: context punky-corky, rather soft, white, 5–7 mm. thick; tubes 5 mm. long, white to pallid within, firm, tough, mouths glistening, very regular, circular, 2–3 to a mm., white to pale-isabelline, edges rather thin, entire: spores subglobose to ovoid, smooth, hyaline, 4–5 μ long, hyphae hyaline, 3–5 μ; cystidia none.

Type collected on the Lamao River, Luzon, 115 m., on dead deciduous wood, December, 1903, by R. S. Williams.

Trametes Williamsii Murrill, sp. nov.

Pileus sessile, dimidiate, subimbricate, at times laterally connate, applanate, thicker behind, 4–5 × 4–7 × 1 cm.; surface finely tomentose to nearly glabrous, slightly zonate, isabelline or avellaneous, sometimes partly murinous, anoderm, slightly tuberculose; margin thick, sterile, entire, easily bruised: context corky, tough, somewhat zonate, white, 5–7 mm. thick, eagerly devoured by insects; tubes pallid, 5 mm. long, tough, firm, mouths circular, regular, pallid, 2–3 to a mm., edges thick, obtuse, entire: spores globose, smooth, hyaline, 4–5 μ; hyphae hyaline, 3–4 μ; cystidia none.

Type collected at Santa Cruz, Gulf of Davao, Mindanao, on dead pine logs, June, 1905, by R. S. Williams.

Tyromyces Elmeri Murrill, sp. nov.

Pileus fleshy, rigid and fragile when dry, dimidiate, sessile, subimbricate, 2–3 × 3–4 × 0.2–0.3 cm.; surface rough, with minute tubercles and pits, glabrous, white to isabelline; margin rather thick, entire, concolorous: context white, fleshy-tough, 1 mm. thick; tubes white to isabelline within, 2 mm. long, mouths slightly angular, minute, regular, 6–7 to a mm., pruinose, glistening, at length avellaneous, edges thin, entire: spores globose, smooth, hyaline, 3–4 μ; hyphae hyaline, 4–5 μ; cystidia none.

Type collected on Mt. Mariveles, Luzon, on dead wood, November, 1904, by A. D. E. Elmer, *no. 6954*.

Subfamily FOMITEAE

Amauroderma Elmerianum Murrill, sp. nov.

Pileus stipitate, umbonate-affixed, subcircular to reniform, usually convex above, plane or slightly concave below, hard and rigid, 3 × 4–7 × 0.5–1 cm.; surface thinly encrusted, finely puberulent, conspicuously radiate-rugose, many times sulcate, marked with narrow, avellaneous lines and broad, fuliginous or black zones; margin thick, truncate, zonate, crumpled or rugose, concolorous: context avellaneous, punky-corky, homogeneous, 2–4 mm. thick; tubes 3–7 mm. long, slender, avellaneous within, mouths regular, circular, constricted, 5–6 to a mm., nearly white to smoky-black, reddish-brown when bruised, edges thick, obtuse, entire: spores subglobose, very pale brown, finely echinulate, thick-walled, 5–6 μ; hyphae subhyaline, 3–5 μ; cystidia none: stipe laterally-attached, ascending, cylindrical, subequal, 3–12 cm. long, 0.7–1.3 cm. thick, resembling the pileus in surface and substance.

Type collected at Palo, Leyte, on dead stumps, January, 1906, by A. D. E. Elmer, *no. 7210.* Also collected on Mt. Mariveles, Luzon, November, 1904, by Elmer, *no. 6960.*

Elfvingia Elmeri Murrill, sp. nov.

Pileus very large,compressed-ungulate, convex above, slightly concave below, sessile, dimidiate, very hard, 20 × 25–35 × 4–7 cm.; surface glabrous, deeply sulcate, tuberculose, horny-encrusted, becoming slightly rimose when old and dry, but never weathering, brown with a grayish tinge; margin thick, rounded, ferruginous, entire: context ferruginous to fulvous, punky-corky, rather firm, 1–2 cm. thick; tubes distinctly stratified, 1–2 mm. long each season, fulvous within, mouths circular, regular, 5 to a mm., edges rather thin, entire: spores ferruginous, globose, smooth, 5–6 μ; hyphae ferruginous, 3–4 μ; cystidia ventricose, fulvous, sharp-pointed, copious, 15–40 μ long.

Type collected on Mt. Mariveles, Luzon, on dead wood, November, 1904, by A. D. E. Elmer, *no. 6961.*

ELFVINGIA TORNATA (Pers.) Murrill, Bull. Torrey Club **30**: 301. 1903. *Polyporus tornatus* Pers.; Gaud. Voy. Freyc. Bot. 173. 1826. (Type from islands in the Pacific ocean.) *Polyporus australis* Fr. Elench. 108. 1828. (Type from islands in the Pacific ocean.)

Luzon: Mt. Mariveles, *Elmer 6916.* Culion: *Merrill 3572.* Leyte: Palo, *Elmer 7209.*

Fomes luzonensis Murrill, sp. nov.

Pileus dimidiate, umbonate-affixed, compressed-ungulate, very convex above, plane or slightly concave below, 4 × 6–8 × 1–2 cm.; surface zonate, sulcate, glabrous, horny-encrusted, dull-brown in the older portions, pale-isabelline on the thin, expanded, recent growth; margin acute, narrowly sterile, pallid, undulate, straight: context thin, 1–2 mm., pale-isabelline, punky-corky; tubes distinctly stratose, isabelline within, 2–3 mm. long each season, mouths regular, circular, 5 to a mm., white to isabelline, opaque, edges thick, firm, tough, obtuse, entire: spores globose, smooth, hyaline, 5 μ; hyphae hyaline, 4 μ; cystidia none.

Type collected on the Lamao River, Luzon, 500 m., on a decaying trunk, January, 1904, by R. S. Williams.

Fomes philippinensis Murrill, sp. nov.

Pileus dimidiate, sessile, bracket-shaped, applanate above, plane or convex below, 5–10 × 10–15 × 1–2.5 cm.; surface horny, thinly encrusted, radiate-rugose, glabrous, somewhat zonate, shallowly sulcate, becoming slightly rimose with age, pale-isabelline to dull-umbrinous; margin sterile, pallid, glabrous, zonate, rather thick, entire, at length somewhat truncate and furrowed: context punky, tough, isabelline, zonate, 5–10 mm. thick; tubes more or less distinctly stratified, 2–3 mm. long each season, isabelline within, mouths pallid, regular, circular, 5 to a mm., edges thick, obtuse, entire: spores ovoid, smooth, hyaline, 5 × 4 μ; hyphae hyaline, 3–4 μ; cystidia none.

Type collected on the Lamao River, Luzon, 700 m., on a dead trunk, March 23, 1904, by R. S. Williams.

FOMES SEMITOSTUS Berk. Jour. Bot. & Kew Misc. **6**: 143. 1854. (Type from the Khasia Mountains, India.)

Luzon: Lamao, 80 m., *Williams;* Mt. Mariveles, *Elmer 6050.* Leyte: Palo, *Elmer 7222.*

GANODERMA AMBOINENSE (Lam.) Pat. Bull. Soc. Myc. Fr. **5**: 70. 1889. *Agaricus amboinensis* Lam. Enc. **1**: 49. 1783. (Type from Amboina.)

Luzon: Lamao, 80 m., *Williams.*

Ganoderma subtornatum Murrill, sp. nov.

Pileus sessile, short-stipitate, flabelliform, with a narrow base, applanate, slightly concave below, hard and rigid, 6–11 × 6–12 × 1 cm.; surface thinly encrusted, shining-black, except where covered with the brown conidia, glabrous, sulcate, radiate-rugose; margin truncate, slightly furrowed, sterile, entire: context 2–4 mm. thick, punky, white above, chestnut-colored below; tubes unstratified, slender, 5–8 mm. long, avellaneous-umbrinous within, mouths regular, circular, 5 to a mm., smoky-fuliginous, edges obtuse, entire: spores ovoid, pale-brown, finely asperulate, 9 × 6–7 μ; hyphae dark-brown, 5–6 μ; cystidia none: stipe lateral, compressed, 0–2 cm. long, 1.5–2 cm. thick, resembling the pileus in surface and substance.

Type collected on the Lamao River, Luzon, 100 m., on a decayed trunk, November, 1903, by R. S. Williams. Collected also on Mt. Mariveles, Luzon, November, 1904, by A. D. E. Elmer, *no. 6943*, and at Palo, Leyte, January, 1906, by Elmer, *no. 7213*.

Ganoderma Williamsianum Murrill, sp. nov.

Pileus sessile, dimidiate, compressed-ungulate or applanate, usually convex above, plane or concave below, subimbricate, rigid, 3–4 × 5–6 × 1–2 cm.; surface shallowly sulcate, slightly zonate, radiate-rugose, avellaneous, with narrow, dark zones when young, at length ochraceous-pulverulent from the secreted varnish, and finally glabrous, laccate, and bay or black; margin conchate at maturity, yellowish-brown, laccate, entire, sterile: context chestnut-colored, punky, soft, 3–6 mm. thick; tubes not stratified, slender, murinous-umbrinous within, hymenium white to ochraceous or melleous, mouths circular to slightly angular, regular, 5 to a mm., edges obtuse and entire when young, soon becoming thin: spores broadly ovoid, truncate, dark-brown, roughly echinulate, thick-walled, 8–9 × 12–14 μ; hyphae concolorous, 5–6 μ; cystidia none.

Type collected on the Lamao River, Luzon, 115 m., on a dead trunk, January, 1904, by R. S. Williams.

NIGROFOMES MELANOPORUS (Mont.) Murrill, Bull. Torrey Club **31**: 425. 1904. *Fomes melanoporoides* Ces. Myc. Borneo 6. 1879. (Type from Borneo.) *Fomes Cornu-bovis* Cooke, Grevillea **13**: 2. 1884. (Type from Malacca.) *? Polyporus cinereo-fuscus* Currey, Trans. Linn. Soc. II. **1**: 124. *pl. 19. f. 1.* 1876. (Type from India.)

Luzon: Lamao, *Williams*; Mt. Mariveles, *Elmer 6959*.

Pyropolyporus albomarginatus (Lév.) Murrill. *Polyporus albomarginatus* Lév. Ann. Sci. Nat. Bot. III. **2**: 191. 1844. (Type from Java.) *Polyporus Kermes* Berk. & Br. Jour. Linn. Soc. Bot. **14**: 49. 1875. (Type from Ceylon.) *Polyporus laeticolor* Berk. Jour. Linn. Soc. Bot. **16**: 46. 1878. (Type from the Philippines.) *Fomes pyrrhocreas* Cooke, Grevillea **14**: 11. 1885. (Type from New Guinea.)

Luzon: Lamao, 115 m., *Williams*.

Pyropolyporus caliginosus (Berk.) Murrill. *Polyporus caliginosus* Berk. Jour. Linn. Soc. Bot. **16**: 46. 1878. (Type from Philippines.) Not *Polyporus caliginosus* Ces. Myc. Borneo 5. 1879. (Type from Borneo.)

Leyte: Palo, *Elmer 7221*.

Pyropolyporus endotheius (Berk.) Murrill. *Polyporus endotheius* Berk. Jour. Linn. Soc. Bot. **16**: 47. 1878. (Type from the Philippines.)

Culion: *Merrill 3575*.

Pyropolyporus fastuosus (Lév.) Murrill. *Polyporus fastuosus* Lév. Ann. Sci. Nat. Bot. III. 2: 190. 1844. (Type from Singapore.)

Luzon: Lamao, 80 m., *Williams.*

Pyropolyporus lamaensis Murrill, sp. nov.

Pileus dimidiate, sessile, thin, subimbricate, applanate, 2 × 4 × 0.3–0.7 cm.; surface finely tomentose, zonate, slightly sulcate, horny-encrusted, fulvous-chestnut; margin thick, obtuse, sterile, ferruginous, entire: context luteous to ferruginous, hard, woody, homogeneous, 3–5 mm. thick; tubes 2 mm. long, smoky-avellaneous within, mouths circular, regular, minute, 6 to a mm., opaque, dull smoke-colored, edges thin, entire: spores globose to ovoid, smooth, hyaline, 3.5–5 μ long; hyphae ferruginous, 4 μ; cystidia slender, pointed, 15–40 μ, dark-fulvous.

Type collected on the Lamao River, Luzon, on decayed wood, November, 1904, by R. S. Williams.

Pyropolyporus Merrillii Murrill, sp. nov.

Pileus sessile, ungulate, plane below, 4 × 6 × 3–5 cm.; surface finely tomentose, deeply sulcate, anoderm or slightly encrusted, hard, bay, becoming blackish and weathered in the older layers; margin fulvous, sterile, finely tomentose, obtuse, undulate: context dark-fulvous, hard, horny, 3–6 mm. thick; tubes indistinctly stratified, fulvous within, 2–4 mm. long each season, mouths fulvous, subcircular, regular, 4 to a mm., edges rather thick, entire: spores ferruginous-fulvous, copious, subglobose, smooth, 3–4 μ; hyphae concolorous, 4 μ; cystidia none.

Type collected in Culion, on decaying trees near the seashore, December 1902, by E. D. Merrill, *no. 3575.*

Pyropolyporus pectinatus (Kl.) Murrill. *Polyporus pectinatus* Kl. Linnaea 8: 485. 1833. (Type from the East Indies.) *Fomes pullus* (Berk. & Mont.) Cooke, Grevillea **14**: 19. 1885. (Type from Java.)

Luzon: Lamao, 80 m., *Williams*; Mt. Mariveles, *Elmer 6933.* Palawan: Ewiig River, *Merrill 3586.*

Pyropolyporus Williamsii Murrill, sp. nov.

Pileus bracket-shaped, sessile, dimidiate, plane above, convex below, very hard, horny and brittle, 5–8 × 8–15 × 1–2 cm., surface finely tomentose to glabrous, dark-bay to black, horny-encrusted, deeply and roughly sulcate, somewhat tuberculose, slightly cracking with age; margin isabelline, sterile, rounded, entire or undulate: context 8–10 mm. thick, ferruginous, hard, radiate-striate, with white dendroid markings; tubes distinctly stratified, 2–3 mm. long each season, umbrinous to avellaneous within, mouths circular, avellaneous, opaque, regular, 5 to a mm., edges thick, obtuse, entire: spores subglobose, smooth, hyaline, 3–5 μ; cystidia dark-fulvous, ventricose, pointed, 15–30 μ long.

Type collected on the Lamao River, Luzon, 80 m., on a dead trunk, December, 1903, by R. S. Williams. What appears to be a young, deformed specimen of this species was collected on Mt. Banahao, Luzon, 500 m., on dead timber, May, 1906, by A. D. E. Elmer, *no. 7556.*

Subfamily DAEDALEAE

DAEDALEA AMANITOIDES Beauv. Fl. Owar. **1**: 44. *pl. 25.* 1804. (Type from Wari.) *Daedalea Palisoti* Fr. Syst. **2**: 335. 1821. *Lenzites Palisoti* Fr. Epicr. 404. 1838. Afzel. Fung. Guin. **1**: *pl. 11. f. 23. a. b. Daedalea repanda* Pers.; Gaud. Voy. Freyc. Bot. 168. 1826. (Type from the island of Rawak.) Mont. Cuba 382. *pl. 14. f. 4.* 1842. *Lenzites repanda* Fr. Epicr. 404. 1338. *Daedalea applanata* Kl. Linnaea **8**: 481. 1833. (Type from Mauritius.) *Lenzites applanata* Fr. Epicr. 404. 1838. *Lenzites pallida* Berk. Lond. Jour. Bot. **1**: 146. 1842. (Type from Manila.) *Lenzites platypoda* Lév. Bonite Crypt. **1**: 184. 1844–1846. Ann. Sci. Nat. Bot. III. **2**: 180. 1844. (Type from Manila.)

Luzon: Lamao, 70 m., *Williams;* Mt. Mariveles, *Elmer 6942.* Leyte: Palo, *Elmer 7218.* Culion: *Merrill 3574.*

DAEDALEA HOBSONI Berk. Jour. Linn. Soc. Bot. **13**: 165. 1873. (Type from Australia.) *? Trametes colliculosa* Berk. Lond. Jour. Bot. **6**: 506. 1847. (Type from Ceylon.)

Luzon: Lamao, 115 m., *Williams;* Mt. Mariveles, *Elmer 6914, 6928, 6948; Merrill 3507.* Culion: *Merrill 3608.*

Gloeophyllum edule Murrill, sp. nov.

Pileus imbricate, sessile, dimidiate, conchate or applanate, slightly decurrent at times, 4–7 × 6–10 × 0.3–0.6 cm.; surface short-tomentose to almost glabrous behind, subzonate, ochraceous-isabelline to pale-fulvous, becoming bleached with age, with a few, shallow, concentric furrows; margin acute, entire or undulate, ochraceous, tomentose, brownish when bruised: context ferruginous, punky, 2–4 mm. thick, soft enough when young to be eaten by the native Igorrotes; hymenium lenzitoid, furrows several times forked, 2–4 mm. deep, about 1 mm. broad, edges pallid to avellaneous-fulvous, entire and rather thick when young, becoming thin and somewhat lacerate-dentate with age: spores elongate-ellipsoid, smooth, hyaline, $7 \times 3\ \mu$; hyphae pale-ferruginous, $3–4\ \mu$; cystidia none.

Type collected at Baguio, Luzon, 1750 m., on fallen dead logs of *Pinus insularis*, September, 1904, by R. S. Williams.

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE
(1907)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions their kindness will be appreciated.

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Barnes, C. R. & Land, W. J. G. Bryological papers. I. The origin of air chambers. Bot. Gaz. **44**: 197–213. *f. 1–22.* 18 S 1907.

Bartlett, H. H. Flower color of the American diervillas. Rhodora **9**: 147, 148. 31 Au 1907.

Bartlett, H. H. The retrograde color varieties of *Gratiola aurea*. Rhodora **9**: 122–124. 12 Au 1907.

Beauverd, G. Plantae Damazianae brazilienses. V. Bull. Herb. Boiss. II. **7**: 138–152. *f. 5.* 4 F 1907; VI. 701–708. *f. 6–8.* 31 Jl 1907.

New species described in *Piper*, *Peperomia* (4), *Stemodia*, *Utricularia*, *Barbacenia*, and *Hirtella*.

Berry, E. W. Contributions to the Pleistocene flora of North Carolina. Jour. Geol. **15**: 338–349. Je 1907.

New fossil species described in *Betula*, *Quercus* (2), *Malus*, *Crataegus* (2), *Dendrium*, and *Vaccinium*.

Berry, E. W. Palaeobotanical notes. Johns Hopkins Univ. Circ. 1907[7]: 79–91. *f. 1–6.* Jl 1907.

Includes descriptions of new fossil species in *Gleichenia*, *Osmunda*, *Williamsonia*, *Crataegus*, and *Zizyphus*.

Binford, R. The development of the sporangium of *Lygodium*. Bot. Gaz. **44**: 214–224. *f. 1–37.* 18 S 1907.

Britton, N. L. *Erythroxylaceae*. N. Am. Fl. **25**: 59–66. 24 Au 1907.

Burnham, S. H. Notes on the flora of San Mateo and Santa Clara counties, California. Muhlenbergia **3**: 73–78. 8 Au 1907.

Caldwell, O. W. *Microcycas calocoma.* Bot. Gaz. **44**: 118–141. *pl. 10–13* + *f. 1–14.* 16 Au 1907.

Chamberlain, E. B. List of plants. Bull. Josselyn Bot. Soc. **1**: 15–23. 20 Au 1907.

Plants collected or observed during meeting of the Josselyn Botanical Society, in the vicinity of Oxford, Maine, July 1–6, 1907.

Chamberlain, E. B. Meeting of the Josselyn Botanical Society. Rhodora **9**: 124. 12 Au 1907.

Chandler, K. Sierra wild flowers. Sunset Mag. **19**: 333–335. Au 1907. [Illust.]

Chodat, R. & Hassler, E. Plantae Hasslerianae soit énumération des plantes récoltées au Paraguay par le Dr. Émile Hassler, d'Aarau (Suisse) de 1885 à 1902. Bull. Herb. Boiss. II. **7**: 279–296. 31 Mr 1907; 597–624. 29 Je 1907; 665–682. 31 Jl 1907.

Christ, H. Appendice aux primitiae costaricenses filic. V in Bull. Herb. Boiss. 1907, mars, 2me sér. VII. Bull. Herb. Boiss. II. **7**: 585, 586. 29 Je 1907.

Christman, A. H. The alternation of generations and the morphology of the spore forms in the rusts. Bot. Gaz. **44**: 81–101. *pl. 7.* 16 Au 1907.

Christman, A. H. The nature and development of the primary uredospore. Trans. Wis. Acad. **15**: 517–526. *pl. 29.* My 1907.

Chrysler, M. A. The structure and relationships of the *Potamogetonaceae* and allied families. Bot. Gaz. **44**: 161–188. *pl. 14–18* + *f. 1–3.* 18 S 1907.

Clute, W. N. A checklist of the North American fernworts. Fern Bull. **15**: 19–24. [Ap] 1907; 45–49. [S] 1907.

Clute, W. N. Fall fruiting of the cinnamon fern. Fern Bull. **15**: 39, 40. [S] 1907.

Clute, W. N. The fern's struggle for existence in the tropics. Fern Bull. **15**: 34–38. [S] 1907.

Clute, W. N. Fossil ferns are rare. Fern Bull. **15**: 54, 55. [S] 1907.

Clute, W. N. Rare forms of ferns. — III. An aberrant *Pteris aquilina pseudocaudata.* Fern Bull. **15**: 43, 44. [S] 1907. [Illust.]

Cobb, N. A. Notes on some diseases of the pineapple. Hawaiian For. & Agric. **4**: 123–144. *f. 1–9.* My 1907.

Collins, J. F., *and others*. Report of the committee on bryophytes, 1907. Bull. Josselyn Bot. Soc. **1** : 13, 14. 20 Au 1907.

Damazio, L. Une Velloziacée remarquable du Brésil. Bull. Herb. Boiss II. **7** : 595, 596. 29 Je 1907. [Illust.]

Barbacenia Beauverdii Damazio sp. nov., native of Minas Geraës, Brazil.

Davidson, A. Flora of Clifton, Arizona. Bull. So. Calif. Acad. Sci. **6** : 34–36. 15 Jl 1907.

Dowell, P. The botanical symposium, at Newton, New Jersey. Torreya **7** : 164–168. 21 Au 1907.

Earl, G. T. Evergreen plants of Ohio. Ohio Nat. **7** : 188, 189. 1 Je 1907.

Eastwood, A. *Cypripedium fasciculatum* in Santa Cruz County, California. Muhlenbergia **3** : 97. 17 S 1907.

Eastwood, A. *Peltiphyllum peltatum.* Muhlenbergia **3** : 78. 8 Au 1907.

Eastwood, A. *Raillardella Muirii* Gray. Muhlenbergia **3** : 78. 8 Au 1907.

Eastwood, A. *Trautvetteria grandis* Nutt. Muhlenbergia **3** : 78. 8 Au 1907.

Elliott, S. B. Pacific coast red cedar (*Thuya gigantea*). Forest Leaves **11** : 56. Au 1907. [Illust.]

Ely, N. Succulent plants of Ohio. Ohio Nat. **7** : 186, 187. 1 Je 1907.

Fernald, M. L. The genus *Suaeda* in northeastern America. Rhodora **9** : 140–146. 31 Au 1907.

Includes *S. Richii* sp. nov., native of Maine.

Fink, B. A round trip between Iowa and Puget Sound. II. In Puget Sound. Plant World **10** : 173–180. *f. 34.* Au 1907.

Fitzherbert, S. W. *Argemone grandiflora.* Gard. Chron. III. **42** : 113. *f. 44.* 10 Au 1907.

Native of Mexico.

Geheeb, A. Une petite contribution à la flore bryologique du Mexique. Rev. Bryol. **34** : 74, 75. [Jl] 1907.

Includes description of a new species of *Bryum.*

Geheeb, A. Les *Splachnum luteum* Montin et *rubrum* Montin, ont-ils été jamais observés en Mexique? Rev. Bryol. **34** : 71–73. [Jl] 1907.

Gies, W. J. On the effects of magnesium sulphate on the growth of seedlings. Science II. **26** : 214–216. 16 Au 1907.

Gilg, E. Über die Verwandtschaftsverhältnisse und die Verbreitung der amerikanischen Arten der Gattung *Draba*. Bot. Jahrb. Beibl. **90**: 35–44. 21 My 1907.

Hall, J. G. Three little known species of North Carolina fungi. Jour. Elisha Mitchell Soc. **23**: 85–88. Je 1907.

Hanks, L. T. & Small, J. K. *Geraniaceae*. N. Am. Fl. **25**: 3–24. 24 Au 1907.

Hans, A. Variable sporelings of *Lomaria Spicant*. Fern Bull. **15**: 33, 34. *pl.* [S] 1907.

Hard, M. E. The genus *Tricholoma* and some of the Ohio species. Myc. Bull. **5**: 289–293. *f. 221–223*. Ja 1907.

Hard, M. E. *Volvaria bombycina*. Myc. Bull. **5**: 293, 294. *f. 224*. Ja 1907.

Harper, R. M. A midsummer journey through the coastal plain of the Carolinas and Virginia. Bull. Torrey Club **34**: 351–377. 12 S 1907.

Harshberger, J. W. Teratological notes. Plant World **10**: 186–189. *f. 35–37*. Au 1907.

Hassler, E. Plantae paraguarienses novæ vel minus cognitæ V. Bull. Herb. Boiss. II. **7**: 718–740. 31 Au 1907. [Illust.]

Includes new species in *Paradolichandra* gen. nov., *Simaba*, and *Waltheria*.

Heald, F. D. *Gymnosporangium macropus*. Science II. **26**: 219, 220. 16 Au 1907.

Heller, A. A. The flora of Santa Clara County, California. III. Muhlenbergia **3**: 69–71. 8 Je 1907; IV. 79–82. 8 Au 1907; V. 98–102. 17 S 1907.

Hemsley, W. B. On the *Julianiaceae*: a new natural order of plants. Phil. Trans. B. **199**: 169–197. *f. 1–23* + *pl. 18–24* + *map*. 29 My 1907.

Includes the genus *Juliania* with four species, natives of Mexico, and *Orthopterygium* with one species, a native of Peru.

Hermessen, J. L. Mexican orchids. Orch. Rev. **15**: 219–221. Jl 1907.

Hough, R. B. Handbook of the trees of the northern states and Canada east of the Rocky Mountains. i–x. 1–470. *f. 1–498* + *maps*. Lowville, N. Y., 1907.

Hoyt, W. D. Periodicity in the production of the sexual cells of *Dictyota dichotoma*. Johns Hopkins Univ. Circ. **1907**[3]: 25–28. *pl. 7, 8*. Mr 1907.

Hyde, E. A little corticicolous fungus. Myc. Bull. **5**: 329, 330. *f. 250.* Je 1907.

Ihering, H. von. Die Cecropien und ihre Schutzameisen. Bot. Jahrb. **39**: 666–670. *f.* 15 Ja 1907; 671–714. *pl. 6–10.* 19 F 1907.

Jennings, O. E. A note on the poisonous qualities of the yellow ladies' slipper. Plant World **10**: 189–191. Au 1907.

Johnson, D. S. A botanical expedition to Jamaica. Johns Hopkins Univ. Circ. **1907**[3]: 21–25. Mr 1907.

Johnson, D. S. A new type of embryo-sac in *Peperomia.* Johns Hopkins Univ. Circ. **1907**[3]: 19–21. *pl. 5, 6.* Mr 1907.

Kauffman, C. H. The genus *Cortinarius* with key to the species. Myc. Bull. **5**: 311–318. *f. 237–244.* Ap 1907; 319–323. My 1907.

Kildahl, N. J. Development of the walls in the proembryo of *Pinus Laricio.* Bot. Gaz. **44**: 102–107. *pl. 8, 9.* 16 Au 1907.

Knox, A. A. The stem of *Ibervillea Sonorae.* Bull. Torrey Club **34**: 329–344. *pl. 24* + *f. A, B.* 12 S 1907.

Léveillé, H. Revision du genre *Epilobium* d'après les Herbiers Boissier et Barbey-Boissier. Bull. Herb. Boiss. II. **7**: 587–590. 29 Je 1907.

Includes *E. Helodes* Lévl. sp. nov., native of Colombia.

Lewis, F. T. The development of pinnate leaves. Am. Nat. **41**: 431–441. *f. 1–4.* 17 Jl 1907.

Lewis, I. F. Notes on the morphology of *Coleochaete Nitellarum.* Johns Hopkins Univ. Circ. **1907**[3]: 29, 30. Mr 1907.

Lindman, C. A. M. A Linnaean herbarium in the Natural History Museum in Stockholm. Ark. Bot. **7**[3]: 1–57. 10 My 1907.

The herbarium contains many American plants.

Lingelsheim, A. Vorarbeiten zu einer Monographie der Gattung *Fraxinus.* Bot. Jahrb. **40**: 185–223. *f.* + *pl. 8.* 2 Au 1907.

Includes descriptions of four new American species.

Lloyd, C. G. Quotations and illustrations from Mycological Notes, relating to the species of *Tylostoma.* Myc. Bull. **5**: 295–302. *f. 221* [bis]–*230.* F 1907; 303–308. *f. 231–236.* Mr 1907.

Long, W. H. The *Phalloideae* of Texas. Myc. Bull. **5**: 335–342. *f. 253–256.* Jl 1907.

Lunell, J. *Sagittaria arifolia* Nutt. in North Dakota. Bull. Leeds Herb. [1–4.] 3 S 1907.

McCleery, E. M. Ohio plants with punctate glands and glandular scales and pubescence. Ohio Nat. **7**: 178–183. *pl. 13.* 1 Je 1907.

Macloskie, G. The *Compositae* of peraustral America. Plant World **10**: 151–156. Jl 1907; 181–186. Au 1907.

Mallett, G. B. American irises. Gard. Chron. III. **41**: 417. 29 Je 1907; **42**: 6. 6 Jl 1907.

Mallett, G. B. *Cypripedium californicum.* Gard. Chron. III. **41**: 418. *f. 171.* 29 Je 1907.

Maynard, W. E. Wild plants used as food. Gard. Chron. Am. **4**: 179, 180. F 1907; **5**: 16. Mr 1907. [Illust.]

Maza, M. G. de la. Determinacion de plantas cubanas (fanerogamas) III. Revista Facult. Let. y Ci. Univ. Habana **4**: 324–352. My 1907.

Merrill, E. D. Index to Philippine botanical literature. Philipp. Jour. Sci. **2**: Bot. 241–250. Je 1907; 345–349. 15 Jl 1907.

Contains many original observations upon Philippine botany.

Merrill, G. P. Catalogue of the types and illustrated specimens of fossil plants in the department of Geology, United States National Museum. Bull. U. S. Nat. Mus. **53**^{2}: 83–349. 1907.

Olsson-Seffer, P. Visits to some botanic gardens abroad. Plant World **10**: 117, 118. My 1907; 130–137. *f. 25–28.* Je 1907; 161–167. *f. 30–32.* Jl 1907; 169–172. *f. 33.* Au 1907.

Parish, S. B. Concerning nomenclature. Fern Bull. **15**: 38, 39. [S] 1907.

Peck, C. H. New species of fungi. Bull. Torrey Club **34**: 345–349. 12 S 1907.

New species described in *Collybia*, *Omphalia* (2), *Lactarius* (2), *Entoloma*, *Eccilia*, *Agaricus*, *Psathyrella*, *Hydnum*, *Macrophoma*, and *Cucurbitaria*, natives of the United States or Canada.

Penhallow, D. P. Contributions to the Pleistocene flora of Canada. Am. Nat. **41**: 443–452. *f. 1, 2.* 17 Jl 1907.

Includes new species in *Acer* and *Gleditschia.*

Perkins, J. The *Leguminosae* of Porto Rico. Contr. U. S. Nat. Herb. **10**: i–ix. 133–220. 10 Je 1907.

Enumerates 67 genera and 141 species, none described as new

Phillips, F. J. Effect of a late spring frost in the southwest. Forestry & Irrig. **13**: 485–492. S 1907. [Illust.]

Pratt, M. B. California red fir in the Tahoe forest reserve. Forestry Quart. **5**: 159–165. Je 1907.

Ransier, H. E. Packing fresh fronds. Fern Bull. **15**: 52, 53. [S] 1907.

Reed, M. The economic seaweeds of Hawaii and their food value. Ann. Rep. Hawaii Agric. Exp. Sta. **1906**: 61–88. *pl. 4–7.* 9 S 1907.

Rehder, A. Some new or little known forms of New England trees. Rhodora **9**: 109–117. 12 Au 1907.

Reiche, K. Bau und Leben der hemiparasitischen *Phrygilanthus*-Arten Chiles. Flora **97**: 375–400. *pl. 13, 14.* 22 Jl 1907.

Reynolds, E. S. The flora of the great swamp of Rhode Island. Rhodora **9**: 117–122. 12 Au 1907.

Robinson, B. L. *Maclura pomifera* (Raf.) Schneider. Rhodora **9**: 148. 31 Au 1907.

Rolfe, R. A. *Epidendrum belizense.* Orch. Rev. **15**: 253. Au 1907.

Native of Central America.

Rolfe, R. A. *Epidendrum trachychilum.* Orch. Rev. **15**: 232. Au 1907.

Native of Mexico.

Rolfe, R. A. *Lacaena bicolor.* Orch. Rev. **15**: 232. Au 1907.

Native of Central America.

Rolfe, R. A. *Laelio-cattleya* × *Wavrinii.* Orch. Rev. **15**: 249, 250. *f. 29.* Au 1907.

Native of Minaes Geraës, Brazil.

Rusby, H. H. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 4. Bull. N. Y. Bot. Gar. **4**: 309–470. 5 S 1907.

Includes descriptions of 222 new species in 153 genera; the genera *Tournefortiopsis* and *Poederiopsis* (*Rubiaceae*), and *Vassobia* (*Solanaceae*) described as new.

Rydberg, P. A. The genus *Pilosella* in North America. Torreya **7**: 157–162. 21 Au 1907.

Includes descriptions of three new species.

Sargent, C. S. The genus *Crataegus* in North America. Jour. Bot. **45**: 289–292. 1 Au 1907.

Sargent, C. S. Names of North American trees. Bot. Gaz. **44**: 225–227. 18 S 1907.

Schenck, M. Über die sog. Hüllspelzen von *Hordeum* und *Elymus.* Bot. Jahrb. **40**: 97–112. *f. 1–5.* 21 My 1907; 113. 2 Au 1907.

Schwarz, G. F. The sprout forests of the Housatonic valley of Connecticut. Forestry Quart. **5**: 121–153. Je 1907. [Illust.]

Scott, W. M. & Rorer, J. B. The relation of twig cankers to the *Phyllosticta* apple blotch. 1–6. 8 Au 1907.

Reprinted from Proc. Benton Co. (Ark.) Hort. Soc.

Sheldon, E. P. Millions in trees; the forest wealth of the Pacific northwest. Sunset Mag. **19**: 388–392. Au 1907. [Illust.]

Sheldon, J. L. Concerning the relationship of *Phyllosticta solitaria* to the fruit blotch of apples. Science II. **26**: 183–185. 9 Au 1907.

Shreve, F. Studies on rate of growth in the mountain forests of Jamaica. Johns Hopkins Univ. Circ. **1907**[3]: 31–37. Mr 1907.

Small, J. K. *Geraniales.* N. Am. Fl. **25**: 1, 2. 24 Au 1907.

Small, J. K. *Linaceae.* N. Am. Fl. **25**: 67–87. 24 Au 1907.

Small, J. K. *Oxalidaceae.* N. Am. Fl. **25**: 25–58. 24 Au 1907.

Smith, G. D. *Sclerotinia tuberosa*; tuberous peziza. Myc. Bull. **5**: 327–329. *f. 249.* Je 1907.

Smith, J. D. Undescribed plants from Guatemala and other Central American republics. XIX. Bot. Gaz. **44**: 108–117. 16 Au 1907.

Includes descriptions of new species in *Nissolia*, *Machaerium* (2), *Drepanocarpus*, *Lonchocarpus*, *Derris* (3), *Inga*, *Faramea* (2), *Themistoclesia*, *Centropogon* (2), *Ardisia*, *Rauwolfia*, and *Gonolobus*.

Sodiro, A. Plantae ecuadorenses. V. Bot. Jahrb. Beibl. **91**: 39–51. 2 Au 1907.

Includes new species in *Bomarea* (2), *Guatteria*, *Weinmannia*, *Eugenia* (2), *Hydrocotyle*, *Bowlesia*, and *Prionosciadium*.

Stephani, F. Species *hepaticarum*. Bull. Herb. Boiss II. **7**: 297–312. 31 Mr 1907; 477–492. 31 My 1907; 683–698. 31 Jl 1907.

Includes new American species in *Lophocolea* (4), and *Chiloscyphus*.

Sudworth, G. B. A new tree juniper for New Mexico (*Juniperus megalocarpa*). Forestry & Irrig. **13**: 307–310. *f. 1, 2.* Je 1907.

Sumstine, D. R. Moulds. Myc. Bull. **5**: 324–326. *f. 246–248.* My 1907.

Terry, E. H. Additional Dorset ferns. Fern Bull. **15**: 49. [S] 1907.

Terry, W. A. A partial list of Connecticut diatoms with some account of their distribution in certain parts of the state. Rhodora **9**: 125–140. 31 Au 1907.

Trotter, S. The Balsam Peaks — the heart of the southern Appalachians. Pop. Sci. Mo. **71**: 149–155. Au 1907.

Many notes on the vegetation of the region.

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Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

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CONTENTS

Phycological studies — III. Further notes on Halimeda and Avrainvillea. (Plates 25–30). . . . . MARSHALL AVERY HOWE 491

The genus Androsace in New Mexico. ELMER OTTIS WOOTON and PAUL STANDLEY 517

INDEX TO AMERICAN BOTANICAL LITERATURE. 521

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OCTOBER, 1907

Phycological studies — III. Further notes on Halimeda and Avrainvillea

Marshall Avery Howe

(with plates 25–30)

A. On the sporangia of Halimeda tridens and of Halimeda Tuna

The sporangia of the genus *Halimeda* were for many years known only in the single species *Halimeda Tuna*,* though in 1876 Zanardini † briefly described those of *H. macroloba* and in 1880 Schmitz ‡ contrasted the characters of the sporangiophores of *Halimeda Tuna* with those of *H. platydisca*. But the true *Halimeda platydisca* Decaisne, according to the original preserved in the Muséum d'Histoire Naturelle of Paris, appears to be simply a large form of *H. Tuna*, § and whether Schmitz was really dealing with two distinct species or with two forms of *H. Tuna* is not altogether clear. In 1904, Mrs. Gepp || described and illustrated in detail the sporangia and sporangiophores of *Halimeda gracilis*

* Derbès & Solier, Suppl. Compt. Rend. **1**: 46, 47. *pl. 11. f. 18–22. pl. 12. f. 1–5.* 1856.

Bompard, Hedwigia **6**: 129. 1867.

Zanardini, Mem. R. Ist. Ven. **19**: 541–543. *pl. 30.* 1876.

† Zanardini, *l. c.* 543.

‡ Sitzungsber. d. niederrheinischer Ges. f. Natur- und Heilkunde 1880: 140–146. 1880.

§ Barton, E. S. The genus *Halimeda*. Siboga-Expeditie, Monographe **60**: 14. 1901. The present writer, after examining the same type, concurs with the monographer of "The genus Halimeda" in the opinion that *H. platydisca* does not offer any satisfactory characters in form or structure to distinguish it from *H. Tuna*.

|| Gepp, E. S. The sporangia of *Halimeda*. Jour. Bot. **42**: 193–197. *pl. 461.* 1904.

[The Bulletin for September, 1907 (34: 445–490) was issued 19 O 1907.]

and *H. Tuna*, using for her studies of the latter, through the courtesy of M. Ed. Bornet, "a portion of the identical specimen" described by Derbès & Solier. Mrs. Gepp in this paper brought out some especially interesting facts in regard to the relation of the sporangiophores to the filaments of the central strand.

In 1905, in distinguishing the newly recognized species *Halimeda scabra*, an ally of *H. Tuna* from Florida and the Bahamas, the present writer * described and figured its sporangia and alluded to a fertile specimen of *H. Tuna* collected in Bermuda. In view of the rarity of the occurrence of fertile specimens in this genus, it may be remarked that the Bermuda specimen was found in the month of June and the Florida specimen of *H. scabra* on March 30.

In each of these cases only a single plant out of the many observed was fertile. But on March 3, 1906, near the mouth of the main harbor of Culebra Island, Porto Rico, the writer found, growing near the low-water mark, an abundance of *Halimeda Tuna* laden with sporangia. The photograph published herewith (PL. 27, FIGS. 2–4) gives an idea of the appearance of these fertile specimens and of the position of the sporangia upon them. The sporangia occur chiefly in crowded clusters on the margins of the segments, but they are also often scattered over the discs or flattened faces of the segments, which they occasionally cover almost completely. Derbès & Solier and Mrs. Gepp describe and figure the sporangia of *Halimeda Tuna* as occurring only on the margins of the segments, but Zanardini both describes and illustrates them as occurring also on the discs. The sporangiophores are 1–2 mm. long and both in these Porto Rican and in the Bermudian specimens they are apparently rather more simple (PL. 25, FIGS. 7–9; PL. 28, FIGS. 1 and 2) than those of the European *H. Tuna;* at least, we have never observed the forking which Mrs. Gepp has described and figured (*l. c., f. 6*) as occurring immediately after the fusion of their basal filaments. All the sporangiophores that we have seen are either simple or once dichotomous near the top — somewhat resembling Derbès & Solier's *figure 2*. Those springing from the margins of the segments (PL. 25, FIGS. 8, 9, 10) are formed by the fusion of two or three filaments of the central strand, but those springing from the discs or flattened faces come directly

* Bull. Torrey Club 32: 241–244. *pl. 11, 12.* 1905.

from the medullary filaments, in most cases, at least, without any fusion, and often apparently lateral in origin (PL. 28, FIGS. 1 and 2). This latter condition is at variance with Mrs. Gepp's conclusion (*l. c.*, p. 196) that in both the vegetative and reproductive parts of *Halimeda* "all fresh growth is preceded by a fusion of filaments of the central strand," but in the specimen examined by Mrs. Gepp the sporangiophores apparently arose only from the segment-margin, in which case in the American plants also fusion is the rule and perhaps universal. The sporangia of these Porto Rican specimens vary from pyriform-obovoid to subglobose and are 0.20–0.33 mm. broad; in arrangement they are somewhat botryoid or irregularly distichous. The plants were kept for a time in a jar of sea-water with the hope that the living zoospores might be seen, but the experiment was unsuccessful, probably on account of lack of continuous observation.

On March 22, 1906, the writer was so fortunate as to find near Tallaboa on the southern shore of Porto Rico, growing in about one meter of water (low tide), two fertile specimens of *Halimeda tridens*,* a species which seems to have been known previously only in a sterile condition, though it was originally described as long ago as 1786 and has since been often collected. A photographic representation of one of these plants is given on PLATE 27, FIG. 1. In comparing it with the fertile specimens of *H. Tuna*, one is impressed at first by the very different color of the sporangia, which are uniformly yellowish-brown or of a burnt-umber shade, while those of *H. Tuna* are uniformly of a bright, dark, intense green. The sporangiophores are the most densely clustered along the upper margins of the segments, especially at the apices of the lobes when lobes are present, but they may emerge from any part of the segment and sometimes completely cover its surface. The second plant, the one not shown in the photograph, is the more densely laden with sporangia, and some of its branches are so thoroughly covered as to obscure their segmentation. The sporangiophores are a little longer than those of *H. Tuna*, ranging from 1.3 to 2.3 mm. in length, and they are much more branched, being 1–5 times dichotomous. We have not seen one wholly simple. The sporangiophores that spring

* For remarks on the name of this species, see page 501.

from the margins of the segments (PL. 28, FIG. 3) are mutually coherent near the point of emergence and communicate with each other there by pits or pores like the vegetative filaments of the central strand at the nodes, but the sporangiophores from the disc-surfaces originate as direct continuations of the peripheral utricles or of the utricles of the subcortical layer and are without fusions or adhesions of any kind (PL. 28, FIGS. 4–7). The sporangia are obovoid or pyriform and are 0.20–0.38 mm. broad. The callose or mucous plugs which we have described * as forming basal septa of a certain sort for the sporangia of *Halimeda scabra* we have not observed in *Halimeda tridens;* such are, however, of occasional and irregular occurrence in the Porto Rican material of *Halimeda Tuna.*

B. ON THE AMERICAN SPECIES OF THE HALIMEDA TUNA GROUP

At the time of describing the strongly marked species *Halimeda scabra*,† attention was directed to another species which likewise had commonly been confused with *Halimeda Tuna*. Of this "smooth plant of the *Tuna-cuneata* alliance," we remarked, "It seems rather violent to identify it either with *Halimeda Tuna* or with *H. cuneata*, and it is possible that further acquaintance with it will show constant and reliable characters for distinguishing it from both." At that time nearly all of our American material of the *Tuna* group belonged to this "species inquirenda" and to *H. scabra* and the only specimens we had seen from the American side of the Atlantic which we could refer to *H. Tuna* were from Bermuda. But since then we have collected what we believe to be the true *H. Tuna* both in Porto Rico and in Jamaica and have seen a specimen of it purporting to come from Key West, Florida, so it now seems probable that both it and its ally are of general distribution in the West Indian region. And the two "forms," so far as we have seen them, are always absolutely and abundantly distinct and in our opinion are as much entitled to be considered specifically different from each other as are *Halimeda Tuna* and *H. Opuntia* or *Halimeda Tuna* and *H. scabra.* It soon became evident that this ally of *H. Tuna* had already been recognized as

* Bull. Torrey Club 32: 243. 1905.

† M. A. Howe, Bull. Torrey Club 32: 241–244. *pl. 11, 12.* 1905.

a species, and it appears that the earliest available name for it that conforms with prevailing rules of nomenclature is *Halimeda discoidea* Decaisne,* under which name the species is described below:

HALIMEDA DISCOIDEA Decaisne, Ann. Sci. Nat. II. **18**: 102. 1842.

? *Halimeda papyracea* Zanard.† Flora **34**: 37. 1851; Mem. R. Ist. Ven. **7**: 288. *pl. 13. f. 2.* 1858.

Of a light bright-green color and lubricous when living, becoming yellowish- or albescent-green and more or less pergameneous or papyraceous and smooth to the touch on drying, suberect or decumbent, 5–15 cm. in height or length, subsessile, very lightly calcified, the calcification usually confined to the narrow area lying between the coherent ends of the peripheral utricles and the distal ends of the subcortical utricles, in the oldest parts sometimes involving the distal half of the subcortex; the branching in one plane, mostly frequent or somewhat congested, usually di- or trichotomous, the larger subbasal segments sometimes originating five or six branches: segments discoid, enervate, deltoid-obovate, semiorbicular, reniform, or subelliptical (with longer axis transverse), 6–35 mm. broad, mostly 0.3–1.2 mm. thick, those near base scarcely different, but sometimes attaining thickness of 1.75 mm., margins entire, the surfaces commonly nitent when dry or in younger parts dull and very minutely spongiose: peripheral utricles mostly hexagonal in surface view, 40–85 μ in diameter, often fusing in twos, threes, or rarely fours, and therefore appearing

* The name *Corallina discoidea* Esper (Pflanzenthiere, Fortsetz. 2, *Corallina, pl. 11.* 1798–1806) appears to have fallen short of effective publication according to both the Vienna and the Philadelphia codes of nomenclature, so may be ignored in determining the correct name of the present species, whether Esper had this species before him or not. The name first appeared on a plate, illustrating a large *Halimeda* of the *Tuna* group, without analysis of parts and without descriptive or explanatory text. In a continuation of Esper's work by F. L. Hammer, many years later (3: 356. 1830), the name (changed to "discoïdes") is found in the synonymy of *Halimeda Tuna*, with a reference to the plate. Esper's plant cannot be satisfactorily determined without examining the original, which, it would seem, is not now to be found in his collections preserved at Erlangen. Lamouroux is sometimes quoted as having a *Halimeda discoidea* but it would appear that he never actually published such a binomial. In 1812, in establishing the genus *Halimeda*, Lamouroux mentions among the examples *Corallina* "*discoidea* Esper," but we do not find that he ever actually printed or adopted the name *Halimeda discoidea*. In the same paper he mentions "*Corallina flabellum* Ell." as an example of his new genus *Udotea*, but when four years later he came really to enter the species into *Udotea* it became *Udotea flabellata* instead of *Udotea Flabellum*.

† See footnote on following page.

larger and of irregular outline, mostly subquadrate, subquadrate-oblong or cyathiform in lateral view, less commonly cornucopiaeform, 65–150 μ long (including the usually slender stalk), truncate at apex, in firm contact above with those adjacent for $\frac{1}{5}$–$\frac{2}{3}$ their length, often interlocked, separable with much difficulty on decalcification: utricles of the subcortical layer in a single series, bullate, varying from broadly funnelform to subglobose or ellipsoidal, mostly ventricose-obovoid, 110–215 μ in maximum width, always much larger than the peripheral utricles, 4–14 of which commonly arise from the subtruncate apex of each: filaments of the central strand fusing in twos or rarely in threes at the nodes, not coherent, the fusion often incomplete: sporangia unknown. [PLATE 25, FIGURES 11–20; PLATE 26.]

TYPE LOCALITY: Unknown ("Kamtschatka, Voyage de la Vénus," according to presumably erroneous label); type specimen in the herbarium of the Muséum d'Histoire Naturelle in Paris.

DISTRIBUTION: Southern Florida and the West Indies; Hawaii; Celebes; Red Sea; probably of general distribution in the tropical seas.

In giving the distribution of the species as above, we are guided only by specimens now in the herbarium of the New York Botanical Garden. Both *Halimeda discoidea* and *H. Tuna* occur in Oahu, Hawaiian Islands. We have specimens of *Halimeda Tuna* also from the Philippines, Singapore, and from some of the East Indian islands visited by the Siboga Expedition, and it seems probable that both *H. Tuna* and *H. discoidea* have a wide distribution in the tropical parts of the Indian and Pacific oceans, as well as of the Atlantic. Askenasy's *figure 11* (Forschungsreise S.M.S. Gazelle 4: *pl. 4*) was very certainly drawn from a specimen of *H. discoidea*, apparently from Dirk Hartog Island, Western Australia, though it was identified by Askenasy with the quite different *H. macroloba* Decaisne. The specimen of *H. discoidea* from the Red Sea, which we have cited above, was collected by Boissier in 1855 (*no. 5*) and was distributed as *H. macroloba.* This specimen resembles very closely Zanardini's figure of his *Halimeda papyracea*, the type * of which also came from the Red Sea. The specimen from the Celebes which we have cited was

* We have been unable to locate the type specimen of Zanardini's *Halimeda papyracea*, which does not appear to exist in his herbarium now preserved in Venice. Mrs. Gepp, in her monograph of the genus *Halimeda* (p. 15), mentions that she had been allowed to see this type specimen "through the kindness of Dr. Beccari." Dr.

distributed as *Halimeda Lessonii* Bory, but we have no conclusive proof that it is an authentic representative of what Bory intended to have bear this name. Moreover, this alleged name of Bory's, so far as the literature of the subject is concerned, appears to be merely a "nomen nudum" without even an indication of the source of the specimen beyond what one may infer from the name itself, and it therefore deserves no recognition in synonymy.

Halimeda discoidea has of late been confused chiefly with *H. Tuna* forma *platydisca* (Decaisne) Barton. The original specimen of *H. platydisca* Decaisne (in herb. Mus. Paris.), as already determined by Mrs. Gepp, seems to be simply a very large condition of *Halimeda Tuna.* Its peripheral utricles show occasional fusion, but they have the form and light contact of *H. Tuna* and the utricles of the subcortical layer also are those of *H. Tuna* and the plants have the heavier calcification of that species. The segments of *Halimeda discoidea* are usually but not always larger and more inclined to be obovate than those of *H. Tuna* and by these characters, together with the lighter calcification of *H. discoidea*, the two species can usually be distinguished at sight, but reliable diagnostic characters can always be found in the amount of contact of the peripheral utricles and in the form and size of the utricles of the subcortical layer. The more important histological characters of the two species are contrasted below:

	Halimeda Tuna	*H. discoidea*
Calcification.	Moderate. Involving subcortical layer, often also the medulla and the bases of the peripheral utricles but rarely extending to the surface.	Slight. Usually confined to the distal ends of the utricles of the subcortical layer.
Peripheral utricles.	Rounded-truncate, 30–70μ in diameter, very rarely fused, in contact above with those adjacent for $\frac{1}{20}$–$\frac{1}{8}$ their length, not interlocked, rather easily separable on decalcification.	Truncate, 40–85μ in diameter, often fused, in contact above with those adjacent for $\frac{1}{5}$–$\frac{2}{3}$ their length, interlocked, separable with much difficulty on decalcification.

O. Beccari, of Florence, in response to our request to see this type, has sent us a fragment of a plant collected by himself at Singapore, with the explanation that it is a portion of the specimen examined by Mrs. Gepp. This Singapore plant, which had been labeled *Halimeda papyracea* Zan., is evidently a form of *H. Tuna*, as already determined by Mrs. Gepp.

Utricles of subcortical layer.	Subturbinate, obconical, cornucopiaeform, or clavate, 35–110 μ in maximum width, often scarcely larger than the peripheral utricles.	Bullate, varying from broadly funnelform to subglobose, mostly ventricose-obovoid, 110–215 μ in maximum width, always much larger than the peripheral utricles.
Nodal filaments of the central strand.	Fusing in twos or threes, often somewhat coherent just above the points of fusion.	Fusing in twos, rarely in threes, not coherent, the fusion often incomplete.

In addition to the differences mentioned above, the utricles of the subcortical layer form a more compact flat-topped stratum in *H. discoidea* than in *H. Tuna*, as will be seen by comparing FIGURE 11 with FIGURE 1. It should be mentioned that in drying the large utricles of the subcortex of *H. discoidea* commonly collapse and are flattened against the medulla and often revive imperfectly on being soaked out; this is especially true of specimens which have been long in herbaria and it doubtless explains why this striking peculiarity has not received earlier recognition.

In the firm and extensive contact of the peripheral utricles, *Halimeda discoidea* bears some resemblance to *Halimeda cuneata* Hering, originally described from Natal Bay, but otherwise the two have little in common. We have not seen Hering's original specimen, but have examined a plant from Natal agreeing in every respect with his description. In this, the peripheral utricles measure 27–44 μ in diameter, surface view, and show no evidence of fusion; they are 60–110 μ long, are in close contact distally for $\frac{1}{4}$–$\frac{2}{5}$ their length, are obconical or clavate, surmounted in a somewhat capitate fashion by the coherent distal parts, which appear subquadrate in a radio-vertical section. The utricles of the subcortical layer are only 27–55 μ in maximum diameter, scarcely larger than those of the peripheral stratum, are 2–4 times dichotomous (*i. e.*, in 2–4 series), and obconical, ovoid-turbinate, or clavate. The nodal filaments of the central strand fuse in twos and threes and are strongly coherent just above the points of fusion, as well described by Mrs. Gepp (*l. c.* 15–17). Branches given off from the filaments near the points of fusion form a compact narrow annular cushion above which the filaments are naked and subtorulose. This annular nodal cushion we have observed in no other species. The segments of *H. cuneata* are cuneate-obdeltoid and are almost without exception longer than broad. The very different utricles of the subcortical layer, with other characters, well distinguish *H. cuneata* from *H. discoidea* and we think it clearly entitled to specific rank. In any event, if one's conception of specific limitations should prove sufficiently elastic to include the two under one specific name, Decaisne's *Halimeda discoidea* has the right of way on priority grounds.

The older writers on the species of *Halimeda* gave very little attention to histological characters. Kützing,* indeed, remarked upon the uniformity of their structure and considered it unnecessary to give detailed figures illustrating the anatomy of each species. Professor Askenasy † in 1888 made an important advance in describing and figuring the details of structure and in emphasizing their value in distinguishing species, but he apparently did not examine authentic material of certain species described by his predecessors, and thus quite naturally made a wrong application of some of the specific names. Mrs. Gepp (Miss Ethel Sarel Barton) in preparing her monograph of "The Genus Halimeda" (*l. c.*) recognized fully the importance of seeing original materials and rendered an important service by investigating carefully the characters of the nodal filaments of the central strand and insisting on the value of these characters in diagnosing species, but she did not emphasize sufficiently the characters of the peripheral utricles and the utricles of the subcortical layer, parts which, in most species, at least, offer peculiarities of as much constancy and value as do the nodal filaments. That the nodal filaments are not altogether invariable is seen in *Halimeda discoidea*, where fusions of the *H. Tuna* type and of the *H. Opuntia* type sometimes occur side by side in a single node (FIGURES 19 and 20) and also in *H. Monile*, in which rarely the filaments are only superficially coherent. The peripheral utricles and those of the subcortical layer also have, of course, a certain range of variation in each species; nevertheless that range is limited and these elements possess characters of taxonomic value of which any final and complete system of classification must take cognizance.

The specimens from Bermuda, Porto Rico, and Jamaica, which

*Tab. Phyc. 7: 9. 1857.

† Forschungsreise S.M.S. Gazelle 4: 11–14. *pl. 3, 4.*

we have identified with the Mediterranean *Halimeda Tuna* present some slight peculiarities which, however, we believe are not sufficiently constant and reliable to warrant a specific separation. In the first place, the American plants are more rigid and rather more calcified than the European specimens that we have seen. When growing, they are commonly suberect and cespitose, while according to Oltmanns * the flat Halimedas of the Mediterranean (" *Tuna, platydisca* ") have a more or less horizontal or pendulous position. The diameter of the peripheral cells averages about 6–12 μ less than in the European specimens examined, though no smaller than in certain Adriatic representatives of *H. Tuna*. The filaments of the central strand, as shown in our FIGURES 5 and 6, are often inclined to cohere strongly at the node just above the points of fusion, while those of *H. Tuna* are usually easily separable under treatment, as described by Mrs. Gepp †; however, we have seen a specimen from the Adriatic (leg. Titius) in which the tendency of these filaments to cohere at the nodes is as pronounced as in the plants of Bermuda and Porto Rico, and Mrs. Gepp mentions (*l. c.*) a similar condition in a specimen brought from Rangiroa by Professor Agassiz. The sporangiophores in the American specimens appear to be rather more simple than those of the European *H. Tuna*, as we have noted above.

The American species of the *Halimeda Tuna* group, thus far recognized, may be distinguished by the use of the following key ‡:

Peripheral utricles truncate or rounded-obtuse.

Peripheral utricles in contact for ⅛ their length or less; utricles of the subcortical layer subturbinate, obconical, or clavate, 35–110 μ in maximum diameter. *H. Tuna.*

Peripheral utricles in contact for ⅕–⅗ their length; utricles of the subcortical layer bullate, mostly ventricose-obovoid, 110–215 μ in maximum diameter. *H. discoidea.*

Peripheral utricles galeate-cuspidate. *H. scabra.*

* Morph. and Biol. Alg. 1: 295. *f. 182;* 296. 1904.

† Siboga-Expeditie. Monographe 60: 16. 1901.

‡ Excluding *Halimeda gracilis* Harv., which agrees essentially with the members of the *Halimeda Tuna* alliance in the character of the nodal filaments, but differs considerably in the form of the segments. The type of *H. gracilis* was from Ceylon, but a specimen dredged by the Challenger Expedition at St. Thomas, West Indies, in 5 to 15 fathoms of water, appears to agree with it in most respects, though the peripheral utricles are larger and more coherent and the utricles of the subcortical layer are very long (mostly 300 to 700 μ).

C. ON THE AMERICAN SPECIES OF THE HALIMEDA TRIDENS GROUP

Even before writing "Phycological studies — II," * in which we described *Halimeda favulosa* as a new species and followed Mrs. Gepp (Ethel S. Barton) and also Harvey in considering *Halimeda Monile* (Ell. & Soland.) Lamour. a mere variety or form, we had seen both *Halimeda tridens* † (*H. incrassata*) and *H. Monile* growing in close proximity to each other in Bermuda, in Porto Rico, and in the Bahamas, and remaining apparently distinct. But the segments in both of these were subject to so much variation in outward form, even in different parts of a single individual, that plants from other localities would sometimes appear to occupy an intermediate position, and great as were the manifest differences between the best representatives of these two types it seemed difficult to draw any satisfactory line between them. When, however, in December, 1906, and January, 1907, we again saw, in several localities in Jamaica, *Halimeda tridens* and *H. Monile* growing either side by side or within a few feet of each other and always maintaining their distinctive characters perfectly, the conviction was forced upon us that a mistake had been made in considering

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* Bull. Torrey Club 32: 563–586. *pl. 23–29.* 1905.

† One who has seen an extensive series of West Indian Halimedas, either growing or in an herbarium, can scarcely have any serious doubts, we believe, as to the intended application of Ellis & Solander's names *Corallina tridens* and *Corallina incrassata* or as to the impossibility of drawing any reliable line of specific separation between the two. This being granted, the next question involves a choice between the two names, published in one work at the same time. Mrs. Gepp, in her monograph of "The Genus Halimeda" (Siboga-Exped. LX) has adopted the specific name *incrassata*, presumably because Ellis & Solander's description of their *Corallina incrassata* was accompanied by the more numerous and more detailed figures. The Rochester and the Philadelphia codes of botanical nomenclature give preference in such cases to the name having "precedence of position," which would here call for the adoption of the specific name *tridens*, the name which, fortunately, in America, at least, has been the more generally employed. The recent Vienna Code (Art. 46) provides that "when two or more groups of the same nature are united, the name of the oldest is retained. If the names are of the same date, the author chooses, and his choice cannot be modified by subsequent authors." In the case in hand, technical priority in the matter of publishing a choice between the two names appears to lie, by a narrow margin, so far as we can discover, with Mr. F. S. Collins, whose choice of *Halimeda tridens* appeared in print in November, 1901 (Proc. Am. Acad. Arts and Sci. 37: 246) while Mrs. Gepp's monograph, in which the name *Halimeda incrassata* is preferred, bears the date of December, 1901.

them forms or varieties of one species and that in addition to their more obvious peculiarities a careful comparison under the microscope would be likely to reveal histological characters of diagnostic value. We have now been able to compare microscopically specimens representing fifty-seven collection-numbers of these two "forms" from Bermuda, southern Florida, and the West Indies, and the results are of interest. In *Halimeda tridens* the peripheral utricles show a range of from 49 to 77 μ in average maximum diameter in surface view; that is, on measuring the distal ends of each the longest way, the average in some individuals is as low as 49 μ and in others as high as 77 μ. In the representatives of *H. Monile*, the peripheral utricles, measured in the same way, range from 30 to 44 μ in diameter; and they are more strongly coherent after decalcification, their lateral walls being in contact for $\frac{1}{3}$–$\frac{1}{10}$ their length *vs.* $\frac{1}{8}$–$\frac{1}{20}$ their length in *H. tridens*. And the utricles of the subcortical layer, at least those of the outmost series, are narrower and less rounded than in *H. tridens*, being 24–55 μ in greatest width *vs.* 35–95 μ, and obconical, clavate, or obovoid, rather than turbinate, subglobose, or ellipsoidal. *Halimeda tridens* and *H. Monile* occasionally simulate each other in form, as indeed in an even greater degree do *Halimeda Tuna* and *H. scabra*, and it is not surprising that Lamouroux, Harvey, and others who have depended upon externalities have had doubts as to their specific distinctness; but we believe that they are really distinct and that they constitute species in the best sense of the word. Ninety-five per cent. of the specimens that one meets with can easily be referred at sight to the one species or the other, and in the case of the few that may seem doubtful on first inspection, an accurate measurement of the peripheral utricles has, thus far, afforded a satisfactory basis for determination.

In addition to *Halimeda tridens*, *H. Monile*, and *H. favulosa*, there is a fourth member of this alliance which we have thus far met with five times in Porto Rico, Jamaica, and the Bahamas, and which holds its distinctive characters so constantly in varying depths of water and under other diverse conditions that we believe it entitled to specific rank. A description of it follows:

Halimeda simulans sp. nov.

Dark- or rather light-green when living, sometimes becoming yellowish-green on drying, erect or somewhat flaccid, 6–15 cm. high, flabellate or subflabellate in habit, sessile or subsessile, the one or two lowest, more or less modified, flattened segments often forming a sort of stipe, strongly calcified, the calcification soon involving the medulla and reaching the outer surface of the peripheral utricles, the surface dull or slightly nitent, appearing smooth, solid, and compact, even under a lens; branching in one plane, usually trichotomous: rhizoids commonly forming a bulbous mass with the adherent sand: segments discoid, plane or obscurely 1- or 3-nerved, subquadrate-reniform, subquadrate, or rhombic-ellipsoidal, rarely obovate, nearly always broader than long, mostly subentire or 3–7-crenulate, sometimes 3-dentate or 3-lobed, 2–9 mm. long, 4–12 mm. broad, 0.5–2 mm. thick (those of extreme base now and then 3 mm. thick): peripheral utricles turbinate or subcrateriform, 27–80 μ long, 33–40 μ in average maximum diameter in surface view, truncate or rounded-obtuse, lateral walls in contact for $\frac{1}{3}$ to $\frac{1}{10}$ their length, usually cohering rather firmly on decalcification: utricles of the subcortical layer in a double, triple, or rarely quadruple series, those of the outmost series turbinate, obovoid, subglobose or ellipsoidal, 30–72 μ in maximum width, those of the inmost series obovoid, obconical, or clavate, 41–110 μ in greatest width: filaments of the central strand strongly coherent at the nodes, communicating there with those adjacent by open pits or very short tubular processes and exhibiting there thickened and often colored walls: sporangia unknown. [PLATE 29.]

Growing on a sandy bottom or occasionally on stones in 3 dm. of water and down to a depth of several meters. Porto Rico: *no. 4332*, type (Culebra Island, M.A.H. — also *no. 4383*); Jamaica: *nos. 4837b* and *4845* (Montego Bay); Bahama Islands: *no. 3561* (Frozen Cay, Berry Islands).

Halimeda simulans is a member of the *Halimeda tridens* (*H. incrassata*) group, being probably most nearly allied to J. Agardh's *Halimeda incrassata α ovata* [Till Alg. Syst. 5: 86. 1887. — "Hab. ad insul. Noukahiva (Jardin)"] the evident type of which is no. 15892 in the Agardh herbarium at Lund. But the peripheral utricles of this Noukahiva specimen average 50 μ in maximum diameter, which would throw it into the form cycle of *H. tridens* according to the measurements which thus far have proved reliable in helping to distinguish the West Indian species of this group. The Noukahiva plant is also less calcified than our

Halimeda simulans and has some of the other minor peculiarities of the true *H. tridens.*

In its nearly sessile plants and in the form of its segments, *Halimeda simulans* sometimes outwardly resembles *H. Tuna,* but its segments are much thicker and more rigid than in that species and they commonly have marginal crenulations or sometimes short lobes which are wanting in *H. Tuna;* and the behavior of the filaments of the central strand at the nodes is very different in the two species. On Culebra Island, *Halimeda simulans, H. Tuna,* and *H. tridens* were found growing within short distances of each other, and no intermediates were discovered. On the outside shore of the outmost of the Bogue Islands, Montego Bay, Jamaica, on January 7, 1907, *H. simulans* was found growing side by side with *H. Tuna,* while within a few rods were *H. tridens* and *H. Monile,* and no forms showing any intergrading among these four species, as we prefer to call them, were observed. From Frozen Cay, Berry Islands, Bahamas, the only *Halimeda* that we brought away besides the *H. simulans* was one of *H. scabra,* but *Halimeda tridens* is in general rather common throughout the Bahamian archipelago.

A key to the American representatives of the *Halimeda tridens* group may be arranged as follows:

Filaments of the central strand coherent at the nodes, communicating there with those adjacent by pits or very short tubular processes, rarely (now and then in *H. Monile*) merely thick-walled at the nodes and separable; segments flattened or subterete, often 3-lobed or 3-dentate.
- Peripheral utricles less than 80 μ in average maximum diameter, surface view.
  - Peripheral utricles 49–77 μ in average maximum diameter, surface view; segments usually flattened. *H. tridens.*
  - Peripheral utricles 30–44 μ in average maximum diameter, surface view.
    - Segments mostly subterete. *H. Monile.*
    - Segments discoid (suggesting *H. Tuna*). *H. simulans.*
- Peripheral utricles 175–190 μ in average maximum diameter, surface view. *H. favulosa.*

D. ON THE SPORANGIA OF AVRAINVILLEA NIGRICANS

(PLATE 28, FIGURES 8–25)

On January 5, 1907, at Montego Bay, Jamaica, while washing and preparing some specimens of *Avrainvillea nigricans* and *A. longicaulis* (*A. Mazei*) which had been collected there in shallow water earlier in the day, our attention was arrested by one plant of *Avrainvillea nigricans*, the surface of which was rather abundantly covered with protruding capitate or subclavate filaments. Remembering that "Fortpflanzungsorgane unbekannt" * was the most that had been said of the mode of reproduction in this genus *Avrainvillea*, which had been recognized since 1842, we proceeded to examine the newly found structures with much interest. The enlarged terminal portions of these filaments varied in form from clavate and fusiform to pyriform or subglobose and they had the appearance of being stipitate, being raised above the general surface once or twice their own length by a scarcely modified part of the filament. The younger and smaller as well as some of the larger of these peculiar bodies were intensely green, contrasting notably with the dingy-fuscous tint of the plant in general, but many of the older and larger had turned brown, the color residing partly in the filament wall and partly in the contents and being evidently an intensification of the color characteristic of the ordinary vegetative condition of the species. After a microscopic examination, the plant was placed in a jar of seawater with the hope that on the following morning living zoöspores might be seen to emerge from the suspected sporangia. But our hopes were disappointed. Then, as on the previous evening, many of the supposed sporangia contained usually from three to five (one to eight) ovoid, pyriform, elongate-ellipsoidal, or difform bodies, occupying together one-half or more of the cavity of the enlargement. Impressed by the evident lack of homology with what little is known of reproduction in other members of the *Codiaceae*, we suspected that these peculiar interior bodies might be endophytic parasites of some sort and that the sporangium-like swellings might be simply galls caused by their presence, and so, with the conviction that the *Avrainvillea* was by this time dead, we added formalin to the seawater to preserve the interesting specimen for further study at some more convenient time. Subsequent investigations have succeeded in bringing to light practically all stages in the development of the sporangium-like organs, including great numbers of withered and empty ones, and nothing has been discovered to indicate that the more or less spore-like bodies

* Wille; Engler & Prantl, Nat. Pflanzenfam. 1^2: 141. 1890.

are anything other than normal parts of the *Avrainvillea* itself; they certainly contain chlorophyl and starch and the chloroplasts appear to be of the same character as those of the ordinary filaments of the thallus. Indeed, the supposed sporangia occur in too great profusion, even though on a single plant, and they are too regular in form and position, we believe, to be anything else than normal.

The sporangia are always terminal on branches, which, except for the presence of the sporangium, are but slightly different from the ordinary vegetative filaments of the flabellum, being, however, less moniliform or torulose, and often more slender than the filament from which they spring. These sporangiophores result from the ordinary forking of the filaments and they are commonly homologous with a vegetative branch which would undergo two or three more dichotomies (FIGURE 15). Some which can be traced back to the deeper-lying filaments are falsely lateral in origin. The form of the sporangia has been alluded to above, but the figures published herewith give a more accurate idea of their character. They vary from 0.35 to 0.83 mm. in length and from 0.20 to 0.35 mm. in width. Sometimes, as shown in FIGURES 22 to 24, the base of the sporangium, underneath the spores, is occupied by a brownish mass of slime or mucilage, forming a more or less complete basal septum. The plug, however, is perhaps more commonly near the base of the sporangiophore, as shown in FIGURE 15. Occasionally, as in FIGURE 13, the stoppage is near the middle of the sporangiophore. Often, two such plugs may be found, one at the base of the sporangium and the other at the base of the sporangiophore. The brown callose-mucilage evidently furnishes the material for healing the wound caused by the withering away of the empty sporangium. Numerous brown, rounded, thick-walled, stump-like processes, like that shown in FIGURE 20, may be found, indicating the position of former sporangiophores. It rarely happens that practically the whole protoplast of the sporangium is consumed in the formation of a single spore, but the usual number is three, four, or five, as stated above, though occasionally as many as six, seven, or eight are formed. The spores are most commonly long-ovoid or pyriform and as they lie in the sporangium the broader end is usually upward. They are densely crowded with chloroplasts and starch-grains but as they mature the amount of starch appears to increase at the expense of the chlorophyl. Some of the spores show a pronounced polarity, or perhaps it may be called a beginning of germination, while still in the sporangium. Thus, in the second spore from the right in FIGURE 21, the foot or base of the young plant is plainly manifest. Such basal parts have less chlorophyl and starch than the remainder of the spore. The membrane enclosing the spore is usually thin and delicate and often scarcely demonstrable. When the spores are well formed, there is a peculiar aggregation of granules at the apex of the sporangium (FIGURES 21, 24) and this appears to be followed soon by the rupturing of the sporangium wall in this region, forming a rather wide irregular opening. All the spores in any single sporangium seem to be discharged at about the same time, for the sporangia as found, with a few possible exceptions, are either empty or contain their full complement of spores. Very little is known of the history of the spores on leaving the sporangium. FIGURE 19 shows a spore which had been caught at the mouth of the sporangium and had evidently begun its extra-sporangial growth, forming an evident foot and the first "bead" of a moniliform filament; this was firm-walled and very brown.

The large size of the spores (130–$300\,\mu \times 66$–$120\,\mu$), their heavy load of starch, and their occasional development of an evident foot while still in the sporangium, make it practically certain, in our opinion, that these bodies are not self-motile, *i. e.*, that they are *aplanospores*. Yet, the thinness of the surrounding membrane and the fact that none of the bodies has thus far been found germinating on the surface of the thallus (if we except the captured one shown in FIGURE 19) have suggested the possibility of their being synzoöspores. However, it is much more probable that we have to do with aplanospores, perhaps analogous to those which occur in smaller size and larger number in *Gomontia polyrhiza* (Lagerh.) Born. & Flah. or to those which have been described as occurring singly in *Vaucheria hamata* and *V. geminata.**

E. ON THE AMERICAN SPECIES OF AVRAINVILLEA

In a former paper † we alluded to some of the difficulties in the way of distinguishing species in the genus *Avrainvillea* and com-

* Waltz, J. Jahrb. Wiss. Bot. 5: 132, 133. 1866.

† Bull. Torrey Club 32: 565–568, 586. 1905.

mented on the characters of the original specimens of *Avrainvillea nigricans* Decaisne and *Rhipilia longicaulis* Kütz. Since that time we have enjoyed the opportunity of seeing again living plants of this genus in Porto Rico and in Jamaica, and have arrived at conclusions that are, to us, more satisfactory as to the number of species that are represented in the West Indian waters, in so far as one may judge of the matter from the material now at hand. We therefore venture to give below a diagnosis of the genus, a key to the American species, and a synoptical account of the four species that we recognize.

AVRAINVILLEA Decaisne, Ann. Sci. Nat. II. **18**: 108. 1842
Fradelia Chauvin, Recherches 124. 1842.
Chloroplegma Zanard. Mem. R. Ist. Ven. **7**: 290. 1858.

Thallus fusco-nigrescent, tawny-green, or olivaceous, usually flabelliform and stipitate, more rarely difform or irregularly digitate, destitute of calcareous incrustation, composed of dichotomous interwoven cylindrical, torulose, or moniliform threads, these nearly similar throughout, being without specialized corticating branches and without fibular processes. Stipe, when differentiated, simple or sometimes forked, terete or flattened. Flabellum suborbicular, reniform-cordate, or cuneiform, or (in *A. Rawsoni*) deficient, rarely zonate. Rhizoids in an irregularly bulbous mass or sometimes forming a rhizome. Sporangia (known only in *A. nigricans*) terminal on filaments exserted from surface of flabellum, containing a few (1–8) spores (aplanospores?). All species marine.

Type species, *Avrainvillea nigricans* Decaisne.

Key to the American species

Thallus eventually developing a flabellum (usually stipitate).
  Fusco-nigrescent or tawny-green; surface subvelutinous, minutely spongiose, or strigose: filaments of flabellum 28–70 μ in diameter.
    Filaments of flabellum moniliform. 1. *A. nigricans.*
    Filaments of flabellum cylindrical with a strong constriction at base of each branch, rarely subtorulose. 2. *A. longicaulis.*
  Olivaceous or cinereous; surface smooth and compact; filaments of surface of flabellum 6–24μ in diameter. 4. *A. levis.*
Thallus not developing a flabellum, forming more or less digitate, sometimes capitate lobes, these commonly very irregular in form, and often branching, diffluent, or anastomosing. 3. *A. Rawsoni.*

1. AVRAINVILLEA NIGRICANS Descaisne, Ann. Sci. Nat. II. 18: 1842.— M. A. Howe, Bull. Torrey Club **32**: 567, 568. 1905.
Fradelia fuliginosa Chauvin, Recherches 124. 1842.

Avrainvillea longicaulis Murr. & Boodle, *p. p.* Jour. Bot. **27**: 70. *pl. 228. f. 1–5.* 1889. (Excluding syn. *Rhipilia longicaulis* Kütz.)

Usually fusco-nigrescent when living or rarely tawny-green, of a similar color on drying or somewhat darker or more sordid, gregarious or scattered, normally with a stout horizontal rhizome (commonly left in substratum as ordinarily collected), or, when small and poorly developed, with a somewhat bulbous or difform base: stipe cylindrical or flattened, 1–16 cm. long, 3–14 mm. wide, now and then deficient or scarcely differentiated, simple or rarely forked near the base: flabellum varying from suborbicular (reniform-cordate when young) to cuneiform (sometimes subclavate when young), 1–25 cm. broad, entire or more or less lacerately or digitately lobed, thin and membranous in the broader forms, thicker and more coriaceous in the narrower, felt-like in texture, very obscurely or not at all zonate, the surface subvelutinous or minutely spongiose: filaments of flabellum distinctly moniliform or torulose (at least those near the surface) usually firm-walled and rather straight and rigid, 33–70 μ in maximum diameter, filaments of stipe similar, but with more differentiation between those of surface and those of interior: sporangia mostly subpyriform, varying from clavate to subglobose, 0.35–0.83 mm. × 0.20–0.35 mm., usually exserted once or twice their own length; spores ovoid, pyriform, or elongate-ellipsoidal, 130–300 μ × 66–120 μ.

TYPE LOCALITY: Iles des Saintes, near Guadeloupe, West Indies; type specimen in the herbarium of the Muséum d'Histoire Naturelle in Paris.

DISTRIBUTION: Bermuda, southern Florida, the West Indies, and South America.

Avrainvillea nigricans, as here conceived, is widely variable in form and size, though tolerably uniform in the character of its filaments. Further remarks by the writer on its range of variation may be found in the place cited above.

2. AVRAINVILLEA LONGICAULIS (Kütz.) Murr. & Boodle, *p.p.* Jour. Bot. **27**: 70. 1889. (Excluding all but syn. *Rhipilia longicaulis* Kütz., which may be fairly considered the "type" of the new binomial.)

Rhipilia longicaulis Kütz.* Tab. Phyc. **8**: 13. *pl. 28. f. II.* 1858.

Avrainvillea Mazei Murr. & Boodle, *l. c. pl. 288. f. 6.*

* M. A. Howe, Bull. Torrey Club **32**: 586. 1905.

Fusco-nigrescent or sometimes sordid- or tawny-green when living, of a similar color on drying, gregarious or scattered, with or without a horizontal rhizome: stipe flattened or subterete, 1–15 cm. long, 3–10 mm. wide, rarely deficient, simple or forking near the base: flabellum cuneate-obovate, oblong, or sometimes suborbicular, now and then diffuse, imperfectly complanate, and irregularly lobed, 1–12 cm. broad, coriaceous in the smaller forms, thinner and of looser texture in the larger, most obscurely or not at all zonate, the surface strigose, subvelutinous, or minutely spongiose: filaments of flabellum cylindrical, strongly constricted just above the dichotomy, rarely here and there subtorulose, usually firm-walled and mostly rather straight and rigid, 28–70 μ in diameter; filaments of surface of stipe commonly more slender, interwoven, rhizoid-like, those of interior sometimes crowded with amylum grains.

TYPE LOCALITY: "Ad Antillas" [Antigua]; type specimen in the Sonder collection of the National Herbarium of Victoria, Australia.

DISTRIBUTION: Bermuda and the West Indies.

The maintenance of the binomial *Avrainvillea longicaulis* for the present species and the crediting of the name to Murray & Boodle are both, we believe, technically correct, even though it may prove a source of some confusion for a time, inasmuch as Murray & Boodle evidently intended that another species — the true *A. nigricans* Decaisne — should bear Kützing's name *longicaulis*. But, as Murray & Boodle in proposing the new combination *Avrainvillea longicaulis* cited Kützing's *Rhipilia longicaulis*, it cannot be denied that this new combination applies also to Kützing's species and that it applies to it in a peculiar and typical way. Notes by the present writer on Kützing's type-specimen have been published in the place cited above and in the same paper also (pages 567, 568) are comments on the relationship of the present species to *A. nigricans*. *A. longicaulis* and *A. nigricans* often grow intermingled and resembling each other so closely that they cannot be determined without a microscopical examination, yet the more that we see of them the more we are inclined to the belief that they represent true species.

3. **Avrainvillea Rawsoni** (Dickie)

Rhipilia Rawsoni Dickie, Jour. Linn. Soc. **14**: 151. *pl. 11. f. 1, 2.* 1874.

Avrainvillea nigricans Murr. & Boodle, *p.p.* Jour. Bot. **27** : 70. 1889. Not *A. nigricans* Decaisne.

Mostly bright- or sordid-green when living, becoming fuscous-brown or nigrescent on drying, forming cespitose masses with usually crowded, subterete, fusiform, clavate, or finger-shaped, sometimes capitate, often difform, branched, and anastomosing lobes, never developing a flabellum; lobes azonate, mostly 4–12 cm. long and 0.5–4.0 cm. in diameter, now and then disappearing in irregular cushions by fusing, the surface velutinous, spongiose, or substrigose: filaments of the lobes subtorulose or the inner cylindrical with occasional constrictions, always strongly constricted just above the dichotomy, rather thin-walled and somewhat easily collapsible, 28–68 μ in diameter. [PLATE 30.]

TYPE LOCALITY: Barbados; type in the herbarium of the British Museum.

DISTRIBUTION: The West Indies.

Apparently common in the West Indies, ranging at least from the northern Bahamas to Jamaica and Porto Rico, growing from low-water mark down to a depth of one meter, often on exposed rocks near the low-water line. The species is represented in the herbarium of the New York Botanical Garden at the present time by specimens under seventeen collection numbers. *No. 770* of the Phycotheca Boreali-Americana of Collins, Holden, and Setchell, issued as *Avrainvillea longicaulis* (Kütz.) Murr. & Bood., and *no. 771* of the same series, issued as *Avrainvillea nigricans* Decaisne, both collected at Montego Bay, Jamaica, by Mrs. C. E. Pease and Miss E. Butler, belong with the present species, at least in the three sets examined, though in one set, the material issued under no. 770 is mixed with *A. nigricans;* however, all three of the species named are found at Montego Bay. *Avrainvillea Rawsoni* is the plant that we once * referred to as "what we believe to be a low-littoral or shallow-water condition of *Avrainvillea Mazei*," but since we have seen it growing profusely in deeper water in Jamaica closely associated with both *A. longicaulis* (*A. Mazei*) and *A. nigricans* and without showing the least tendency to intergrade with either, we cannot do otherwise than consider it abundantly entitled to specific rank. The plant evidently never develops a true flabellum and the filaments are thinner-walled, more collapsi-

* Bull. Torrey Club **32**: 568. 1905.

ble and more torulose than is ordinarily the case in the true *A. longicaulis* (*A. Mazei*) and they are thinner-walled and less moniliform than in *A. nigricans*. The specimen selected for our photograph (PL. 30) represents a common form of the species, though its lobes are narrower, more clavate or subfusiform than those of the plant originally described and figured by Dickie.

4. AVRAINVILLEA LEVIS M. A. Howe, Bull. Torrey Club **32**: 565. *pl. 23. f. 1; pl. 26. f. 8–10.* 1905

Avrainvillea sordida Murr. & Boodle, Jour. Bot. **27**: 70. 1889. Not *Avrainvillea sordida* (Mont.) Crouan; * Mazé & Schramm, Essai Alg. Guad. 89. 1870–'77.

TYPE LOCALITY: Cave Cays, Exuma Chain, Bahamas.

DISTRIBUTION: Bahamas; Jamaica; Guadeloupe; Grenada (*fide* Murray & Boodle).

SPECIES EXCLUDENDAE

After examining authentic specimens, we agree with Murray & Boodle † in referring *Rhipilia tomentosa* Kütz. to *Udotea* and in identifying with it *Avrainvillea laetevirens* Crouan. However, the characters of this species seem to make the line of separation between the genera *Avrainvillea* and *Udotea* an almost arbitrary one. Outside of the possession of occasional attachment organs by the filaments — so little abundant that they were overlooked by Kützing — the species has more in common with *Avrainvillea* than with *Udotea*, bearing, in fact, a close external resemblance to certain conditions of *A. longicaulis*. Our *no. 3209*, from North Cat Cay, Bahamas, evidently belongs with *Udotea tomentosa*. ‡

* For a discussion of the technical application of this name, see Bull. Torrey Club 32: 566. 1905.

† Jour. Bot. 27: 72. 1889.

‡ UDOTEA TOMENTOSA (Kütz.) Murray, Jour. Bot. 27: 239. 1889.
Rhipilia tomentosa Kütz. Tab. Phyc. 8: 12. *pl. 28. f. 1.* 1858.
Avrainvillea laetevirens Crouan; Mazé & Schramm, Essai Alg. Guad. 89. 1870–77 (nomen seminudum).

Plants 3–6 cm. high, from a scarcely rhizomatous base, bright-green, fading to yellowish-albescent or isabelline, without calcareous incrustation; stipe subterete or flattened, 0.5–2 cm. long, 2–4 mm. wide, simple: flabellum cuneiform-obovate, obdeltoid, or oblong-cuneiform, 3–5 cm. long, 1–3.5 cm. broad, entire, 2–4-lobed, or at length irregularly lacerate, very obscurely or not at all zonate, rather thick, uncorticated, spongiose in texture, surface spongiose-tomentose, the stipe of similar appearance: filaments of flabellum thin-walled, imperfectly reviving on being soaked out, intricately intertangled, 35–70 μ in diameter, cylindrical or irregularly inflated here and there especially at apices, usually a little constricted just above a dichotomy, the dichotomies often near together and the branches sometimes pseudolateral, many of the shorter branches (often apparently and perhaps truly lateral) terminating in 2–4 or more short small divaricate processes which serve as organs of attachment to adjacent filaments, thus forming more or less of a network; filaments of stipe similar but with greater diversity in size, those of interior 55–100 μ in diameter, those of surface often only 16–30 μ.

TYPE LOCALITY: Antigua, British West Indies; type specimen in the Sonder collection of the National Herbarium of Victoria, Australia.

DISTRIBUTION: Antigua; Guadeloupe; Bahamas.

We owe to Mr. J. R. Tovey, of the National Herbarium of Victoria, Australia, the privilege of examining a portion of the type material, including, evidently, the plants from which Kützing drew his figure *a′*.

A second West Indian species of somewhat doubtful generic position is the following:

UDOTEA LUTEOFUSCA (Crouan) Murray, Jour. Bot. 27: 239. 1889 (nomen seminudum).

Flabellaria luteofusca Crouan; Mazé & Schramm, Essai Alg. Guad. 88. 1870–'77 (nomen seminudum).

Plants 4–10 cm. high, fuscous or dark yellowish-brown, uncalcified; stipe simple or 1–3 times dichotomous, flattened or subterete, 2–7 cm. long, 2–5 mm. wide, corticated: flabellum cuneate-obovate or irregularly semiorbicular with cuneate base, sometimes 4 or 5 flabella to a plant through forking of stipe, each 2–5 cm. long, 1–6 cm. wide, not at all or very obsoletely zonate, corticated, the surface smooth or longitudinally somewhat rugulose, the margins erose, lacerate, or irregularly lobed: filaments of the medulla yellowish or yellowish-brown, in several layers or towards the margins almost unistratose, being there commonly visible through the cortex and giving the plant a venulose appearance under a lens, 50–80 μ in diameter, cylindrical or slightly and irregularly constricted, their falsely lateral branches forming the intricate, labyrinthine cortex by repeated divaricate often somewhat zig-zag dichotomies, the ultimate branchlets of the corticating filaments 4–10 μ in diameter, decolorate.

TYPE LOCALITY: Lake Simpson, St. Martin, West Indies; type specimen *no. 1403* of the Mazé & Schramm collection in herb. Crouan (in herb. Bornet, Paris).

DISTRIBUTION: Known only from the type locality.

This interesting plant offers points of contact with the genera *Avrainvillea*, *Udotea*, and *Cladocephalus* (Bull. Torrey Club 32: 569), but is perhaps most at home in *Udotea*, where Murray (*l. c.*) has doubtfully placed it. But we find no grounds for supposing with Murray that this "form" is an "imperfect state." In color and general habit it has most in common with *Avrainvillea*, but it is corticated; the general character of the cortex, however, is rather different from that of any other described species of *Udotea*, the corticating filaments being much more regularly dichotomous than in *Udotea Desfontainei* and without the ultimate lateral nodular excrescences or irregularly cristate-pectinate coherent branchlets of that species. In the nature of the cortex it closely resembles *Cladocephalus scoparius;* in fact, the species stands in much the same relation to *Cladocephalus* that *Udotea conglutinata* does to *Penicillus*, *Udotea conglutinata* being a *Penicillus* except in having a flabellum instead of a capitulum.

Explanation of plates 25-30

PLATE 25

1–10. *Halimeda Tuna*

1. Portion of a segment (decalcified), in radio-vertical section, showing peripheral utricles, utricles of the subcortical layer, and medullary filaments.

2 and 3. Peripheral utricles and utricles of the subcortical layer, decalcified and teased out; the peripheral utricles separating rather easily.

4. Peripheral utricles, decalcified, in surface view; no fusion is noticeable.

5. Vertical section by microtome through the filament of the central strand (decalcified) at a node; just above the points of fusion the filaments are somewhat enlarged and are inclined to cohere.

6. Two filaments from the central strand of a node, teased out, each formed by the fusion of two; just above the points of fusion there has been considerable coherence of the adjacent filaments and the outer layers of the filament-walls are more or less scarred and lacerated by the process of teasing the filaments apart.

7. A young simple sporangiophore.

8. A sporangiophore from the margin of a segment, formed by the fusion of three filaments of the central strand.

9. A forked sporangiophore from the margin of a segment, formed by the fusion of two filaments of the central strand.

10. The beginning of a sporangiophore at margin of segment. (For sporangiophores of a different origin, see Plate 28, Figures 1 and 2.)

Figures 1–10 are all drawn from formalin-preserved material of our *no. 4201* (Culebra Island, Porto Rico); 1–6 are magnified 40 diameters; 7–10, 24 diameters.

11–20. *Halimeda discoidea*

11. Portion of a segment (decalcified), in radio-vertical section, showing peripheral utricles of the subcortical layer, and medullary filaments.

12 and 13. Peripheral utricles and distal ends of the utricles of the subcortical layer, decalcified, showing contact of the peripheral utricles and their occasional interlocking.

14 and 15. Peripheral utricles, etc., showing fusion as well as interlocking.

16. Utricle of the subcortical layer bearing numerous peripheral utricles.

17. Peripheral utricles, decalcified, in surface view, showing fusions; fusions of two utricles are common; near the upper left-hand corner and a little below the middle, in the figure, are fusions of three utricles; near the lower left-hand corner is a fusion of four.

18. Peripheral utricles, decalcified, in surface view, the dotted lines indicating the form and position of the distal ends of the utricles of the subcortical layer, which are often clearly visible through the peripheral utricles.

19. Filaments from central strand of nodes, showing incomplete fusion.

20. Filament from central strand of node, showing complete fusion of two filaments to form one, which afterwards divides into three. The filaments shown in Figures 19 and 20 are from the same node.

Figures 11–20 are all drawn from formalin-preserved material of our *no. 2964* (Caesar's Creek, Florida); 11, 16–20 are magnified 40 diameters; 12–15, 55 diameters.

PLATE 26. *Halimeda discoidea*

Photograph of a formalin-preserved specimen from Caesar's Creek, Florida (*no. 2964*, 31 Mr 1904), natural size.

PLATE 27

1. *Halimeda tridens*. Photograph of a formalin-preserved fertile specimen from Tallaboa, Porto Rico (*no. 4424*, 22 Mr 1906), natural size.

2–4. *Halimeda Tuna*. Photograph of formalin-preserved fertile specimens from Culebra Island, Porto Rico (*no. 4201*, 3 Mr 1906), natural size.

PLATE 28

1 and 2. *Halimeda Tuna*

1 and 2. Sporangiophores of apparently lateral origin from the central filaments and formed without fusion; these were from the flattened face of a segment.

The figures are drawn from formalin-preserved material of our *no. 4201* (Culebra Island, Porto Rico); the magnification is 24 diameters.

3–7. *Halimeda tridens*

3. A cluster of three sporangiophores from the margin of a segment; each is a continuation of a filament of the central strand coherent with the adjacent filaments near the point of emergence and anastomosing with them.

4. A sporangiophore from the flattened face of a segment; this is a direct continuation of a utricle (distal series) of the subcortical layer.

5. Base of sporangiophore of origin similar to that shown in Figure 4.

6 and 7. Bases of sporangiophores from the flattened faces of segments; these are direct continuations of the peripheral utricles; in Figure 6 the sporangiophore forks at the base, perhaps abortively.

Figures 3–7 are drawn from formalin-preserved material of our *no. 4424* (Tallaboa, Porto Rico); all are magnified 24 diameters.

8–26. *Avrainvillea nigricans*

8. Portion of surface of the flabellum, with exserted sporangia.

9–13. Young sporangia in various stages of development. Near the middle of the stipe in Figure 13 is indicated the position of the mucous or callose plug.

14. A sporangium which has aborted and resumed vegetative growth.

15. A nearly mature sporangium; the figure shows the mucous plug near the base of the stipe and the usual relation of the sporangiophore to the vegetative filaments.

16. A young sporangium paired with an old and empty one.

17. A sporangium with spores nearly formed.

18. A pair of empty and shriveled sporangia, showing the wide erose or lacerate opening at the apex of each and the mucous or callose thickening at the base of the sporangiophore.

19. A spore adhering to the mouth of an empty sporangium, where it has begun its extra-sporangial development.

20. A healed-over "stump" left by the decay of an old sporangiophore.

21. A mature sporangium with four spores. A collection of granules at the apex seems to indicate the area of the future rupture of the sporangium-wall.

22. A mature sporangium with four spores; the base of the sporangium is nearly filled and closed by brown mucus.

23. A sporangium open at apex, although the enclosed spores are still imperfectly outlined.

24. A mature sporangium with three spores; a mucous plug in the base of the sporangium and a collection of granules at its apex.

25. A large sporangium containing four spores clearly outlined and three or more others imperfectly formed.

Figures 8–25 are all drawn from formalin-preserved material of our *no. 4794* (Montego Bay, Jamaica); 8 is magnified 12 diameters; 9–19, 24 diameters; 20–25, 52 diameters.

PLATE 29. *Halimeda simulans*

Photograph of a dried specimen (*no. 4332*, type — Culebra Island, Porto Rico, 6 Mr 1906, M.A.H.), natural size.

PLATE 30. *Avrainvillea Rawsoni*

Photograph of formalin-preserved specimen in water (*no. 4843*, Montego Bay, Jamaica), natural size.

The genus Androsace in New Mexico

Elmer Ottis Wooton and Paul Standley

The early reports upon the botany of the southwest recognize two species of *Androsace*, *A. occidentalis* Pursh and *A. septentrionalis* L. The latter species, according to Dr. E. L. Greene, does not occur in this country, being an alpine plant of the northern parts of Europe and Asia.

Of the species that formerly went as *A. septentrionalis* one has been named *A. pinetorum* by Dr. Greene in Pittonia **4** : 149, which is no doubt perfectly distinct. This species, originally described from southern Colorado, is found in the higher mountain ranges of that state and of New Mexico. The only specimens from this Territory in our herbarium are one from Bear Cañon, Sandia Mountains, collected in June, 1898, by Dr. C. L. Herrick (*no. 205*), and one collected on South Percha Creek, in the Black Range, Sierra County, May 3, 1905, by O. B. Metcalfe (*no. 1586*). It no doubt occurs in the mountains of the northern part of the Territory, since it seems to be quite common in southern Colorado. The species may be readily separated from the other members of its group by its relatively large pinkish or white flowers, whose corollas are longer than their calyces.

Another more common species of this Territory which also passed as *A. septentrionalis* is *A. diffusa* Small.* This is represented in our herbarium by specimens from the following localities in New Mexico:

In the White Mountains, Lincoln County: at Gilmore's Ranch on Eagle Creek, July 14, 1897, and August 5, 1897 (*Wooton 598*), alt. approx. 2200 meters; on Little Creek, May 11, 1899 (*Turner 168*), alt. approx. 2400 meters; White Mountain Peak, August 1, 1901 (*Wooton*), alt. approx. 3100 meters. In the Sacramento Mountains, in Otero County: at Winter Folly, August 1, 1899 (*Wooton*), alt. approx. 2700 meters; in James Cañon near Cloudcroft, August 11, 1899 (*Wooton*), alt. approx. 2400 meters. In the Sandia Mountains in Bernalillo County: in Bear Cañon, May,

* Bull. Torrey Club **25** : 318.

1898 (*C. L. Herrick 256*). In the Mogollon Mountains, in western Socorro County: on the west fork of the Gila River, near its head, August 2, 1903 (*Metcalfe 341*).

These localities show that the species is pretty well distributed over the southern two thirds of New Mexico. It is no doubt found in the northern part of the Territory, for it is also common in Colorado. It is a species of the higher mountain ranges, growing at elevations of from 2100 to 3100 meters. One of the new species here proposed, *A. glandulosa*, is evidently closely related to *A. pinetorum* and *A. septentrionalis*. It has the strict, erect scapes which are relatively long and the pedicels are but little if at all spreading. The flowers are much smaller than those of *A. pinetorum*, and the corolla, though slightly surpassing the calyx, is a clear white. The character which readily distingushes the species is the glandular pubescence found in greater or less abundance upon the leaves, scapes, pedicels, and calyces.

A. puberulenta Rydb. * is said by Dr. Rydberg to extend into New Mexico, though particular New Mexican specimens are not cited. The plant is related to *A. diffusa*, from which it may be separated by the very puberulent pedicels and calyces and the long, lanceolate, strongly keeled calyx-lobes which much exceed the fruit. Our collection does not contain specimens of the species, but it will probably be met in the higher mountains of the northern part of the Territory.

Androsace occidentalis Pursh is accredited to New Mexico by several authorities and we have some specimens from the Organ Mountains before us which we refer to that species with some hesitation, since fruiting specimens show characters not ascribed to the species and not shown by material from the central states.

Another species, *A. platysepala*, is here proposed, which is a close relative of *A. occidentalis*, though it seems to us to be sufficiently distinct to be recognized. It has the habit and broad involucral bracts of *A. occidentalis*, but the calyx-segments are noticeably different, being broadly oblong to ovate and foliaceous.

The New Mexican species of *Androsace* now known to us may

* Bull. Torrey Club 30: 260. *A. septentrionalis*, *Rothrock 51*, from Santa Fé, is probably to be referred to one of the species above mentioned. Whether *A. subulifera* (Gray) Rydb. comes into the Territory or not we are unable to say.

be separated by the following key. It is likely that further search will reveal several of the Colorado species in the mountains of the northern part of the Territory and it is altogether probable that *A. arizonica* Gray* from the Santa Catalina Mountains of southeastern Arizona will be found in the adjoining parts of New Mexico when those parts are properly explored.

Involucral bracts narrow; scapes mostly long.
 Plant glandular. *A. glandulosa.*
 Plant not glandular.
  Corolla longer than the calyx; scapes erect. *A. pinetorum.*
  Corolla equal to or shorter than the calyx; scapes divergent.
   Calyx-lobes as long as the capsule. *A. diffusa.*
   Calyx lobes much longer than the capsule. *A. puberulenta.*
Involucral bracts broad; scapes short.
 Calyx-lobes triangular, acute. *A. occidentalis.*
 Calyx-lobes broadly oblong to ovate. *A. platysepala.*

Androsace glandulosa sp. nov.

Annual, acaulescent: leaves basal, linear-oblanceolate or spatulate, 1–2.5 cm. long, usually 1 cm. long, 3–4 mm. wide, obtuse or acute, thin, serrate with few teeth above the middle, sparsely covered with short, scattered, glandular hairs, sessile or with winged petioles: scapes 2 or 3 to many, erect, 8–15 cm. high, covered with short glandular-viscid pubescence: bracts glandular-pubescent, lanceolate, 1–2 mm. long: pedicels slender, erect, slightly spreading with age, numerous, 2.5–8.5 cm. long, mostly 3 cm. long, with short glandular-viscid pubescence: calyx campanulate or broadly obpyramidal, strongly carinately angled even in the flowers, 2.5 mm. long, 2.5–3 mm. broad, segments narrowly triangular, very acute, hardly half as long as the pale tube: corolla white, slightly longer than the calyx, segments 1 mm. broad or less, narrowly oblong, obtuse, about half the length of the tube: anthers twice as long as the filaments: capsules globose, about the length of the calyx, 2.5–3 mm. in diameter.

Collected in New Mexico on the Middle Fork of the Rio Gila, August 5, 1900, at an altitude of about 2100 meters, by E. O. Wooton.

Androsace platysepala sp. nov.

Annual, acaulescent, 4–8 cm. high: leaves basal, blades narrowly oblong, acutish, sparingly toothed near the apex, or almost entire, sessile, 12–23 mm. long, 4–6 mm. wide; upper surface bright-green, lower surface paler; glabrous except along the

*Proc. Am. Acad. 17: 221.

margins and near the apex where they are beset with close simple pubescence: scapes numerous, simple, erect or ascending, 3.5–7 cm. long, with short, fine, abundant, branched pubescence: bracts oblong, 4–7 mm. long, 2–3 mm. wide, with short, scattered, simple pubescence on lower surfaces and margins, upper surface glabrous: pedicels slender, 7–25 mm. long, with pubescence like that of the scapes, most abundant near the summits: calyx campanulate, rather obtuse at base, 3–5 mm. high, 3–4.5 mm. wide; tube pale-green, almost glabrous, segments broadly oblong to ovate with rather acute apices tipped with reddish points, slightly overlapping one another at the base, one half longer than the tube, with abundant short simple pubescence: corolla white, shorter than the calyx, about 2.5 mm. broad, segments oblong, retuse at apex, longer than the tube: anthers twice as long as filaments.

Type *no. 1547* collected at Kingston, Sierra county, New Mexico, on open hills, March 30, 1905, by O. B. Metcalfe. This species is close to *A. occidentalis* Pursh, from which it may be distinguished by its broader, toothed leaves, and broader bracts. There is no mature fruit on the type specimens, but what is taken to be the same plant, collected on Bear Mountain near Silver City, April 24, 1903, by O. B. Metcalfe (*no. 35*, distributed as *A. diffusa* Small, from which it is altogether different) has globose capsules, 3 mm. broad by 3.5 mm. high, one third shorter than the calyx, capped by the withered remains of the corolla.

HERBARIUM OF THE
NEW MEXICO AGRICULTURAL COLLEGE.

INDEX TO AMERICAN BOTANICAL LITERATURE
(1907)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions their kindness will be appreciated.

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Ames, O. *Orchidaceae* halconenses: an enumeration of the orchids collected on or near Mount Halcon, Mindoro, chiefly by Elmer D. Merrill. Philipp. Jour. Sci. **2**: Bot. 311–337. 15 Jl 1907.

Comprises 102 species in 29 genera, 40 described as new.

Arechavaleta, J. Flora Uruguaya **3**: 85–228. *pl. 15a–41* + *f. 1, 2.* 1907.

Anal. Mus. Nac. Montevideo, vol. 6.

Arthur, J. C. Cultures of *Uredineae* in 1906. Jour. Myc. **13**: 189–205. 12 S 1907.

Includes *Uromyces effusus* sp. nov., native of the eastern United States.

Arthur, J. C. *Peridermium pyriforme* and its probable alternate host. Rhodora **9**: 194, 195. 13 S 1907.

Atkinson, G. F. & Edgerton, C. W. Preliminary note on a new disease of the cultivated vetch. Science II. **26**: 385, 386. 20 S 1907.

Atkinson, G. F. & Edgerton, C. W. *Protocoronospora*, a new genus of fungi. Jour. Myc. **13**: 185, 186. 12 S 1907.

Protocoronospora nigricans sp. nov., native of New York State.

Bailey, W. W. The spurges. Am. Bot. **13**: 7–9. S 1907.

Baker, C. F. Determinations of Cuban *Piperaceae*. Torreya **7**: 201–203. 18 O 1907.

Barber, M. A. On heredity in certain micro-organisms. Kansas Univ. Sci. Bull. **4**: 1–48. *pl. 1–4.* Mr 1907.

Barnhart, J. H. The dates of Rafinesque's New Flora and Flora Telluriana. Torreya **7**: 177–182. 21 S 1907.

Bartlett, H. H. Some new Washington plants. Bot. Gaz. **44**: 302–304. 19 O 1907.

Includes *Oenothera* (*Onagra*) *cheradophila* sp. nov., native of Washington and Wyoming.

Bean, W. J. *Cladrastis tinctoria* (Yellow Wood). Gard. Chron. III. **42**: 186, 187. *f. 78*. 7 S 1907.

Native of the United States.

Bean, W. J. *Prunus Besseyi*. Curt. Bot. Mag. IV. **3**: *pl. 8156*. S 1907.

Native of the northwestern United States.

Bellini, R. Criteri per una nuova classificazione delle *Personatae* (*Scrophulariaceae* et *Rhinantaceae*). Ann. di Bot. **6**: 131–145. 20 Au 1907.

Benedict, R. C. The genus *Antrophyum*—I. Synopsis of sub-genera, and the American species. Bull. Torrey Club **34**: 445–458. 19 O 1907.

Includes *A. Dussianum* and *A. Jenmani* spp. nov., natives respectively of the West Indies and Guiana.

Bessey, C. E. Notes on spider-flowers. Plant World **10**: 208, 209. S 1907.

Bioletti, F. T. *Oidium* or powdery mildew of the vine. Calif. Agric. Exp. Sta. Bull. **186**: 315–352. *f. 1–17*. F 1907.

Britton, N. L. Further exploration in Jamaica. Jour. N. Y. Bot. Gard. **8**: 229–236. O 1907.

Britton, N. L. The sedges of Jamaica. Bull. Dep. Agric. Jamaica **5**: Suppl. 1–19. 19 S 1907.

Enumerates 96 species in 15 genera.

Broadhurst, J. A disease of sycamore trees. Plant World **10**: 213. S 1907.

Brotherus, V. F. *Musci*, in Engler & Prantl, Die nat. Pflanzenfam. **1**^{3}: 961–1008. *f. 701–732*. 1907.

Hookeriaceae (Schluss), *Hypopterygiaceae*, *Helicophyllaceae*, *Rhacopilaceae*, *Leskeaceae-Heterocladieae*, *Thelieae*, *Anomodonteae*, *Leskeeae*, und *Thuidieae*.

Buckhout, W. A. The formation of the annual ring of wood in the European larch and the white pine. Forestry Quart. **5**: 259–267. S 1907. [Illust.]

Chodat, R. & Hassler, E. Plantae Hasslerianae, soit énumération des plantes récoltées au Paraguay par le Dr. Émile Hassler, d'Aarau (Suisse) de 1885 à 1902. Bull. Herb. Boiss. II. **7**: 795–826. 30 S 1907.

Many species indicated as new, but not described.

Christ, H. Sertum *Aneimiarum* novarum aut minus cognitarum. Bull. Herb. Boiss. II. **7**: 789–794. 30 S 1907.

Includes 6 new species of *Aneimia*, natives of South America or Mexico.

Clute, W. N. The blazing star. Am. Bot. **13**: 1–3. S 1907. [Illust.]

Cockerell, T. D. A. A redwood described as a moss. Torreya **7**: 203, 204. 18 O 1907.

Cockerell, T. D. A. Some Old-World types of insects in the Miocene of Colorado. Science II. **26**: 446, 447. 4 O 1907.

Includes mention of *Heyderia coloradensis* sp. nov. (*Pinaceae*), and publication of the combination *Sequoia Haydeni*.

Cocks, R. S. The flora of the Gulf Biologic Station. Bull. Gulf Biol. Sta. **7**: 1–42. 1907.

Coker, W. C. The development of the seed in the *Pontederiaceae*. Bot. Gaz. **44**: 293–301. *pl. 23*. 19 O 1907.

Conn, H. W., Esten, W. M. & Stocking, W. A. A classification of dairy bacteria. Ann. Rep. Storrs Agric. Exp. Sta. **18**: 91–203. 1907.

Correvon, H. De quelques Composées vivaces nouvelles ou pue connues. Rev. Hort. **79**: 467, 468. 16 O 1907.

Deals almost wholly with American species.

Coulter, S. & Dorner, H. B. A key to the genera of the native forest trees and shrubs of Indiana. 1–24. *pl. 1, 2*. Lafayette, 1907.

Davidson, A. Notes on *Sphaerostigma*. Muhlenbergia **3**: 105–108. 26 O 1907.

Includes *S. Hallii* sp. nov., native of California.

Davis, J. J. A new species of *Protomyces*. Jour. Myc. **13**: 188, 189. 12 S 1907.

Protomyces gravidus sp. nov., native of Wisconsin.

Day, M. A. Some perplexities of the indexer. Bot. Gaz. **44**: 304–306. 19 O 1907.

Dietel, P. Einige neue Uredineen aus Südamerika. Ann. Myc. **5**: 244–246. 20 Jl 1907.

New species in *Uromyces*, *Puccinia* (3), and *Coleosporium*.

Drummond, J. R. & Wright, C. H. *Agave* (*Littaea*) *Watsoni*. Kew Bull. Misc. Inf. **1907**: 322, 323. Au 1907.

Durand, E. J. The mycological writings of Theodor Holmskjold and their relation to Persoon's Commentatio. Jour. Myc. **13**: 141, 142. 25 Jl 1907.

Fernald, M. L. The soil preferences of certain alpine and subalpine plants. Rhodora **9**: 149–193. 13 S 1907.

Fernow, B. E. The high Sierra Maestra. Bull. Am. Geog. Soc. **39**: 257–268. *map*. My 1907.

Fink, B. Further notes on cladonias. XII. *Cladonia bacillaris*, *Cladonia macilenta* and *Cladonia didyma*. Bryologist **10**: 77–79. *pl. 10*. 3 S 1907.

Fink, B. A round trip from Iowa to Puget Sound. III. Eastward bound. Plant World **10**: 237–244. *f. 46*. O 1907.

Foussat, J. Le *Choisya ternata* dans la région mediterranéenne. Rev. Hort. **79**: 370, 371. *f. 121, 122*. 16 Au 1907.
Native of Mexico.

Gager, C. S. The absence of undergrowth in the hemlock forest. Jour. N. Y. Bot. Gard. **8**: 237–240. *f. 34*. O 1907.

Gratacap, L. P. A trip around Iceland. Pop. Sci. Mo. **71**: 289–302. O 1907; 420–432. N 1907. [Illust.]
Contains notes upon the flora.

Greene, E. L. Linnaean memorial address. Proc. Wash. Acad. Sci. **9**: 241–271. 31 Jl 1907.

Gürke, M. *Echinocactus brachyanthus* Gürke, n. sp. Monats. Kakteenk. **17**: 123, 124. 15 Au 1907.
Native of Argentina.

Gürke, M. *Echinocactus Kurtzianus* Gürke. Monats. Kakteenk. **17**: 126, 127. 15 Au 1907. [Illust.]
Native of Argentina.

Gürke, M. *Echinopsis lateritia* Gürke, n. sp. Monats. Kakteenk. **17**: 151, 152. 15 O 1907.
Native of Bolivia.

Gürke, M. *Echinopsis mamillosa* Gürke, n. sp. Monats. Kakteenk. **17**: 135, 136. 15 S 1907.
Native of Bolivia.

Gürke, M. *Mamillaria Brandegeei* Engelm. Monats. Kakteenk. **17**: 136, 137. 15 S 1907.

Gürke, M. *Mamillaria Haynii* Ehrenb. Monats. Kakteenk. **17**: 152–155. 15 O 1907.
Native of Mexico.

Gürke, M. *Pterocactus decipiens* Gürke, n. sp. Monats. Kakteenk. **17**: 145–148. 15 O 1907.
Native of Argentina.

Handy, L. H. A pink-petaled form of *Clethra alnifolia*. Rhodora **9**: 195, 196. 13 S 1907.

Harper, R. M. A Long Island cedar-swamp. Torreya **7**: 198–200. 18 O 1907.

Harrow, R. L. *Heeria elegans*. Gard. Chron. III. **42**: 293. *f. 118*. 26 O 1907.
Native of Mexico.

Harshberger, J. W. The reclamation and cultivation of salt marshes and deserts. Bull. Geog. Soc. Phila. **5**: 12–23. *f. 1–4*. Jl 1907.

Hart, J. H. *Arpophyllum giganteum*. Gard. Chron. III. **42**: 162. 31 Au 1907.

Hart, J. H. Some polypodiums in Trinidad. Gard. Chron. III. **42**: 252. 5 O 1907.

Hasse, H. E. Unreported plants from the vicinity of Los Angeles, California. Muhlenbergia **3**: 114. 26 O 1907.

Hein, W. H. Some observations on the flowers of *Acer saccharinum*. Plant World **10**: 200–205. S 1907.

Heller, A. A. The flora of Santa Clara County, California — VI. Muhlenbergia **3**: 115–118. 26 O 1907.

Heller, A. A. The habitat of *Polypodium Scouleri*. Muhlenbergia **3**: 114. 26 O 1907.

Hemsley, W. B. *Bigelovia graveolens*. Curt. Bot. Mag. IV. **3**: *pl. 8155*. S 1907.
Native of western North America.

Hieronymus, G. Plantae Stübelianae. *Pteridophyta*. Von Dr. Alfons Stübel auf seinen Reisen nach Südamerika, besonders in Columbien, Ecuador, Peru und Bolivien gesammelte Pteridophyten (Gefässkryptogamen). II. Hedwigia **46**: 322–336. *pl. 3–5*. 8 Je 1907; 337–364. *pl. 6–8*. 15 Jl 1907.
Includes new species in *Hypoderris*, *Dryopteris* (19), *Aspidium*, and *Polystichum* (3).

Hollick, A. Description of a new Tertiary fossil flower from Florissant, Colorado. Torreya **7**: 182–184. *f. 1, 2*. 21 S 1907.
Phenanthera petalifera sp. nov.

Holzinger, J. M. *Musci* and *Hepaticae* of Washington, D. C., and vicinity. Bryologist **10**: 85–92. 3 S 1907.

Jennings, O. E. A case of poisoning by *Amanita phalloides*. Jour. Myc. **13**: 187, 188. 12 S 1907.

Kellerman, W. A. Fungi selecti guatemalenses. Exsiccati decade II. Jour. Myc. **13**: 99–102. 31 My 1907.

Kern, F. D. New western species of *Gymnosporangium* and *Roestelia*. Bull. Torrey Club **34**: 459–463. O 1907.

Three new species in *Gymnosporangium* and 3 in *Roestelia*.

Kindberg, N. C. New notes on the North American bryology. Rev. Bryol. **34**: 87–92. Au 1907.

Includes new American species in *Pseudoleskea*, *Hypnum* (2), *Dichodontium*, *Grimmia* (2), *Bryum* (4), and *Pohlia*.

Land, W. J. G. Fertilization and embryogeny in *Ephedra trifurca*. Bot. Gaz. **44**: 273–292. *pl. 20–22.* 19 O 1907.

Lewis, F. T. The capitalization of specific names. Am. Nat. **41**: 525–529. 26 Au 1907.

Linden, L. *Odontoglossum Pescatorei* Linden, versus *O. nobile* Reichb. f. Gard. Chron. III. **42**: 275. 19 O 1907.

Lloyd, C. G. The phalloids of Australasia. 1–24. *f. 1–8, 10–17, 19–25.* Jl 1907.

Loew, O. On the effects of magnesium sulphate on plants. Science II. **26**: 512. 18 O 1907.

Long, W. H. The *Phalloideae* of Texas. Jour. Myc. **13**: 102–114. *pl. 102–106.* 31 My 1907.

McAtee, W. L. Census of four square feet. Science II. **26**: 447–449. 4 O 1907.

MacBride, T. H. On certain fossil plant remains in the Iowa herbarium. Proc. Davenport Acad. Sci. **10**: 153–162. *pl. 1–12.* 20 F 1907.

New species in *Sigillaria*, *Psaronius*, and *Araucarioxylon*.

MacDougal, D. T. Factors affecting the seasonal activities of plants. Plant World **10**: 217–237. *f. 43–45.* O 1907.

Macoun, J. M. *Eruca sativa* Mill. Ottawa Nat. **24**: 113. 24 O 1907.

Marshall, N. L. Mosses and lichens. A popular guide to the identification and study of our commoner mosses and lichens, their uses, and methods of preserving. i–xviii, 1–327. New York, 1907. [Illust.]

Merrill, E. D. The ascent of Mount Halcon, Mindoro. Philipp. Jour. Sci. **2**: Gen. Sci. 179–205. *pl. 1.* 20 Je 1907.

Many notes upon the vegetation of the region.

Merrill, E. D. The flora of Mount Halcon, Mindoro. Philipp. Jour. Sci. **2**: Bot. 251–309. 15 Jl 1907.

Includes descriptions of 39 new species and 2 new genera, *Halconia* (*Tiliaceae*), and *Mearnsia* (*Myrtaceae*): the families *Iridaceae* and *Centrolepidaceae* reported as new to the Philippines.

Murrill, W. A. An old locust post. Jour. N. Y. Bot. Gard. **8**: 173–175. *f. 27.* Au 1907.

Murrill, W. A. Some Philippine *Polyporaceae.* Bull. Torrey Club **34**: 465–481. 19 O 1907.

Includes new species in *Cori lus*, *Funalia*, *Hapalopilus*, *Inonotus*, *Microporellus*, *Polyporus* (2), *Spongipellis*, *Trametes*, (5), *Tyromyces*, *Amauroderma*, *Elfvingia*, *Fomes* (2), *Ganoderma* (2), *Pyropolyporus* (3), and *Gloeophyllum.*

Nash, G. V. A collection of American desert plants. Jour. N. Y. Bot. Gard. **8**: 169–173. *pl. 40* + *f. 26.* Au 1907.

Nash, G. V. Water lilies and other aquatics: their relation to horticulture. Jour. N. Y. Bot. Gard. **8**: 202–220. *pl. 41* + *f. 29–33.* S 1907.

Noter, R. de. Les *Gaura.* Rev. Hort. **79**: 373, 374. *f. 123.* 16 Au 1907.

Noter, R. de. Les Pentstémons. Rev. Hort. **79**: 330–332. *f. 110–113.* 16 Jl 1907.

Olsson-Seffer, P. Visits to some botanic gardens abroad. Plant World **10**: 193–200. *f. 38–41.* S 1907.

Orton, W. A. Plant diseases in 1906. Yearbook U. S. Dept. Agric. **1906**: 499–508. 1907.

Osterhout, W. J. V. On the importance of physiologically balanced solutions for plants. II. Fresh-water and terrestrial plants. Bot. Gaz. **44**: 259–272. *f. 1–7.* 19 O 1907.

Palla, A. Neue Cyperaceen. Oesterr. Bot. Zeits. **57**: 257, 258. Au 1907.

New South American species of *Cyperus* and *Bulbostylis.*

Parish, S. B. An abnormal leaf in *Rumex.* Torreya **7**: 184, 185. *f. 3.* 21 S 1907.

Patouillard, N. Basidiomycètes nouveaux du Brésil recueillis par F. Noack. Ann. Myc. **5**: 364–366. 20 S 1907.

New species in *Septobasidium*, *Lachnocladium*, *Melanopus*, *Leptoporus*, *Xanthochrous* (2), and *Calvatia.*

Pease, C. E. A new botanical garden. Am. Bot. **13**: 3–5. S 1907.

Perkins, J. *Styracaceae.* Das Pflanzenreich 4^{241}: 1–111. *f. 1–18.* 3 S 1907.

Purpus, A. *Echeveria turgida* Rose, n. sp. Monats. Kakteenk. **17**: 148–151. 15 O 1907. [Illust.]
Native of Mexico.

Purpus, J. A. *Mamillaria hidalgensis* J. A. Purpus, n. sp. Monats. Kakteenk. **17**: 118–121. 15 Au 1907. [Illust.]
Native of Mexico.

Quaintance, A. L. & Shear, C. L. Insect and fungous enemies of the grape east of the Rocky Mountains. U. S. Dept. Agric. Farm. Bull. **284**: 1–48. *f. 1–35.* 10 My 1907.

Quehl, L. *Mamillaria Wrightii* Engelm. und *Mamillaria zephyranthoides* Scheidw. Monats. Kakteenk. **17**: 124–126. 15 Au 1907.

Record, S. J. The forests of Arkansas. For. Quart. **5**: 296–301. S 1907.

Reed, H. S. The parasitism of *Neocosmospora.* Science II. **26**: 441–443. 4 O 1907.

Rehm, H. *Ascomycetes* exs. fasc. 39. Ann. Myc. **5**: 207–213. 20 Jl 1907.
Includes new species of *Nectria* (undescribed) and *Asterina* from South America.

Rick, J. *Fungi* austro-americani fasc. VII und VIII. Ann. Myc. **5**: 335–338. 20 S 1907.

Rolfe, R. A. *Cattleya* × *bahiensis.* Orch. Rev. **15**: 279, 280. S 1907.
Native of Brazil.

Rolfe, R. A. *Cattleya* × *bahiensis.* Orch. Rev. **15**: 316. O 1907.
Native of Brazil, though not of Bahia.

Rolfe, R. A. *Cattleya* × *Frankeana.* Orch. Rev. **15**: 280. S 1907.
Native of Brazil.

Rolfe, R. A. Mexican laelias. Orch. Rev. **15**: 302, 303. O 1907.

Rolfe, R. A. Natural hybrid cattleyas. Orch. Rev. **15**: 293–296. O 1907.

Rolfe, R. A. *Odontoglossum nobile* and *O. Pescatorei.* Orch. Rev. **15**: 311, 312. O 1907.
Native of South America.

Rolfe, R. A. *Oncidium Stanleyi.* Orch. Rev. **15**: 281, 282. *f. 32.* S 1907.
Native of Brazil.

Rolfe, R. A. *Spiranthes gracilis.* Orch. Rev. **15**: 313–315. *f. 35.* O 1907.

With notes on some other North American orchids.

Rusby, H. H. Some little-known edible native fruits of the United States. Jour. N. Y. Bot. Gard. **8**: 175, 177–188. Au 1907.

Ruthven, A. G. A collection of reptiles and amphibians from southern New Mexico and Arizona. Bull. Am. Mus. Nat. Hist. **23**: 483–603. *f. 1–22.* 20 Au 1907.

Contains notes on the flora and illustrations of vegetation.

Rydberg, P. A. Studies on the Rocky Mountain flora—XVIII. Bull. Torrey Club **34**: 417–437. 10 O 1907.

Includes new species in *Homalobus* (5), *Diholcos, Kentrophyta, Aragallus* (3), *Hedysarum, Lathyrus, Capnoides* (2), *Lepidium* (3), *Thelypodium* (2), *Pleurophragma, Sophia* (2), and *Arabis:* and the new genera *Thelypodiopsis, Pleurophragma, Hesperidanthus, Stanleyella, Heterothrix,* and *Chlorocrambe.*

Schelle, E. *Pterocactus Kuntzei* K. Schum. Monats. Kakteenk. **17**: 137, 138. 15 S 1907.

Native of Argentina.

Schulz, O. E. *Erythroxylaceae.* Das Pflanzenreich 4^{134}: 1–176. *f. 1–32.* 13 Au 1907.

Scott, D. H. The flowering plants of the Mesozoic age, in the light of recent discoveries. Jour. Roy. Micr. Soc. **1907**: 129–141. *pl. 6–9.* 17 Ap 1907.

Scotti, L. Contribuzioni alla biologia fiorale delle "*Myrtiflorae.*" Ann. di Bot. **6**: 25–108. 20 Au 1907.

Setchell, W. A. Some unreported Alaskan *Sphagna,* together with a summary of the cryptogamic work of the University of California botanical expedition to Alaska in 1899. Univ. Calif. Publ. Bot. **2**: 309–315. 27 S 1907.

Shear, C. L. Cranberry diseases. U. S. Dept. Agric. Bur. Pl. Ind. Bull. **110**: 1–64. *pl. 1–7.* 10 O 1907.

Sheldon, J. L. Species of *Hepaticae* known to occur in West Virginia. Bryologist **10**: 80–84. 3 S 1907.

Sheldon, J. L. A study of the leaf-tip blight of *Dracaena fragrans.* Jour. Myc. **13**: 138–140. 25 Jl 1907.

Physalospora Dracaenae sp. nov.

Smith, E. F. The parasitism of *Neocosmospora* — inference versus fact. Science II. **26**: 347–349. 13 S 1907.

Smith, R. E. Report of the plant pathologist to July 1, 1906. Calif. Agric. Exp. Sta. Bull. **184**: 219–258. *f. 1–12.* Ja 1907.

Smith, W. *Escallonia pterocladon.* Gard. Chron. III. **42**: 162. 31 Au 1907.
Native of Patagonia.

Solms-Laubach, H. Graf zu. Ueber eine kleine Suite hochandiner Pflanzen aus Bolivien, die Prof. Steinmann von seiner Reise im Jahre 1903 mitgebracht hat. Bot. Zeit. **65**[1]: 119–138. *pl. 2.* 15 Jl 1907.
New species in *Malvastrum*, *Oxalis*, *Echinocactus*, *Adesmia*, and *Haylockia.*

Spaulding, P. A blight disease of young conifers. Science II. **26**: 220, 221. 16 Au 1907.

Spaulding, P. Heart rot of *Sassafras Sassafras* caused by *Fomes Ribis.* Science II. **26**: 479, 480. 11 O 1907.

Spillman, W. J. The artificial production of mutants — a suggestion. Science II. **26**: 479. 11 O 1907.

Stevens, F. L. The chrysanthemum ray-blight. Bot. Gaz. **44**: 241–258. *f. 1–15.* 19 O 1907.

Stevens, F. L. & Hall, J. G. An apple rot due to *Volutella.* Jour. Myc. **13**: 94–99. *f. 1–6.* 31 My 1907.
Volutella fructi sp. nov., native of North Carolina.

Stockberger, W. W. The drug known as pinkroot. U. S. Dept. Agric. Bur. Pl. Ind. Bull. **100**: 41–49. *f. 5, 6 + pl. 5, 6.* 25 Ap 1907.

Stockdale, F. A. Disease of coconut trees. Bull. Misc. Inf. Trinidad **7**: 261–287. O 1907.

Sturgis, W. C. The *Myxomycetes* of Colorado. Colo. Coll. Publ. Sci. **12**: 1–43. S 1907.
Includes *Physarum testaceum* sp. nov.

Sumstine, D. R. *Polyporus pennsylvanicus* sp. nov. Jour. Myc. **13**: 137, 138. 25 Jl 1907.

Sydow, H. & P. Novae *Fungorum* species — IV. Ann. Myc. **5**: 338–340. 20 S 1907.
Includes new American species in *Uromyces*, *Dimerosporium*, *Leptosphaeria*, *Apo-sphaeria*, *Cercospora*, and *Botryoconis.*

Sydow, H. & P. Verzeichnis der von Herrn F. Noack in Brasilien gesammelten Pilze. Ann. Myc. **5**: 348–363. 20 S 1907.
Includes new species in *Puccinia*, *Uredo*, *Sphaerella*, *Diplotheca ?*, *Lizoniella*, *Xylaria* (2), *Nectria*, *Peloronectria*, *Hypocrella*, *Phyllachora*, *Dothidea*, *Dothidella*, *Acrospermum*, *Leptothyrium* (2), *Melasmia*, and *Gloeosporium.*

Taylor, N. A new *Mikania* from Cuba. Torreya **7**: 185, 186. 21 S 1907.
Mikania alba sp. nov.

Taylor, N. A rare seedling at the propagating houses. Jour. N. Y. Bot. Gard. **8**: 240–243. *f. 35.* O 1907.

Tumboa Bainesii (*Welwitschia mirabilis*).

Thornber, J. J. Alfilaria in Arizona. Plant World **10**: 205–208. *f. 42.* S 1907.

Trotter, S. Peter Kalm's "Travels." Pop. Sci. Mo. **71**: 413–419. N 1907.

Tuzson, J. Ueber einen neuen Fall der Kleistogamie. Bot. Jahrb. **40**: 1–14. *pl. 1, 2.* 21 My 1907.

Ule, E. Die Pflanzenformationen des Amazonas-Gebietes. Pflanzengeographische Ergebnisse meinen in den Jahren 1900–1903 in Brasilien und Peru unternommenen Reisen. Bot. Jahrb. **40**: 114–172. *pl. 3–7.* 2 Au 1907.

Many species indicated as new, but without descriptions.

Underwood, L. M. The names of some of our native ferns. Torreya **7**: 193–198. 18 O 1907.

Watson, W. *Iris verna.* Curt. Bot. Mag. IV. **3**: *pl. 8159.* O 1907.

Native of the eastern United States.

Wercklé, C. Columbianische Agaven. Monats. Kakteenk. **17**: 121–123. 15 Au 1907.

Wight, W. F. The history of the cowpea and its introduction into America. U. S. Dept. Agric. Bur. Pl. Ind. Bull. **102**[6]: 1–21. *pl. 1–3.* 10 Je 1907.

Williams, F. N. A revision of *Stellaria* subg. *Adenonema.* Bull. Herb. Boiss. II. **7**: 830–836. 30 S 1907.

Wilson, E. Notes on the genus *Vaccinium.* Ottawa Nat. **24**: 114, 115. 24 O 1907.

Wilson, G. W. An historical review of the proposed genera of *Phycomycetes* — I. *Peronosporales.* Jour. Myc. **13**: 205–209. 12 S 1907.

Wilson, G. W. Studies in North American *Peronosporales* — II. *Phytophthoreae* and *Rhysotheceae.* Bull. Torrey Club **34**: 387–416. 10 O 1907.

Includes *Phytophthora Thalictri* Wilson & Davis sp. nov., and the new genus *Rhysotheca.*

Witasek, J. Ueber Kränzlins Bearbeitung der "*Scrophulariaceae-Antirrhinoideae-Calceolarieae*" in Englers "Pflanzenreich." Oesterr. Bot. Zeits. **57**: 217–230. *f. 1–9.* Je 1907; 259–265. *f. 10, 11.* Au 1907.

Woodburn, W. L. A remarkable case of polyspermy in ferns. Bot. Gaz. **44**: 227. *f.* 18 S 1907.

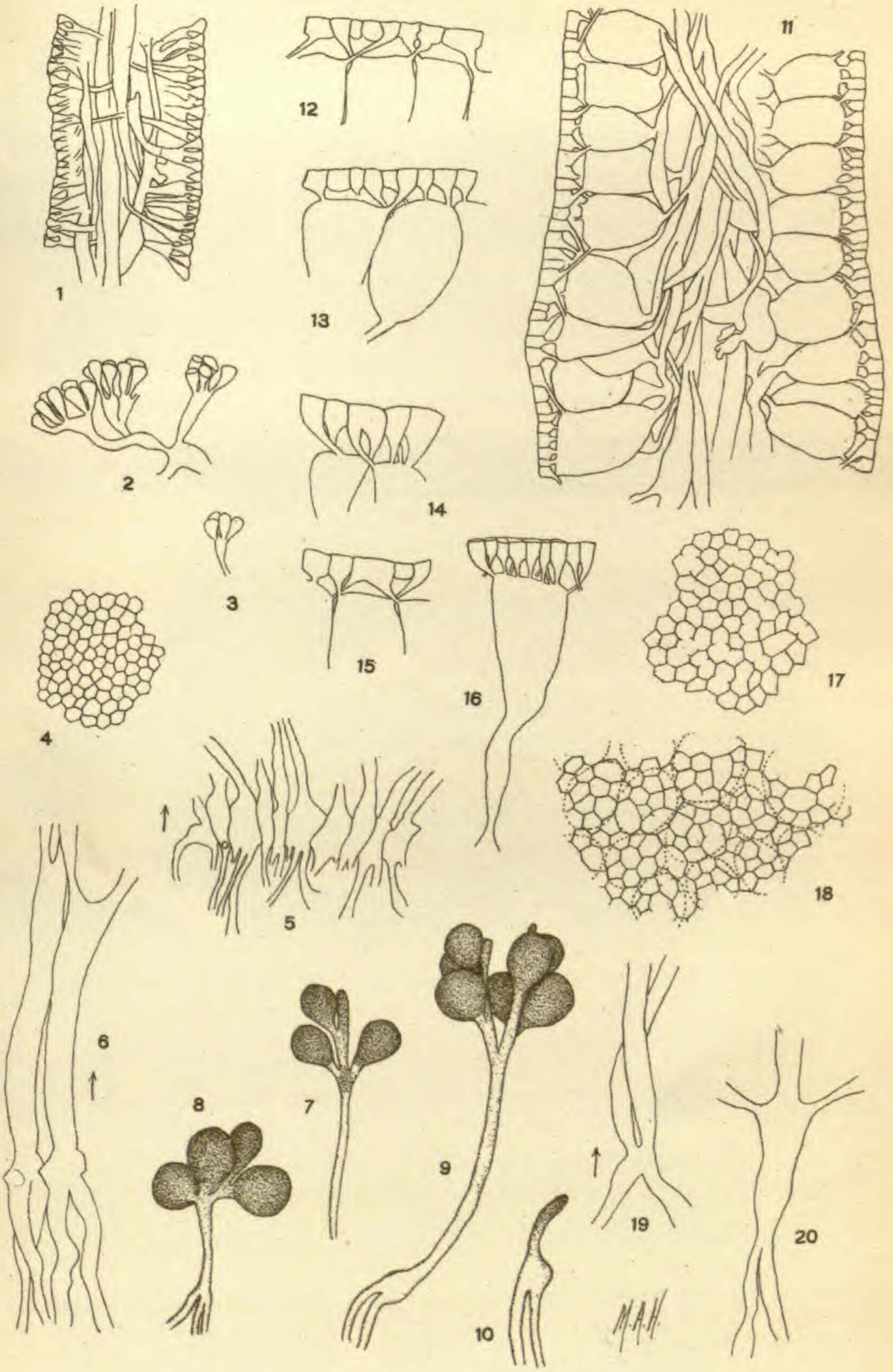
Woods, A. F. Plant pathology. Science II. **26**: 541–543. 25 O 1907.

Wright, C. H. *Calathea angustifolia.* Curt. Bot. Mag. IV. **3**: *pl. 8149.* Au 1907.
Native of Central America.

Wright, C. H. *Herbertia Amatorum.* Kew Bull. Misc. Inf. **1907**: 321, 322. Au 1907.
A new species, native of Uruguay.

Yamanouchi, S. Apogamy in *Nephrodium.* Bot. Gaz. **44**: 142–146. 16 Au 1907.

Young, M. S. The male gametophyte of *Dacrydium.* Bot. Gaz. **44**: 189–196. *pl. 19.* 18 S 1907.



1-10 HALIMEDA TUNA (Ell & Soland) Lamour.
11-20 HALIMEDA DISCOIDEA Decaisne.

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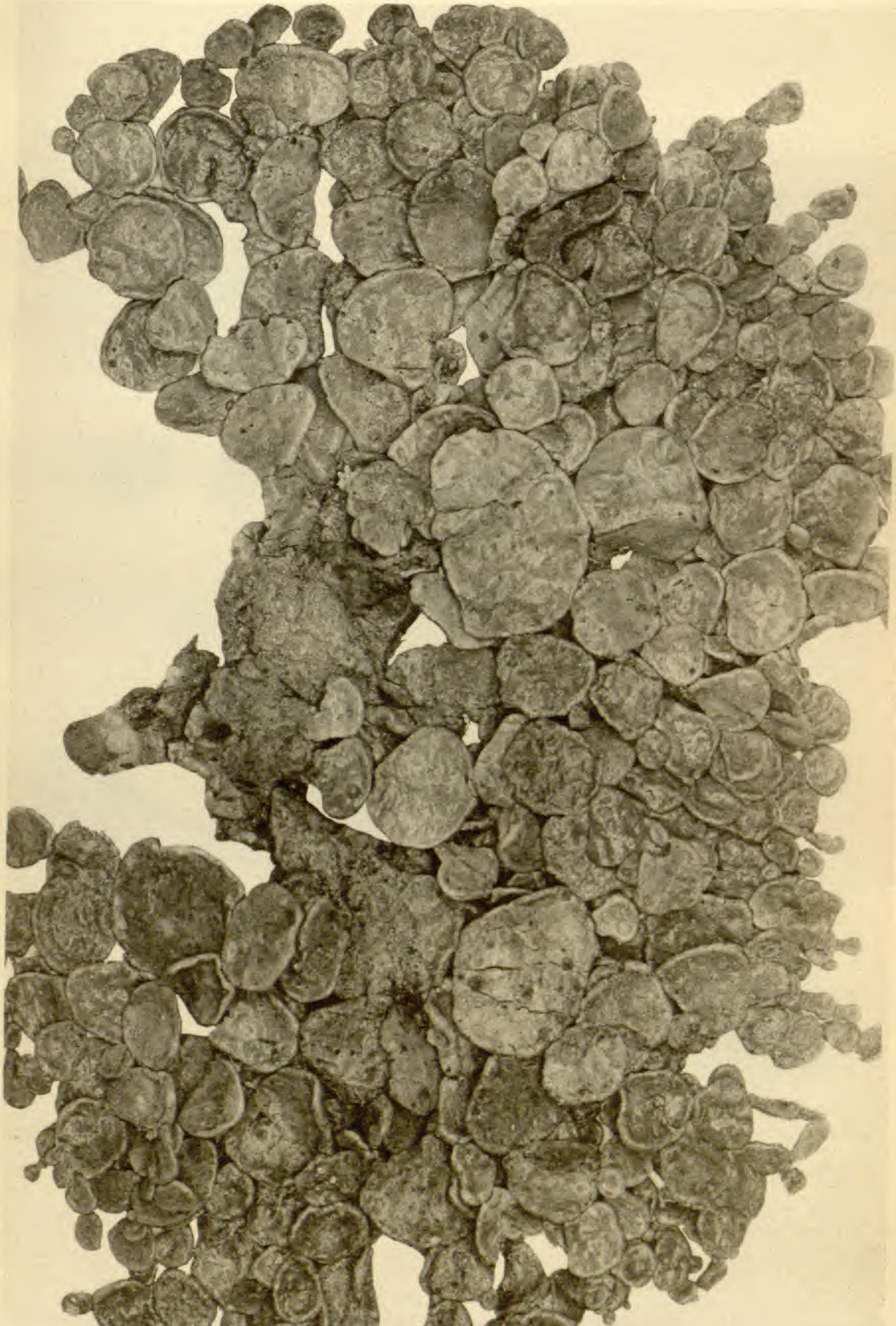

HALIMEDA DISCOIDEA Decaisne

1. HALIMEDA TRIDENS (Ell. & Soland.) Lamour.
2-4. HALIMEDA TUNA (Ell. & Soland.) Lamour.

1 and 2 HALIMEDA TUNA (Ell. & Soland.) Lamour.
3-7 HALIMEDA TRIDENS (Ell. & Soland.) Lamour.
8-25 AVRAINVILLEA NIGRICANS Decaisne.

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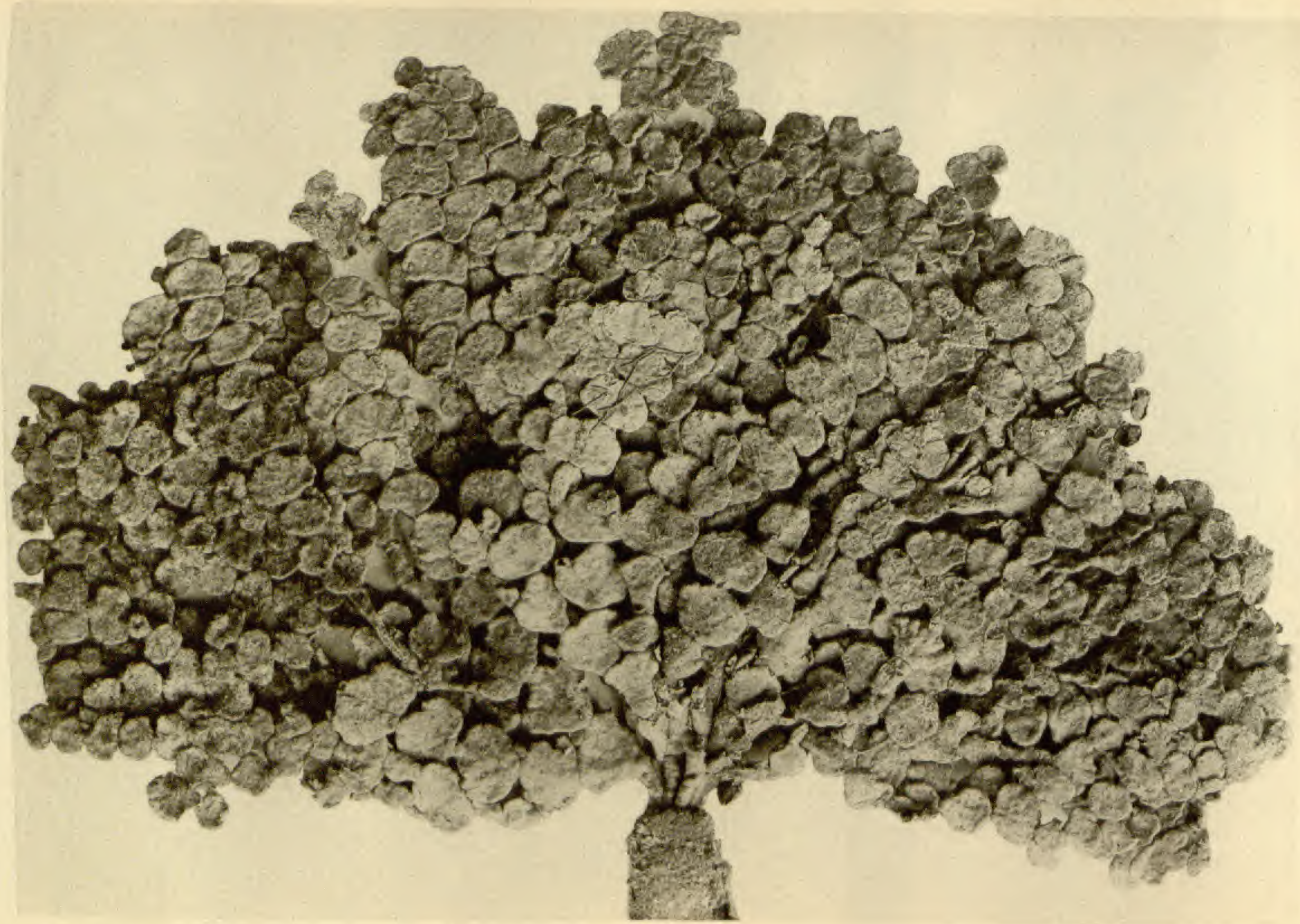

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Martindale, Isaac Comly. Marine algae of the New Jersey coast and adjacent waters of Staten Island. Pages 87–111. 24 Au 1889.

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Spruce, Richard. *Hepaticae* Bolivianae, in Andibus Boliviae orientalis, annis 1885–6, a cl. H. H. Rusby lectae. Pages 113–140. 20 Ja 1890.

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Sturtevant, Edward Lewis. On seedless fruits. Pages 141–187. 30 My 1890.

Vol. 2, No. 1; not furnished separately:

Halsted, Byron David. Reserve food-materials in buds and surrounding parts. Pages 1–26, *plates 1, 2.* 10 S 1890.

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Vail, Anna Murray & Hollick, Charles Arthur. Contributions to the botany of Virginia. Pages 27–56, *plates 3, 4.* 23 D 1890.

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Holm, Herman Theodor. Contributions to the knowledge of the germination of some North American plants. Pages 57–108, *plates 5–19.* 15 Ap 1891.

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Morong, Thomas. The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74.* 15 Mr 1893.

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Underwood, Lucien Marcus. Index *Hepaticarum*. Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

Small, John Kunkel & Vail, Anna Murray. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 93–201, *plates 75–82.* 18 N 1893–17 Ap 1894.

Vol. 4, No. 3; price, 50 cents:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

Vol. 4, No. 4; price, 50 cents:

Pettit, Anna Stockton. *Arachis hypogaea* L. Pages 275–296, *plates 83–85* 5 Je 1895.

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CONTENTS

Hepaticae of Puerto Rico—VIII. Symbiezidium, Marchesinia, Mastigolejeunea, Caudalejeunea, and Bryopteris. (Plates 31–33.) ALEXANDER WILLIAM EVANS 533

Mosses from tropical America . . . . . ROBERT STATHAM WILLIAMS 569

INDEX TO AMERICAN BOTANICAL LITERATURE. 575

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NOVEMBER, 1907

Hepaticae of Puerto Rico

VIII. SYMBIEZIDIUM, MARCHESINIA, MASTIGOLEJEUNEA, CAUDALEJEUNEA, AND BRYOPTERIS

ALEXANDER WILLIAM EVANS

(WITH PLATES 31–33)

SYMBIEZIDIUM

The authors of the Synopsis Hepaticarum divided the genus *Lejeunea* into the three sections *Phragmicomoideae* (with 38 species), *Typicae* (with 225 species), and *Ceratanthae* (with 29 species).* In these sections they included all the species which they referred to the genus, with the exception of a few which were incompletely known. Apparently the first attempt to segregate this vast group was made by Trevisan in 1877.† His method was very simple and consisted in the elevation of the three sections to generic rank. To the first he gave the name *Symbiezidium*, for the second he retained the name *Lejeunea*, for the third (as already noted by the writer in another connection) he revived the old generic name *Colura* of Dumortier. For some reason the genus *Symbiezidium* has been virtually ignored by subsequent writers, perhaps because Trevisan's compilation was so soon followed by the thorough and well-known work of Spruce on South American *Hepaticae*, perhaps because according to our present views the genus is still an aggregate and includes species which would now be distributed among ten recognized genera. Neither of these reasons is sufficient to

* *L. c.* 308–410. 1845; 748–770. 1847.

† Schema di una nuova classificazione delle epatiche. Mem. Ist. Lomb. III. 4: 383–451. 1877.

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invalidate its claims for recognition and, with emended characters, it should reappear in the literature of hepaticology. The first species which Trevisan quotes under *Symbiezidium* is *S. transversale*, based on the *Jungermannia transversalis* of Swartz. This species therefore should be regarded as the type of the genus. *J. transversalis*, however, has a number of close allies and forms with them the recognized genus *Platylejeunea*,* one of the most natural genera of the *Lejeuneae*. In consequence of these facts the writer suggests that the name *Platylejeunea* be replaced by the older generic name of Trevisan.

As thus restricted the genus *Symbiezidium* comprises twelve species, nine of which grow in the American tropics and the other three on various islands of the Pacific. No species are known at present from either Asia or Africa. The genus includes some of the most robust of the *Lejeuneae*, the stems in certain species being sometimes 10–15 cm. in length. The plants tend to be glossy and are nearly always more or less pigmented with brown or olive. The stems are at first prostrate and sometimes the prostrate habit is retained throughout life by both stems and branches. In other cases the plants become pendulous, but a marked contrast between a creeping caudex and secondary, pendulous stems never becomes apparent. The branching is irregular and is often abundant on old plants. In nearly every case, however, the ends of the stem and of the principal branches remain simple for a considerable distance, thus giving the members of the genus a peculiar and characteristic appearance.

The leaves are more or less imbricated, and their lobes spread widely from the stem (PLATE 31, FIGURES 1, 11), not shrinking appreciably nor changing their position upon drying. They vary in outline from ovate-oblong to broadly ligulate and tend to be convex along the antical side and at the apex and concave along the postical side. They are rounded to subcordate at the base and arch across or a little beyond the axis (FIGURE 2). The apex is broad and almost always rounded but in certain species is occasionally apiculate or even subacute. Except for these rare apical teeth the margins are entire or nearly so.

The lobule, even in the same species, varies greatly in size and

* See Schiffner; Engler & Prantl. Nat. Pflanzenfam. 1[3]: 130. 1895.

in the degree of complexity which it exhibits. Much of this apparent variation, however, is simply due to imperfect development. In a normal lobule an inflated basal portion and plane outer portion may be clearly distinguished. The basal portion dilates abruptly from a short line of insertion and is strongly involute, the free margin thus coming into contact with the lobe. In this way a distinct water-sac is formed, which sometimes includes the greater part of the lobule. The sac often bulges forward considerably beyond the short basal line. The plane outer portion of the lobule beyond the sac is bounded by the sinus, which separates slightly from the lobe, thus opening up into the sac a passage-way along the keel. The sinus is usually straight or nearly so, but sometimes shows a rounded or blunt angle. If the involute portion of the free margin is spread out, a slight indentation will be found between its outer extremity and the beginning of the sinus. This indentation is bounded by two projecting cells between which a third cell is situated, sometimes at the bottom of the indentation, sometimes extending forward as far as the projecting cells themselves but in a different plane. The hyaline papilla is borne upon this third cell and is usually curved inward and concealed within the water-sac (FIGURES 6, 7). Apparently the cell which bears the papilla is homologous with the apex of the lobule as seen in other *Lejeuneae*. At any rate the lobule of a perigonial bract, which is normally acute and tipped with a single cell, bears a papilla upon this cell. The keel of the lobule varies greatly, being sometimes straight or slightly arched throughout, sometimes distinctly incurved near the base and arched in the outer portion.

The leaf-cells have firm and pigmented walls and often bulge slightly on the outer surface of the lobe. Their trigones (FIGURE 5) are usually distinct but vary greatly in size even on a single plant; they are of the triradiate type, and the ends of the rays are separated from one another and from the frequent intermediate thickenings by narrow pits. Ocelli are not developed. The cell-structure on the whole resembles that of *Lopholejeunea* and of several other genera of the *Lejeuneae*.

The underleaves in *Symbiezidium* are relatively large and are sometimes scarcely surpassed in size by the leaves themselves. They are attached by a strongly arched line of insertion and are orbicular to reniform in outline (FIGURES 1, 3, 11). They are broad at the apex and vary at the base from cordate to cuneate and long-decurrent, a considerable degree of variation sometimes occurring in a single species. The rhizoids, which are occasionally very abundant, are borne on a rudimentary basal disc.

The female branch is exceedingly short, bearing a single rudimentary leaf with its underleaf in addition to the involucre and perianth (FIGURES 1, 11). All of these parts are so small that they are more or less completely hidden by the large foliage leaves. The flower innovates on one side, the innovation being short and simple. In autoicous species the innovation is sometimes occupied by a male spike. The perichaetial bracts are shortly and subequally bifid, the lobule in some cases being a little larger than the lobe, a remarkable and unique condition among the *Lejeuneae* (FIGURES 8, 9, 12, 13). Both lobe and lobule are entire and vary at the apex from rounded to apiculate. The bracteole is free and is sometimes truncate at the apex, sometimes retuse and sometimes distinctly bifid (FIGURES 10, 14).

The perianth bears a marked resemblance to that found in *Odontolejeunea.* It is obovate in outline and strongly compressed, the broad and low postical keel being rounded or bluntly two-angled in the upper part. The sharp lateral keels bear laciniate wings, and in certain species there are scattered laciniae on the postical surface. The apex of the perianth is distinctly beaked.

The male spikes vary in position and in length; they are sometimes found on leading branches, when they tend to proliferate (FIGURE 3), sometimes on short branches, the growth of which they tend to limit (FIGURE 4). The diandrous bracts are characterized by a rounded lobe and a more or less pointed lobule. The bracteoles are usually restricted to the base of the spike and become very rudimentary when they extend toward the apex. Rudimentary bracteoles are somewhat unusual among the *Lejeuneae Holostipae* but are also found in *Stictolejeunea* and in a few other genera.

The relationship between the present genus and *Lopholejeunea* is commented upon by Spruce. Both genera are characterized by fimbriate perianths, but in *Lopholejeunea* the plants are smaller and more deeply pigmented, the female inflorescence is borne on a longer branch and is normally destitute of an innovation, the bracts are as large as the vegetative leaves or larger, and the male spikes bear bracteoles throughout their entire length. *Odontolejeunea* differs from *Symbiezidium* in its dentate leaves and underleaves, in its denticulate lobules, and in its longer female branch with large bracts.

Four species of *Symbiezidium* have been reported from Puerto Rico, two by Hampe and Gottsche from the collections of Schwanecke, and two others by Stephani from the collections of Sintenis. Of these four species only two occur in the material studied by the writer. These two species are described and figured in the present paper, and attention is called to the other two species.

SYMBIEZIDIUM TRANSVERSALE (Swartz) Trevis.

Jungermannia transversalis Swartz, Prodr. Fl. Ind. Occ. 144. 1788.

Phragmicoma transversalis Nees, Naturg. Europ. Leberm. 3: 248. 1838.

Lejeunea transversalis Nees; G. L. & N. Syn. Hep. 310. 1845 (excluding β and γ).

Symbiezidium transversale Trevis. Mem. Ist. Lomb. III. 4: 403. 1877.

Lejeunea (*Platy-Lejeunea*) *transversalis* Spruce, Hep. Amaz. et And. 124. 1884.

Platylejeunea transversalis Schiffn.; Engler & Prantl, Nat. Pflanzenfam. 1^3: 131. 1895.

Brownish- or yellowish-green, rarely bright-green, slightly glossy, at first scattered but afterwards forming depressed mats of considerable extent: stems prostrate, loosely adherent to the substratum, 0.25 mm. in diameter, at first simple or sparingly branched, becoming copiously and irregularly pinnate with age, the branches prostrate, similar to the stem but with somewhat smaller leaves, not microphyllous: leaves imbricated, the lobe widely spreading, falcate, ovate, on robust stems from 1.5–2 mm. long, 1.2 mm. wide, rounded to slightly cordate at the base and arching across or a little beyond the axis, antical margin slightly outwardly curved to the broad and rounded apex, postical margin incurved near keel and forming with it a rounded or obtuse angle; lobule ovate or ovate-lanceolate in general outline, 0.45 mm. long, 0.2 mm. wide, strongly inflated in the basal half; cells of lobe averaging 25 μ at the margin, 30 μ in the middle and $40 \times 30\,\mu$ at the base, trigones with acute to truncate rays, intermediate thickenings circular: underleaves imbricated, plane or convex along the lateral margins (from below), plane or revolute at the apex, reniform, 1.2 mm. long, 2 mm. wide, straight to rounded or subcordate at the base and sometimes a little decurrent, apex broad, rounded to slightly retuse, margin entire or vaguely and irregularly sinuate: inflorescence dioicous: ♀ branch arising from the stem or a leading branch; bracts erect-spreading to widely spreading, complicate, sometimes with a short and narrow wing along the keel, lobe oblong, 0.85 mm. long, 0.35 mm. wide, rounded at the apex, lobule similar to the lobe, rounded to apiculate at the apex; bracteole oblong-obovate, 0.85 mm. long, 0.4 mm. wide, truncate to slightly bidentate at the apex with a lunulate sinus and blunt to apiculate teeth; perianth about half-exserted beyond the bracts but almost hidden by the foliage leaves, 1.25 mm. long, 1 mm. wide, truncate to subretuse at the apex with a short beak, lateral keels winged to about the middle, the wings deeply and irregularly laciniate to within from one to three cells of the keel, laciniae long and slender, mostly five to ten cells in length and one or two cells wide at the base, surface of perianth smooth or nearly so: ♂ inflorescence occupying a short branch or borne on a longer branch, in the latter case often proliferous; bracts mostly in five to ten pairs, imbricated, subequally bifid, the lobule obtuse, acute or apiculate, keel narrowly alate in the upper part, the wing one cell wide and crenulate; bracteoles at base of spike similar to the underleaves, wanting altogether or very rudimentary in the upper part: mature sporophyte not seen (PLATE 31, FIGURES 1–10).

On trees. Sierra de Naguabo, *Sintenis* (*2*). North slope of the Luquillo Mountains, *Heller* (*784*, *1144*, *1159*, *1161*, *4761*). El Yunque, *Evans* (*25*, *67*, *126*). The species is apparently confined to the West Indies. In addition to Puerto Rico, it is now known from the following islands: Jamaica, the type locality, *Swartz*, *Evans*; Cuba, *Underwood & Earle*; St. Kitts, *Breutel*; Dominica, *Eggers*, *Lloyd*. The specimens collected by Sintenis, which the writer has had the privilege of studying, evidently belong to the same species as the other specimens listed above. As Stephani states, the Sintenis material agrees closely with Swartzian specimens in the Lindenberg herbarium at Vienna, so that there can be no doubt about the correctness of the determination.

S. transversale is one of the most variable of the *Lejeuneae*, a fact which Stephani has already emphasized.* It varies not only in color and in size but also in some of the structural characters derived from the leaves, underleaves and floral organs, characters which are usually regarded as more or less constant. To a certain extent this variability is indicated in the preceding description, but the lobules and underleaves deserve a few words in addition. The lobules vary considerably in size, being sometimes no longer than the diameter of the axis; they vary more strikingly, however, in the relative size of the water-sac as compared with the plane portion. In extreme cases almost the whole of the lobule enters into the formation of the sac, and under these circumstances the keel sometimes makes a very acute angle with the stem, thus giving the lobule a strong superficial resemblance to the water-sacs in *Frullania.* The underleaves vary somewhat in outline but are nearly always broader than long. They show more marked variation at the base. The margin in this region is sometimes straight, meeting the axis at approximately a right-angle, but it may be rounded, subcordate or distinctly short-decurrent. It is not unusual to find these various conditions on the underleaves of a single stem, and even the two sides of the same underleaf are sometimes very different from each other. The perianth yields some of the most constant characters of the species, although its outline varies somewhat with age, becoming longer as the sporophyte develops. In rare cases the postical surface bears a few scattered cilia near the apex, but it is usually smooth.

SYMBIEZIDIUM GRANULATUM (Nees) Trevis.

Jungermannia granulata Nees; Martius, Fl. Bras. **1**[1]: 352. 1833.

Phragmicoma granulata Nees, Naturg. Europ. Leberm. **3**: 248. 1838.

Lejeunea granulata Nees; G. L. & N. Syn. Hep. 311. 1845.

Symbiezium granulatum Trevis. Mem. Ist. Lomb. III. **4**: 403. 1877.

Lejeunea (*Platy-Lejeunea*) *taeniopsis* Spruce, Hep. Amaz. et And. 126. 1884.

Lejeunia (*Platylejeunea*) *granulata* Steph. Hedwigia **27**: 285. 1888.

Platylejeunea granulata Evans, Trans. Conn. Acad. **10**: 417. 1902.

* Hedwigia **27**: 286. 1888.

Puerto Rico, without definite locality, *Schwanecke*. The original determination of these specimens by Hampe and Gottsche has been confirmed by Stephani and also by Schiffner. The species has also been recorded from Brazil, the type locality, *Sellow*, *Spruce*; from Surinam, *Reichenbach*, *Kegel*; and from St. Vincent, *Elliott*. Stephani also mentions specimens from Ecuador without giving the collector's name.

S. granulatum is known to the writer mainly from South American specimens, and these are too incomplete to give an adequate idea of the species. Its relationship to *S. transversale* is very close, but Stephani considers the two species distinct. In pointing out the differences between them he notes that the lobule in *S. granulatum* is smaller and also that the underleaves are smaller, more rotund in outline, cuneate and long-decurrent at the base and reflexed on the margin. The underleaves in *S. transversale* are said to be reniform, rounded at the base and plane. From the notes on *S. transversale* already given in the present paper it will be seen that some of these differential characters are not altogether reliable, on account of the great variability of the species. It should be stated, however, that the underleaves of *S. granulatum* seem to be constantly cuneate at the base, and that their decurrence is not only more constant but more pronounced than in *S. transversale*. Whether the differential characters which Stephani derives from the perianth are trustworthy is also open to some doubt. In *S. granulatum* the wings of the perianth are said to be coarsely dentate, while those of *S. transversale* are described as long-fimbriate. According to Spruce, however, the wings in *L. taeniopsis*, which Stephani reduces without question to *S. granulatum*, are incised-ciliate, some of the cilia being very long. Apparently some of these questions cannot be settled until more complete material is available for study.

Symbiezidium barbiflorum (Lindenb. & Gottsche)

Lejeunea transversalis β Hookeriana G. L. & N. Syn. Hep. 311. 1845.
Jungermannia incrassata Tayl. *l. c.* (as synonym).
Lejeunea barbiflora Lindenb. & Gottsche, Linnaea **24**: 630. 1851.
Lejeunea (*Platylejeunea*) *barbiflora* Steph. Hedwigia **27**: 282. 1888.
Lejeunea (*Platylejeunea*) *incrassata* Tayl.; Bescherelle & Spruce, Bull. Soc. Bot. France **36**: clxxix. 1889.

Brownish-green, growing in depressed mats, similar in general habit to *S. transversale*: stems 0.15 mm. in diameter: leaves imbricated, the lobe plane or slightly convex along the antical side and sometimes revolute at the apex, scarcely falcate, ovate-oblong, mostly 1–1.2 mm. long and 0.7–0.85 mm. wide, rounded or subcordate at the base and arching across or just beyond the axis, antical margin slightly outwardly curved to the broad and rounded apex, postical margin nearly straight; lobule very variable and often poorly developed, in normal cases attaining a maximum size of 0.35 × 0.25 mm. but often only half as large, similar in structure to that of *S. transversale*; cells of lobe averaging 17μ at the margin, 28μ in the middle, and 35μ at the base, local thickenings of the walls often inconspicuous: underleaves imbricated, plane or a little concave (from below) and sometimes slightly reflexed at the apex, orbicular, 0.75 mm. long, abruptly cuneate and long-decurrent at the base: inflorescence autoicous: subfloral innovation sterile or occupied by a male spike; perichaetial bracts similar to those of *S. transversale* but smaller, both lobe and lobule measuring 0.5–0.7 mm. in length and 0.25–0.35 mm. in width, usually rounded at the apex; bracteole ovate-rectangular, 0.5 mm. long, 0.35 mm. wide, bifid one fourth to one third with a variable sinus and rounded to acute or apiculate divisions; perianth about two thirds exerted beyond the bracts and usually extending beyond the leaves, 1 mm. long, 0.85 mm. wide, truncate at the apex and with a short beak, lateral keels winged in the upper part, the wings deeply and irregularly incised to within one or two cells of the keel, the alar teeth mostly from three to six cells long and one or two cells wide at the base, sometimes subdivided, postical surface with a low keel, rounded or sometimes two-angled in the upper part, surface-laciniae numerous, similar to the alar teeth, irregularly scattered or sometimes more crowded along the angles of the postical keel: ♂ inflorescence occupying a short branch or a subfloral innovation, rarely terminal on a longer branch, not proliferating; bracts mostly in from three to six pairs, imbricated, similar to those of *S. transversale*; bracteoles mostly restricted to the base of the spike: mature sporophyte not seen (PLATE 31, FIGURES 11–14).

On rotten logs. Puerto Rico, without definite locality, *Schwanecke*. North slope of the Luquillo Mountains, *Heller* (779). The species has also been collected in Surinam, the type locality, *Kegel*, *Parker*, and on the islands of Cuba, *Underwood & Earle*, and Guadeloupe, *Marie*. Through the kindness of correspondents the writer has been able to compare Heller's specimens with a portion of Kegel's type material, with Schwanecke's Puerto Rico specimens, and also with Marie's type specimens of *Lejeunea incrassata*. All of these various plants agree closely with one another and evidently belong to the same species.

S. barbiflorum is a smaller plant than *S. transversale*, the lobes of its leaves are less falcate and plane or nearly so along the postical side, and its underleaves are constantly long-decurrent. It is further distinguished by its autoicous inflorescence and by the scattered laciniae on the postical surface of the perianth. In rare cases these laciniae are few in number or even absent altogether, and a smooth or nearly smooth perianth is the result. These smooth perianths, however, present every appearance of being poorly developed, and since they are usually found on plants which bear normal perianths as well, they will rarely be a source of confusion. In all the involucres examined the bracteole has been distinctly bifid, and it is possible that this character may also be relied upon in distinguishing the species from its allies.

SYMBIEZIDIUM VINCENTINUM (Gottsche) Trevis.

Lejeunea vincentina Gottsche; G. L. & N. Syn. Hep. 313. 1845.

Symbiezidium vincentinum Trevis. Mem. Ist. Lomb. III. 4: 403. 1877.

Lejeunea (*Platy-Lejeunea*) *vincentina* Spruce, Hep. Amaz. et And. 127. 1885.

Platylejeunea vincentina Schiffn.; Engler & Prantl, Nat. Pflanzenfam. 1^3: 131. 1895.

Puerto Rico, without definite locality, *Sintenis* (*64*). The type locality of the species is the island of St. Vincent, but the original collector is not mentioned by Gottsche. The following stations have also been recorded: Guadeloupe, *Husnot*; Dominica, *Elliott*; Colombia, *Moritz*; Brazil, *Schenck*; Ecuador, *Spruce*. The species has also been collected in Jamaica by *Maxon*, but no specimens from Puerto Rico have been seen by the writer.

S. vincentinum agrees with *S. barbiflorum* in its autoicous inflorescence. Its leaves, however, although usually rounded at the apex, are occasionally apiculate or shortly acute, a peculiarity which is emphasized by both Gottsche and Spruce. The underleaves are somewhat broader than in *S. barbiflorum*, tending to be reniform in outline, but they agree in being decurrent. The perianth, finally, is provided with incised wings along the lateral keels but is usually quite free from surface-laciniae. In a single instance a very few cilia were found at the apex of the indistinct postical keel. In comparing *S. vincentinum* with *S. transversale* it is seen to be a somewhat smaller plant and to differ in its autoicous inflorescence, in its occasionally apiculate leaves, and in its constantly decurrent underleaves. In other respects the two species are much alike. The material of *S. vincentinum* at the writer's disposal, although including a portion of the type specimen from the Hooker herbarium, is too incomplete to give a good idea of its various forms, and more study will be necessary before its differential characters are fully understood.

MARCHESINIA

The genus *Marchesinia* of S. F. Gray (1821) * was monotypic, being based on the single species *Jungermannia Mackaii* Hook. The genus *Phragmicoma* of Dumortier,† published the following year, was also monotypic and was based on the same species. *Phragmicoma* should therefore be considered a simple synonym of *Marchesinia*. Dumortier's genus, however, was accepted by Nees von Esenbeck,‡ who referred to it sixteen tropical species in addition to the single species upon which it was based. In the Synopsis Hepaticarum § the genus is still further enlarged by the addition of other tropical species until it numbers thirty-four in all. With the exception of three species these are all included in the two sections *Typus* (with six species) and *Ptychanthoides* (with twenty-five). *Phragmicoma* continued to be used by writers until Gray's genus was revived by Carruthers ‖ in the original sense. When Trevisan ¶ made use of the genus *Marchesinia* he gave it practically the characters of *Phragmicoma*, section *Typus*, of the Synopsis, referring to it seven species in all. The section *Ptychanthoides* became his new genus *Ptychocoleus*. Spruce recognized neither *Marchesinia* nor *Phragmicoma* as a genus, but his subgenus

* Nat. Arr. Brit. Pl. 1: 689. 1821 (as *Marchesinus* and *Marchesinius*).

† Comm. Bot. 112. 1822.

‡ Naturg. Europ. Leberm. 3: 245. 1838.

§ *L. c.*, 292, 740. 1845 and 1847.

‖ Jour. Bot. 3: 301. 1865.

¶ Mem. Ist. Lomb. III. 4: 405. 1877.

Homalo-Lejeunea * is proposed as their practical equivalent. When Schiffner † raised *Homalo-Lejeunea* to generic rank he appreciated this fact and designated the genus by the name *Marchesinia.* It is worthy of note that Spruce's subgeneric name has never been applied to a formally published genus, although species of *Homalolejeunea* may be found described in the literature.

The species of *Marchesinia*, like those of the preceding genus, are among the most robust of the *Lejeuneae.* At the present time about fourteen species are recognized; of these the type species, *M. Mackaii* (Hook.) S. F. Gray, has a local distribution in Europe, two are known from Africa, a few others from the Galapagos and Hawaiian Islands, and the remainder from tropical America. They grow occasionally on rocks but more frequently on the bark of trees or on rotten logs, and certain species are found on both inorganic and organic substrata. The plants sometimes grow mixed with other bryophytes but usually form pure mats of considerable extent. They are more or less pigmented with brown or purple and in some of the species are distinctly glossy.

The stems are at first prostrate and often look very much as if they might belong to the genus *Symbiezidium.* In most species, however, secondary stems are soon developed, which separate more or less completely from the substratum. These stems give the plants a more characteristic appearance, and in old tufts it becomes difficult to find traces of the original prostrate stems. The secondary stems are irregularly pinnate and sometimes grow for a considerable distance without branching. In most of the species the female stems exhibit a striking false dichotomy, owing to the development of subfloral innovations in pairs.

The leaves are more or less imbricated and, so far as their lobes are concerned, bear much resemblance to those of the preceding genus. In certain species, however, the apical region is constantly or occasionally dentate (PLATE 32, FIGURES 1, 2, 17). The lobules exhibit considerable variety in form and in size but possess certain structural features in common. In normal cases, for example, the free margin bears a distinct apical tooth; this may be blunt, consist-

* Hep. Amaz. et And. 132. 1884.

† Engler & Prantl, Nat. Pflanzenfam. 1^3: 128. 1895.

ing of a single projecting cell, or it may be longer and prolonged into a straight or curved row of from two to four cells. Frequently the tooth is bent inward toward the lobe. The hyaline papilla is situated in the vicinity of this tooth but is displaced several cells from the margin on the inner surface of the lobule (FIGURE 6). In addition to the apical tooth the free margin sometimes bears from one to three accessory teeth between the apex and the base (FIGURES 3, 16), but these vary considerably in size and degree of distinctness even when normally present and in some species are apparently absent altogether. The leaf-cells are essentially like those of *Symbiezidium* (FIGURE 4), but the local thickenings of the walls are sometimes very indistinct. The underleaves are also very much alike in the two genera.

The female inflorescence in *Marchesinia* is borne on a leading branch and normally innovates on both sides (FIGURE 1), the innovations varying greatly in length and often being limited in growth by the development of new inflorescences. In a few of the species, however, of which *M. Mackaii* is a striking example, double innovations are the exception rather than the rule, most of the flowers innovating on only one side. The lobes of the bracts are similar to those of the foliage leaves but tend to be narrower and more strongly dentate (FIGURES 7, 8, 11, 12, etc.). The lobules are distinct but vary greatly in form, size, and marginal characters, a considerable degree of variation being sometimes observable on an individual plant (FIGURES 14, 15). The bracteoles are free and mostly oblong to obovate in outline; they are frequently toothed (FIGURES 9, 13, 20) and sometimes distinctly bifid (FIGURE 21).

The perianth is one of the most characteristic features of the genus. It is strongly compressed and broadly oblong or obovate in outline (FIGURE 1). The apex is truncate or slightly retuse with rounded outer angles and bears a distinct beak. The postical keel is low and scarcely discernible, and there are no teeth either on the sharp lateral keels or on the postical surface. In many respects the perianth resembles that found in *Stictolejeunea*, but there are never distinct auricles at the upper angles.

The male inflorescence is usually terminal on a more or less elongated branch and bears bracteoles throughout its entire length. The bracts are imbricated and bear the antheridia singly or in pairs. In some cases the two lobes are subequal; in other cases the lobe is distinctly larger than the lobule. In the paroicous *M. robusta* (Mitt.) Schiffn., Spruce notes that antheridia are occasionally developed in the axils of the perichaetial bracts.

At the present time the only species of *Marchesinia* known from Puerto Rico is the variable and widely distributed *M. brachiata*, and even this species has not been previously recorded from the island. It may be described as follows:

MARCHESINIA BRACHIATA (Swartz) Schiffn.

Jungermannia brachiata Swartz, Prodr. Fl. Ind. Occ. 144. 1788.
Lejeunea Bongardiana Lehm. & Lindenb.; Lehmann, Pug. Plant. **7**: 18. 1838.
Phragmicoma Guilleminiana Nees & Mont. Ann. Sci. Nat. Bot. II. **16**: 128. 1841.
Lejeunea brachiata Nees; G. L. & N. Syn. Hep. 313. 1845.
Lejeunea complicata Hampe, *l. c.* 321. 1845.
Phragmicoma Bongardiana Lindenb. *l. c.* 740. 1847.
Symbiezidium brachiatum Trevis. Mem. Ist. Lomb. III. **4**: 403. 1877.
Marchesinia Guilleminiana Trevis. *l. c.* 405. 1877.
Marchesinia Bongardiana Trevis. *l. c.* 405. 1877.
Lejeunea (*Homalo-Lejeunea*) *Guilleminiana* Spruce, Hep. Amaz. et And. 134. 1884.
Lejeunea (*Homalo-Lejeunea*) *Bongardiana* Spruce, *l. c.* 135. 1884.
Lejeunea (*Homalo-Lejeunea*) *brachiata* Steph. Hedwigia **29**: 14. 1890.
Marchesinia brachiata Schiffn.; Engler & Prantl, Nat. Pflanzenfam. $\mathbf{1}^3$: 128. 1895.

Olive- or purplish-green, glossy, scattered or growing in loose tufts: secondary stems 0.35 mm. in diameter, at first pendent but eventually spreading at the tips, sparingly pinnate or, on female plants, falsely dichotomous, the branches similar to the stem, not microphyllous but sometimes with smaller leaves: leaves loosely imbricated, the lobe widely spreading, scarcely falcate, ovate, 2 mm. long, 1.2 mm. wide, slightly convex especially along the postical margin and sometimes revolute at the apex, rounded or subcordate at the base and arching across or a little beyond the axis, antical margin slightly outwardly curved to apex, postical margin straight or nearly so, forming an angle of 90° or more with the keel, apex abruptly acute or apiculate, margin otherwise entire or sparingly and irregularly denticulate in the outer part; lobule ovate, trapezoidal in outline, more or less inflated, especially in basal and carinal regions, keel arched, free margin dilated and sometimes involute near base, straight or a little curved in outer part, apical tooth usually consisting of two superimposed teeth, accessory teeth normally two, each consisting of a single projecting cell, often indistinct or obsolete, sinus straight or nearly so, forming an angle of 135–180° with postical margin of lobe; cells of lobe plane or a little convex, averaging 22 μ at the margin, 40 × 30 μ in the middle and 55 × 45 μ at the base, trigones distinct and usually conspicuous, triradiate, the rays either acute or dilated and rounded at the apex, intermediate thickenings numerous, circular or oval, pits usually distinct and often relatively broad: underleaves imbricated, broadly orbicular, 1–1.7 mm. long, rounded and narrowly revolute at the apex, gradually or abruptly cuneate toward the base, long-decurrent and attached by a strongly arched line, the decurrent portion sometimes minutely rounded at the very base, margin entire or minutely denticulate in apical region: inflorescence dioicous: ♀ inflorescence terminating a secondary stem or a leading branch, innovating on both sides, the innovations obliquely spreading, simple or soon again floriferous; bracts obliquely spreading, the lobe ovate-oblong, 2.2 mm. long, 1.1 mm. wide, apex abruptly apiculate or acute, margin entire or sharply and irregularly dentate in the upper half, the teeth sometimes numbering as many as twelve; lobule (maximum size) 1 mm. long, 0.65 mm. wide (often much smaller), ovate to lanceolate, mostly acute and sometimes entire but usually irregularly dentate or lacerate; bracteole free, obovate, 1.5 mm. long, 1.25 mm. wide, cuneate toward base, apex broad, rounded, retuse or shortly bifid, margin sharply and irregularly dentate in the upper part; perianth more than half exserted, obovate-oblong in outline, 4 mm. long, 2 mm. wide, apex truncate or slightly retuse, basal region cuneate: ♂ inflorescence and mature sporophyte not seen (PLATE 32).

On trees, rotten logs, and rocks. North slope of the Luquillo Mountains, *Heller* (*1145*). El Yunque, *Evans* (*59*). Mount Morales, near Utuado, *Howe* (*1088, 1127, 1136*). The species is very abundant in the mountains of Jamaica, the type locality, where it was originally collected by *Swartz* and more recently by *Underwood* and by the writer. The following localities may also be noted: — Mexico, *Liebmann*; Cuba, *Wright, Underwood, Mrs.*

Britton; St. Vincent and Dominica, *Elliott*; Trinidad, *Fendler*; Venezuela, *Moritz*, *Funck & Schlim*; Colombia, *Moritz*; Brazil, *Guillemin* (the type specimen of *P. Guilleminiana*), *Chamisso* (the type specimen of *L. Bongardiana*), *Beyrich*, *Hantsch*, *Lindman*; Ecuador, *Spruce*; Bolivia, *Rusby*; Galapagos Islands, *Baur*.

The synonymy as given above is based largely on the work of Stephani. When he studied the *Lejeuneae* in the Lindenberg herbarium * he found that Montagne's specimen of *P. Guilleminiana* was identical with another Brazilian specimen which had been referred to *L. brachiata* and which he considered authentic. He therefore reduced Montagne's species to synonymy. Stephani's decision was soon confirmed by Schiffner,† who was able to study a portion of Swartz's original Jamaican material in the herbarium at Berlin. Both authors agreed further that *L. Bongardiana* was simply a very lax form of *M. brachiata* from wet situations. Spruce, to be sure, considered *L. Guilleminiana* as distinct from *L. Bongardiana*, but it is by no means certain that the Peruvian specimens which he referred to Montagne's species were correctly determined. These specimens were distributed in *Hepaticae Spruceanae*, and, since they do not agree in all respects with West Indian material of *M. brachiata*, perhaps represent a distinct species. Judging from the specimens of *P. Bongardiana* distributed by Wright in his *Hepaticae Cubenses*, this species might almost be considered valid. Schiffner states, however, that even these specimens, which represent an extreme form, are connected with typical *M. brachiata* by a series of intermediate conditions.

Accepting *M. brachiata* in the broad sense of Stephani and Schiffner, it is certainly a most variable species. Its numerous forms show marked differences in size, in color, and in certain structural characters derived from leaves, underleaves, and floral organs. The lobes of the leaves, for example, may be entire or dentate. The lobules may be strongly dilated and involute at the base so that they project forward beyond the line of attachment, they may be but slightly dilated with the free margin extending obliquely from the axis, or they may remain in a poorly developed condition. The leaf-cells normally show conspicuous trigones,

* Hedwigia 29: 6. 1890.

† Bot. Jahrb. 23: 581. 1897.

but in certain delicate forms the local thickenings are scarcely to be demonstrated. The underleaves are usually reflexed at the apex, but they are occasionally plane, and their margins vary from entire to denticulate. The bracts and bracteoles vary greatly with respect to their marginal teeth, and the lobules of the bracts vary not only in size but but also in form. Among the most constant characters of the species are the following: the apiculate or acute leaves, the tridenticulate lobules, the decurrent and usually reflexed underleaves, the more or less toothed bracts, and the toothed and bifid bracteole. Unfortunately even these characters are subject to some variation, but will usually serve to distinguish the species from its allies. The perianth is also a remarkably constant organ but presents no reliable differential characters.

In the preceding description the inflorescence of *M. brachiata* is described as dioicous, because the specimens studied by the writer have all been either sterile or purely archegonial. Spruce also admits that the inflorescence in *L. Bongardiana* is dioicous but implies that it is normally autoicous in his somewhat doubtful *L. Guilleminiana*. Gottsche * also ascribes a monoicous inflorescence to the same species. It would perhaps be more accurate, therefore, to describe the inflorescence as polyoicous. Gottsche gives but few details about the antheridial spike. He says that it is either terminal on a branch or intercalary, that the bracts are in eight to ten pairs, and that the antheridia are borne singly or in pairs. .

MASTIGOLEJEUNEA

The genus *Mastigolejeunea* is very widely distributed in tropical and subtropical regions and contains from thirty to thirty-five recognized species. The majority of these grow on trees or on logs, but a few are sometimes found on rocks. The genus is apparently confined to low altitudes, from the sea level up to two thousand feet. The first species mentioned by Spruce and by Schiffner is *M. auriculata* (Wils. & Hook.) Schiffn. This may therefore be considered the type of the genus. At the present time it is the only species known to occur in Puerto Rico. In fact no other species have been recorded from North America, if we

* Mex. Leverm. 171. 1863.

except the African *Mastigo-Lejeunea crispula* Steph.,* which its author reports from Costa Rica.† The plants belonging to this genus usually form depressed mats of considerable extent. They are often deeply pigmented and sometimes appear almost black, with little or no lustre, when they become dry. The pigmentation, however, rarely shows the brownish hues which are characteristic of such genera as *Lopholejeunea* and *Symbiezidium*, and the plants are occasionally glaucous.

The distinction between creeping caudex and secondary stems is much better marked in *Mastigolejeunea* than in the two preceding genera. The caudex clings closely to the substratum by means of numerous rhizoids and in an old tuft is difficult to demonstrate except along the edges. The secondary stems, although frequently prostrate, develop very few rhizoids and can be easily separated from the substratum. These stems branch irregularly and sometimes copiously and branches of a second or higher order often occur. The branches are of three types: normal branches similar to the stem, microphyllous branches with shorter and relatively broader leaves, flagelliform branches with very rudimentary leaves. These distinctions, however, are not always well-marked, and it frequently happens that a branch is microphyllous at the base and normal or flagelliform at the extremity. The flagelliform branches usually develop an abundance of rhizoids and doubtless play an important part in affixing the plants to the substratum.

The leaves are densely crowded; when dry they spread obliquely and are strongly convex, overlapping each other closely; when moist they become squarrose and spread more widely, the imbrication being thereby much less apparent. The lobes are falcate from a round or subcordate base and vary in outline from ligulate to ovate. The postical margin is more or less revolute, thus increasing the appearance of convexity, but the antical margin is plane or nearly so. The apex varies from rounded to subacute and is never reflexed. The margin is entire or vaguely and irregularly sinuate but is never distinctly dentate.

The lobule usually consists of two portions, a narrow inflated water-sac along the keel, and a plane portion along the free

* Hedwigia 27: 111. 1883.

† Bull. Soc. Roy. Bot. Belgique 31: 180. 1892.

margin. The water sac opens out into the revolute portion of the lobe, and it is often difficult to distinguish where the sinus ends and the postical margin of the lobe begins. The plane portion varies greatly in form and in size but is normally appressed to the lobe. Frequently, however, no plane portion is developed, the free margin being revolute and the whole lobule entering into the formation of the water-sac. The free margin is so variable, even in a single species, that it is difficult to assign it definite characters. It is sometimes entire or nearly so, passing by an indistinct rounded angle, which represents the apex, into the vaguely defined sinus. In other cases the apex is much more distinct, being tipped by a single cell or even by a cell-row consisting of several cells. When the apical tooth is well developed there is sometimes a second tooth at some little distance from it on the proximal side. The hyaline papilla is also proximal in position but is sometimes marginal and sometimes slightly displaced from the margin and hidden within the water-sac. Many of these variations are clearly shown by *M. auriculata.*

The leaf-cells are usually longer than broad and are plane or nearly so. They are characterized by distinct trigones, but the intermediate thickenings are infrequent except toward the base of the lobe. Sometimes the trigones are confluent but rarely sufficiently so to obliterate the pits. The cell-wall is the seat of the pigmentation, and the middle lamella by its still deeper color is sometimes but not always distinguishable. No ocelli are developed.

The underleaves vary from distant to closely imbricated. They are attached by an almost straight line and broaden out from a cuneate base. In outline they vary from orbicular to obovate, the apex being broad and frequently retuse. On robust stems they are convex in the middle (from below) and their margins, which are entire or nearly so, are more or less revolute along the sides or at the apex.

The primary female inflorescence is borne on a secondary stem or one of its leading branches and innovates on one side or more rarely on both. The innovations are sometimes long and similar to the stem, but they are more frequently abbreviated and repeatedly floriferous. The complicate bracts are deeply and unequally bifid; the lobes are broader than in the leaves and tend to be more pointed, the lobules are rounded to retuse at the apex, and the keels are destitute of wings. The bracteole is free and larger than the underleaves but otherwise similar to them.

The perianth is more or less concealed by the bracts and is oblong in outline varying to pyriform or obovate. It is strongly trigonous with sharp lateral keels and a high and narrow postical keel. In certain species supplementary keels, both antical and postical, are developed, but the trigonous character of the perianth still remains apparent. The principal keels are sometimes provided with narrow and interrupted wings, which are destitute of teeth. The beak of the perianth is short but distinct.

The male inflorescence is terminal on a leading branch but often proliferates at the apex. The bracts are numerous and crowded, bearing the antheridia singly, and the bracteoles extend along the whole length of the spike.

The genera *Mastigolejeunea* and *Thysananthus* are so closely allied that the propriety of trying to keep them separate is perhaps questionable. In *Mastigolejeunea* the lobes of the leaves, the underleaves, the bracts, bracteoles and keels of the perianth are entire; in *Thysananthus* they are more or less dentate. In other respects the two genera are essentially alike. The subgenera *Dendro-Lejeunea* Spruce * and *Phragmo-Lejeunea* Schiffn., † separated from *Thysananthus* on account of their lack of flagelliform branches, are now included by Schiffner ‡ under *Thysananthus* and have never been recognized as genera.

M. auriculata has recently been described by the writer, with figures and a full synonymy, in another connection. § In the present paper, therefore, attention is simply called to its general distribution and to its local distribution in Puerto Rico.

MASTIGOLEJEUNEA AURICULATA (Wils. & Hook.) Schiffn.

On trees, rotten logs and rocks. Near Mayaguez, *Heller* (*4462, 4463*), *Mrs. Britton & Miss Marble* (*649 p. p.*). Road from Arecibo to Utuado, *Howe* (*378*). The species is widely dis-

* Hep. Amaz. et And. 110. 1884.

† Lebermoose der Forschungsreise S. M. S. Gazelle 24. 1890.

‡ Engler & Prantl, Nat. Pflanzenfam. 1^3: 129. 1895.

§ Mem. Torrey Club 8: 129. *pl. 17. f. 10–19.* 1902.

tributed in tropical and subtropical America, and the following localities may also be noted: Florida, Alabama, and Louisiana in the United States; Mexico, *Liebmann*; Bahama Islands, *Coker*, *Mrs. Britton*; Cuba, *Wright*, *Underwood & Earle*, *Mrs. Britton*; Hayti, *Nash*; Jamaica, *Mrs. Britton*, *Evans*; Colombia, *Moritz*; Surinam, *Kegel*; Brazil, *Spruce*, *Lindman*; Paraguay, *Lindman*; Peru, *Spruce*.

CAUDALEJEUNEA

In the subgenus *Lopho-Lejeunea* as originally proposed Spruce included a Brazilian species which he called *L. harpaphylla*, remarking at the same time that it differed from the other members of the subgenus in several important respects. A few years later Stephani* proposed the subgenus *Cauda-Lejeunea* for the reception of *L. harpaphylla* and its allies. Meanwhile Spruce had also reached the conclusion that his species ought to be separated subgenerically from *Lopholejeunea* and suggested, in a paper by Pearson,† that it be made the type of a new subgenus, to which he gave the name *Callistolejeunea*. Since Stephani's name was more formally published and clearly had the right of priority, it was used by Schiffner as the proper name of the group when he raised it to generic rank.

Schiffner accredits eight species to the genus and enumerates seven of them by name. The omitted species is *L.* (*Cauda-Lejeunea*) *Lehmanniana*, which ought really to be considered the type species because it is the first one mentioned by Stephani. Of the listed species three are from tropical America, two from Africa, one from various islands of the Pacific, and one from tropical Asia. *L. Lehmanniana* is also from tropical America. Stephani has since added two species to the genus, one from Cuba and Brazil and the other from New Guinea, so that it now apparently contains ten species in all. The species from Asia, however, has never been published except as a *nomen nudum*, and in the opinion of the writer the five so-called American species are simply forms of a single one. If this opinion is accepted, there will be only five well-established species left in the genus. The American species,

* Hedwigia 29: 18. 1890.

† Christiania Videns.-Selsk. Forhandl. 1892[8]: 7.

which has been collected once in Puerto Rico, may be described as follows:

Caudalejeunea Lehmanniana (Gottsche)

Lejeunea Lehmanniana Gottsche; G. L. & N. Syn. Hep. 325. 1845.

Lejeunea Crescentiae Lindenb. & Gottsche, *l. c.* 752. 1847.

Lejeunea (*Lopho-Lejeunea*) *harpaphylla* Spruce, Hep. Amaz. et And. 123. 1884.

Phragmicoma Haenkeana Schiffn. Bot. Centralbl. **27**: *pl. 1. f. 3.* 1886.

Lejeunea (*Mastigolejeunea*) *Haenkeana* Steph. Hedwigia **28**: 257. 1889.

Lejeunea (*Cauda-Lejeunea*) *Lehmanniana* Steph. *l. c.* **29**: 18. 1890.

Lejeunea (*Cauda-Lejeunea*) *Leiboldii* Steph. *l. c.* 19. 1890 (*nomen nudum*).

Lejeunea (*Cauda-Lejeunea*) *harpaphylla* Steph. *l. c.* 19. 1890.

Lejeunea (*Cauda-Lejeunea*) *Crescentiae* Steph. *l. c.* 19. 1890.

Caudalejeunea harpaphylla Schiffn.; Engler & Prantl, Nat. Pflanzenfam. **1**^{3}: 129. 1895.

Caudalejeunea Crescentiae Schiffn. *l. c.* 129. 1895.

Caudalejeunea Haenkeana Schiffn. *l. c.* 129. 1895.

Caudalejeunea Leiboldii Steph. Hedwigia **34**: 233. 1895.

Bright- or pale-green, not glossy, scattered or growing in loose tufts: stems prostrate, 0.15 mm. in diameter, irregularly pinnate, the branches obliquely spreading, simple or sparingly subdivided, similar to the stem but often ascending and free from the substratum: leaves loosely imbricated, the lobe plane or somewhat convex, obliquely to widely spreading, more or less falcate, oblong-ovate, 1–1.3 mm. long, 0.6–0.7 mm. wide, arching across or a little beyond the axis, rounded at the base, antical margin outwardly curved to the apex, postical margin straight or a little curved, forming a continuous line or a very obtuse angle with the slightly arched keel, apex varying from rounded to acute, margin usually entire, sometimes irregularly angular-dentate near the apex; lobule inflated throughout, ovate-oblong in outline, 0.35 mm. long, 0.17 mm. wide, free margin usually revolute and appressed to the lobe throughout a part of its length, crenulate near base, mostly bidentate in outer part, the apical tooth being acute and curved, often three or four cells long and two or three cells wide at the base, the inner (proximal) tooth shorter, blunter and frequently obsolete, sinus long and shallow, forming an acute angle with the keel, hyaline papilla marginal, situated near the proximal base of the apical tooth, often reflexed and hidden within the water-sac; cells of lobe averaging 14 μ at the margin, 28 × 21 μ in the middle, and 35 × 28 μ at the base, slightly convex, thin-walled but with distinct local thickenings, the trigones circular or vaguely triangular in outline, the intermediate thickenings numerous, circular, sometimes two or even three between two trigones; ocelli none: underleaves distant to subimbricated, orbicular, plane or nearly so, 0.35 mm. long, cuneate toward the base and distinctly short-decurrent on both sides, line of attachment somewhat arched, apex broad and more or less retuse, margin entire or nearly so: inflorescence autoicous: ♀ inflorescence sometimes borne on the main stem or on a leading branch but usually on a more or less abbreviated branch, without innovation; one or several pairs of leaves below the involucre intermediate in character between the bracts and normal leaves; bracts obliquely spreading, the lobe ovate-lanceolate, 1–1.4 mm. long, 0.45–0.6 mm. wide, subacute to acuminate, antical margin distinctly outwardly curved, postical margin less curved or nearly straight, margin entire or irregularly dentate in the upper part; lobule consisting of a narrow, more or less inflated fold at the base of the lobe, measuring about 0.5 × 0.09 mm., margin passing very gradually into the postical margin of the lobe without a distinct apex, entire; bracteole free, plane or nearly so, ovate, 0.75–0.85 mm. long, 0.4–0.5 mm. wide, gradually narrowed toward the apex, bifid about one tenth with erect, acute and often connivent teeth separated by a narrow sinus, margin entire or irregularly sinuate to dentate in the upper part; perianth less than half exserted, obovate in outline from a narrow base, measuring 1 × 0.75 mm. when well grown, apex broad, truncate to retuse with a distinct beak variable in length, trigonous, with sharp lateral keels and a high and narrow postical keel extending from the apex to the middle or below, antical surface plane or nearly so, lateral keels sometimes narrowly and interruptedly alate, the wing entire or sparingly and irregularly sinuate or dentate: ♂ inflorescence terminal, often on a leading branch; bracts mostly in from three to six pairs, imbricated, diandrous, shortly and unequally bifid with obtuse to acute divisions, the lobe ovate-oblong or ovate-ligulate, the lobule ovate, keel arched; bracteoles imbricated, extending along the whole length of the spike, orbicular to ovate, retuse to bidentate at the apex with rounded to acute divisions: mature sporophyte not seen (PLATE 33, FIGURES 1–12).

On twigs. Santurce, *Heller* (*838*). The species also grows on living leaves, and has been recorded from the following additional localities: Mexico, *Liebmann* (the type specimen of *L. Crescentiae*), *Haenke* (the type specimen of *P. Haenkeana*); Costa Rica, *Tonduz;* Cuba, *Wright, Leibold* (the type specimen of *C. Leiboldii*), *Underwood, Mrs. Britton;* Brazil, *Liebmann* (the type specimen of *L. Lehmanniana*), *Spruce* (the type specimen of *L. harpaphylla*), *Ule.*

Largely through the kindness of correspondents the writer has been enabled to examine type material of *L. Lehmanniana* and *L. Crescentiae* and authentic material of *L. harpaphylla* and *C. Leiboldii. P. Haenkeana* is still known to him from Schiffner's description and figures only, but these are sufficient to indicate that the species is synonymous with the others, and Schiffner himself admits that it may not be distinct from *C. Crescentiae.** Stephani has already reduced *L. harpaphylla* to a synonym of the same species.†

If the original descriptions of *L. Lehmanniana, L. Crescentiae* and *C. Leiboldii* are consulted it will be seen that the three are very much alike, the most important differences between them being derived from the involucral leaves and the perianths. In the first the bracts (and also the upper leaves) are said to be apiculate, sparingly serrate, or serrulate-denticulate at the apex, the bracteole is said to be serrate, and the perianth sparingly ciliate on the margin. In the second and third the bracts, bracteoles and perianths are said to be entire.

The type material of *L. Lehmanniana* is very scanty. The portion from the Lindenberg herbarium studied by the writer consists of two fragments, one with a perianth and two male inflorescences, the other with two perianths. The perichaetial bracts are irregularly dentate, the teeth varying with respect to both number and size (FIGURE 1). The bract which is most strongly dentate shows seven teeth, the longest three cells long and two cells wide at the base, the shortest consisting of a single slightly projecting cell. Other bracts show only one or two teeth, thus exhibiting an approach to an entire condition. The lateral keels

*Bot. Jahrb. 23: 585 (footnote). 1897.

†Hedwigia 34: 234. 1895.

of the perianth are irregularly dentate, but the postical keel, which is rather indistinct, is destitute of teeth. On the whole the dentation of both bracts and perianths is so indefinite that it can hardly be considered a valid specific character, more especially since similar teeth are occasionally found in *L. Crescentiae*. In *C. Leiboldii* the bracts and perianths are usually entire but often show indications of marginal teeth. The forms of *C. Lehmanniana*, which grow on living leaves and which have heretofore been referred to *L. Crescentiae*, show a marked development of the prostrate portions of the plant and thus acquire a somewhat peculiar appearance. This, however, is not supported by any structural characters which would justify us in attempting to separate these leaf-forms specifically, and Stephani did not hesitate to refer to *L. Crescentiae*, as a synonym, the *L. harpaphylla* of Spruce, which grew on bark. According to Schiffner *P. Haenkeana* is found on both leaves and bark.

The writer has as yet been unable to compare *C. Lehmanniana* with other members of the genus and therefore makes no attempt to discuss the generic characters in detail. Perhaps the genus is best characterized by its trigonous perianth and lack of subfloral innovations. The latter character and the fact that the lateral keels of the perianth are sometimes toothed indicates a relationship to the genus *Lopholejeunea*, but in this genus the plants are deeply pigmented, the lobule is differently constructed, and the postical keel of the perianth is sharply two-angled. The trigonous perianth in *Caudalejeunea* allies it with *Mastigolejeunea* and *Thysananthus*, but in both of these genera subfloral innovations are a constant feature. It is an interesting fact that one of the most important differential characters separating these genera breaks down in *Caudalejeunea*, both entire and toothed leaves being sometimes present on a single individual.

BRYOPTERIS

The genus *Bryopteris* is so distinct that it has had a rather uneventful history. Two of its best known species, *B. filicina* and *B. diffusa*, were originally collected by Swartz in the West Indies and were described by him under *Jungermannia* in 1788. About thirty years later *J. filicina* was figured and redescribed by

Hooker,* who pointed out its possible affinity to the two European species, *J. dilatata* and *J. Tamarisci.* Raddi expressed this relationship more positively by referring *J. filicina* to his recently established genus *Frullania*, which he had based upon *J. dilatata* and *J. Tamarisci.* He also included in the same genus a plant which he described as new and figured under the name *F. dichotoma* but which is now considered identical with Swartz's *J. diffusa.*† The name *Bryopteris* first appears in the writings of Nees von Esenbeck, who applied it to a subgenus under *Frullania.*‡ In this subgenus he included three species, *F. filicina*, *F. diffusa*, and *F. spathulistipa*, the last being the earlier *Jungermannia spathulistipa* R. Bl. & N., of Java.§ When Lindenberg, in the Synopsis Hepaticarum, raised *Bryopteris* to generic rank, he excluded the third of these species, transferring it to the genus *Thysananthus*, which he proposed in the same volume.‖ Under *Bryopteris* he included not only *B. filicina* and *B. diffusa* but also five other species, most of which were described as new. *B. filicina*, being the first species described, may be considered the type of the genus. Lindenberg apparently recognized the fact that *Bryopteris* was related to the *Lejeuneae* rather more closely than to *Frullania*, because he placed it at the beginning of the subtribe *Jubuleae*, *Frullania* being placed at the end and *Lejeunea*, with its immediate allies, occupying an intermediate position. Spruce emphasized the relationship to the *Lejeuneae* still more strongly by reducing *Bryopteris* to a subgenus under *Lejeunea*, giving it the name *Bryo-Lejeunea* to conform with his other subgeneric names.¶ Its generic rank, however, was soon restored to it by Schiffner, and it is now again known by its original name *Bryopteris.***

The genus is confined to the tropics, and at the present time about nine species are recognized. These seem to flourish equally well both on trees and on rocks and frequently grow in exposed localities. All of the species are American except *B. Gaudichaudii*

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* Musc. Exot. *pl. 142.* 1819.

† Mem. Soc. Ital. Modena Fis. 19 : 35. 1823 ; 20 : *pl. 1a.* 1829.

‡ Naturg. Europ. Leberm. 3 : 211 (footnote). 1838.

§ Nova Acta Acad. Caes. Leop.-Carol. 12 : 212. 1824.

‖ *L. c.* 284. 1845 ; 737. 1847.

¶ Hep. Amaz. et. And. 111. 1884.

** Engler & Prantl, Nat. Pflanzenfam. 1^3 : 130. 1895.

Gottsche,* which is known from Asia and from the Mascarene Islands. The only species which has been reported from Puerto Rico is the type of the genus, *B. filicina*, but it is probable that other species remain to be discovered. Unfortunately for the systematist certain members of the genus are exceedingly variable, and it often becomes difficult, on this account, to discover valid differential characters between closely related species.

The distinction between a prostrate caudex and secondary stems is even better marked in *Bryopteris* than in *Mastigolejeunea*. The caudex, which is sparingly and irregularly branched, is closely appressed to the substratum, clinging to it by means of numerous rhizoids. The secondary stems spread widely from the substratum and develop few or no rhizoids. They are slender, but more or less elongated, sometimes attaining a length of 30 cm. or more. The stems exhibit a pinnate branching and the branches are usually short and limited in growth. For these reasons and also because the branches develop in one plane, the secondary shoot-systems acquire a characteristic fern-like appearance, which accounts for the generic name. In some species the branches normally remain simple; in others they tend to be more or less subdivided. The branches usually bear smaller leaves than the main axis, but strongly resemble it in other respects. In *B. tenuicaulis* Tayl., however, and probably in other species, slender flagelliform branches are often produced upon which the leaves and underleaves are not only minute but exhibit modifications in form and structure.

An apparent exception to the pinnate form of branching is found in *B. diffusa*, which is described in the literature as dichotomous. Of course a true dichotomy is unknown among the *Jungermanniaceae*, and an examination of this species shows that the branching is really monopodial in character, just as in the other members of the genus. A branch, however, is as robust as the main axis and deflects it to one side, thus producing the effect of a fork. The branches are farther apart than in the other species and tend to be unlimited in growth and to become branched themselves in the same manner as the original axis. In this way the entire shoot-system seems to be made up of a series of dichotomies.

From a morphological standpoint the branches in *Bryopteris*

*Ann. Sci. Nat. Bot. IV. 8: *pl. 16. f. 19–28.* 1857.

agree essentially with those found in *Stictolejeunea*.* In other words, each normal vegetative branch represents the postical half of one of the lateral segments cut off from the apical cell (PLATE 33, FIGURE 13), while each sexual branch, either male or female, represents a portion only of such a half-segment (FIGURE 16). When flagelliform branches are produced these agree with the sexual branches in origin, arising behind leaves with lobules.

The leaves present a very different appearance according to whether they are dry or wet. When dry they are suberect and strongly convex, tending to be closely imbricated and wrapped about the axis. When wet they spread widely from the axis and become more nearly plane, although the postical margin usually remains more or less revolute (FIGURES 13, 16). The lobes are falcate from a cordate base (FIGURE 14) and are approximately ovate in outline, being distinctly narrowed in the outer part. The apex is acute and the margin more or less serrate, the teeth being sometimes restricted to the apical region and sometimes extending well toward the base. These teeth vary greatly in size, but are usually sharp and coarse, resembling those found in *Thysananthus*.

The lobule is less definite in structure than in most genera of the *Lejeuneae* and sometimes consists of little more than a dilation at the postical base of the lobe. Even when well-developed it is attached to the axis by an exceedingly short line, from which it expands abruptly. The free margin is involute near the base and more nearly plane in the outer part, the sinus passing gradually into the postical margin of the lobe. In this way a rudimentary water-sac is formed at the base of the lobule with a broad opening leading into it. In some cases the sac opens directly into the revolute portion of the lobe. The hyaline papilla is unusually large but tends to disappear early on account of its fragile nature. It is situated on the free margin a short distance beyond the middle (FIGURE 20). In certain species there is neither indentation nor tooth to mark its position; in other cases there is a rounded angle which is proximal in position to the papilla. This angle evidently represents the apex of the lobule and marks the beginning of the sinus. The papilla may therefore be considered as distal to the apex.

* See Evans, Bull. Torrey Club 34: 4. 1907.

In *B. diffusa* the lobule exhibits characters which are decidedly aberrant. As in the other species the line of attachment is very short, the free margin is involute near the base and the sinus passes gradually into the postical margin of the lobe. The free margin, however, instead of being straight or rounded in the apical region, is coarsely and sharply dentate. In normal cases three teeth are developed, the median tooth being larger than the others and sometimes attaining a length of ten cells and a width of seven or eight cells at the base. In rare instances a small additional tooth, proximal in position to the others, may also be demonstrated. In the few cases where the hyaline papilla was observed it occupied a position on the inner surface of the most distal tooth, close to the sharp sinus between this tooth and the median tooth. The remarkable peculiarities just described, taken in connection with the false dichotomy of the species, are perhaps sufficient to warrant a generic separation of *B. diffusa* from *Bryopteris*. If it is still retained in the genus, the large median tooth must be considered the apex of the lobule, the tooth bearing the papilla would then be situated in what is morphologically the sinus, and the papilla itself, slightly displaced from the margin, would be distal to the apex.

The leaf-cells are plane or slightly convex and vary considerably in size and in form in different parts of the lobe. In the basal auricles they are isodiametric, but in other parts of the lobe they are nearly always distinctly longer than broad (FIGURE 17). The largest and most elongated cells occupy a broad band in the postical part of the lobe, extending from the base (FIGURE 18) to about the middle. These cells are often four times as long as broad but are never truly prosenchymatous. In the middle of the band they lie with their long axes approximately parallel, but they become more or less divergent as the vague boundaries of the band are approached. In passing from this band toward the margins and apex of the lobe, the cells gradually decrease in size and in relative length, some of the marginal cells being nearly isodiametric (FIGURE 19). The elongated cells thus form an indistinct false nerve, similar to those found in certain species of *Bazzania* and *Herberta*. The cell-walls are practically colorless and show well-developed local thickenings, which are approximately circular in outline. In the most elongated cells there are frequently four or five intermediate thickenings between two trigones. In most of the species the thickenings show a strong tendency to become confluent and thus to obliterate the pits. Enough of the latter, however, usually persist to enable a cell to communicate with most if not all of the cells which surround it, but not infrequently lateral communication between cells is completely cut off. On account of the peculiarities of the wall the cavities of the cells acquire a wavy contour, not unlike what is found in the cells of *Herberta* and several other genera of the *Jungermanniaceae*.

The underleaves are usually contiguous or imbricated (FIGURE 16). They vary in outline from oblong or obovate to orbicular or quadrate and are attached by an arched line of insertion. The broad apex is rounded or truncate, and the base, which varies from rounded to cuneate, is usually abruptly decurrent. The apical region is toothed as in the leaves, the teeth sometimes extending down the sides as far as the middle. The lateral margins are more or less involute (from below), and the median basal region is distinctly gibbous, the bulge sometimes partially concealing the line of attachment.

The female branches are short and destitute of subfloral innovations (FIGURE 15). They usually arise in abundance from both stem and primary branches. Their leaves are reduced to four or five pairs, including the involucre, and there is a gradual transition from the minute basal leaves, closely appressed to the branch, and the large and widely spreading perichaetial bracts. All of the leaves are distinctly modified (FIGURE 21). The innermost bracts are deeply and unequally bifid, the lobule being narrower than the lobe but often fully as long. Both are long-acuminate and usually bear scattered teeth, especially near the apex. The bracteole is free and also bifid, with long-acuminate divisions separated by a narrow sinus. Both lobules and bracteole tend to be more or less revolute along the margin.

The perianth projects beyond the involucre for about half its length and is ovate or oblong in outline, bearing a distinct beak at the rounded or slightly retuse apex. It is strongly compressed with a high and narrow postical keel. The sharp lateral keels are at first deflexed, making the perianth convex antically and concave postically, the postical keel running lengthwise through the concavity (FIGURE 22). As the sporophyte develops the perianth becomes more inflated, and the lateral keels tend to straighten out. The surface is perfectly smooth and the three keels are entirely destitute of both wings and teeth.

The male branches also arise from both stem and primary branches (FIGURE 16). The inflorescence usually occupies the entire branch but occasionally proliferates at the apex. The bracts, which vary considerably in number, are imbricated and shortly bifid with acute lobes. The antheridia are borne in pairs, and the bracteoles, which extend along the whole length of the spike, tend to be bidenticulate at the apex.

BRYOPTERIS FILICINA (Swartz) Nees

Jungermannia filicina Swartz, Prodr. Fl. Ind. Occ. 145. 1788.

Frullania filicina Raddi, Mem. Soc. Ital. Modena Fis. **19**: 35. 1823.

Frullania (*Bryopteris*) *filicina* Nees, Naturg. Europ. Leberm. **3**: 211 (footnote). 1838.

Bryopteris filicina Nees; G. L. N. Syn. Hep. 284. 1845.

Lejeunea (*Bryo-Lejeunea*) *filicina* Spruce, Hep. Amaz et And. 113. 1884.

Dark-green, growing in loose tufts: secondary stems 10–15 cm. long, 0.4 mm. in diameter, rather closely pinnate, the branches subopposite or distinctly alternate, spreading at an angle of about 60°, mostly 1.5–2.5 cm. long, rarely subdivided; flagelliform branches none: leaves imbricated (even when wet), falcate, ovate, about 2 mm. long and 1 mm. wide on the stem, a little smaller on the branches, arching a little beyond the axis, antical margin more or less outwardly curved from the cordate or auriculate base to the acute apex, postical margin slightly curved, revolute for half its length or more, marginal teeth usually confined to the apical region, from one to three on each side of the apex, mostly two or three cells long from a broad base, margin otherwise entire or vaguely sinuate; lobule inflated, ovate, 0.2 mm. long, 0.17 mm. wide, keel arched, water-sac opening directly into the revolute portion of the lobe, free margin straight or slightly rounded in the outer part, without a distinct apex; cells of lobe averaging 7 μ at the margin, 25 × 11 μ in the middle, and 52 × 14 μ near the base, plane or nearly so, local thickenings large and more or less confluent, the trigones mostly triangular in outline with two sides convex, and one concave: underleaves imbricated, obovate-quadrate, 0.8 mm. long, 0.7 mm. wide, rounded to truncate at the apex, cuneate and short-decurrent at the base, lateral margins more or less revolute and entire or nearly so, apex plane, coarsely and irregularly dentate, the teeth mostly six to ten, similar to those on the leaves: inflorescence autoicous: ♀ branches numerous, arising from both stem and primary branches; (innermost) bracts widely spreading, the lobe ovate, 2 mm. long, 0.7 mm. wide, long-acuminate, irregularly toothed in the upper part, lobule lanceolate, 1.5–2 mm. long, 0.35 mm. wide, long-acuminate and toothed in upper part, revolute along the free margin; bracteole narrowly ovate, 2 mm. long, 0.7 mm. wide, bifid about one fourth with long-acuminate divisions, sparingly denticulate in the upper part, more or less revolute along the lateral margins; perianth narrowly ovate in outline, 2–2.5 mm. long, 1 mm. wide: ♂ branches numerous, arising from both stem and primary branches; bracts in about six pairs, an entire spike about as long as one of the stem-leaves: capsule 1 mm. in diameter; spores greenish, irregular in form but usually longer than broad, measuring about 25 μ in short diameter, minutely verruculose; elaters about 0.5 mm. long, 12 μ in diameter (PLATE 33, FIGURES 13–22).

Puerto Rico, without definite locality, *Sintenis* (*1*), reported by Stephani. No specimens of *Bryopteris* occur in the Puerto Rico collections studied by the writer. *B. filicina* has a wide distribution in tropical America. Among other West Indian islands it has been collected on Jamaica, the type locality, *Swartz, Underwood*, and on Guadeloupe, *Husnot*. From the mainland the following stations may be quoted: Mexico, *Miquel, Leibold, Liebmann;* Costa Rica, *Maxon;* Colombia, *Moritz, Lindig, Karsten;* Brazil, *G. A. Lindberg*. The species has also been reported from Tahiti by Reichardt, the specimens having been collected by the Novara Expedition. Stephani confirms Reichardt's determination but suspects a mistake in the label. In all probability, therefore, *B. filicina* is confined to America.

It is evident that the present species was understood by the older writers and probably by Swartz himself in a much broader sense than is indicated above. *Jungermannia filicina* was originally described from sterile specimens, and it is by no means certain that these would be considered sufficient at the present time for a positive determination. In Stephani's opinion the Swartzian specimen in the Lindenberg herbarium is an indeterminable fragment.* Mitten, however, according to Spruce,† considered another Swartzian plant as identical with *B. tenuicaulis*. Whether these specimens actually represented portions of the type material is not apparent. The Lindenberg herbarium also contains several specimens of *J. filicina* which were communicated by Hooker, but Stephani refers them all to *B. fruticulosa* Tayl. In the herbarium at Berlin there is a Brazilian specimen collected by Raddi; Schiffner has recently determined this as *B. tenuicaulis*.‡ Until 1863 no attention was paid to the nature of the inflorescence as a specific character. In that year Gottsche § referred to *B. filicina* a series of Mexican specimens in which the inflorescence was monoicous. In 1864 ‖ he ascribed a monoicous inflorescence to the species as a definite character. Spruce also restricted the name *B. filicina* to monoicous plants and imagined that he saw traces of androecia in Hooker's figure of a fruiting plant. Both Stephani and Schiffner follow Spruce in thus restricting the name and the same course is pursued in the present paper.

As thus defined *B. filicina* is the only member of the genus in which the inflorescence is monoicous. Its closest ally is *B. fruticulosa*, which has a very similar geographical distribution. In this species, however, the inflorescence is always dioicous, and the plants are usually smaller and more closely pinnate then in *B. filicina*. Unfortunately these last two differences are inconstant, and specimens of *B. fruticulosa* are sometimes met with which are as large and as loosely pinnate as typical *B. filicina*. As Schiffner justly remarks, there are no absolutely trustworthy characters to separate the species except the differences in the inflorescence, and the attempt to keep them apart on this ground alone is perhaps questionable. The only other West Indian species with which *B. filicina* is likely to be confused is *B. tenuicaulis*. In this plant the secondary stems are even longer and tend to be more loosely pinnate, with widely spreading branches, some of which assume a flagelliform character. So far as observed the lobules in this species usually show a distinct apex, and this peculiarity may also

* Hedwigia 29: 2. 1890.

† Hep. Amaz. et And. 114. 1884.

‡ Hedwigia 33: 174. 1894.

§ Mex. Leverm. 167. 1863.

‖ Ann. Sci. Nat. Bot. V. 1: 45. 1864.

be cautiously employed in distinguishing it from *B. filicina.* According to Schiffner *B. trinitensis* Lehm. & Lindenb., of the Synopsis Hepaticarum, together with its variety *intermedia*, is synonymous with *B. tenuicaulis*, so far as the American specimens quoted are concerned. *B. trinitensis* was based on *Jungermannia trinitensis* Lehm. & Lindenb., which was published in 1833. It would appear, therefore, that the name *B. tenuicaulis* ought to be superseded, because it was not published until 1845. Unfortunately the type specimen of *J. trinitensis*, which was collected on the island of Trinidad by Beyrich, is too poorly developed and fragmentary to give an adequate idea of a specific type in this variable genus, and it becomes necessary to allow this name to disappear from the literature.

The genera most closely allied to *Bryopteris* are perhaps *Thysananthus* and *Ptychanthus*, both of which develop secondary stems from a prostrate caudex and usually exhibit a definite pinnate branching. In these two genera, however, subfloral innovations are always developed. *Thysananthus* is further distinguished by the dentate wings which are borne on the keels of the perianth, while in *Ptychanthus* the perianth, although smooth, bears from four to seven ridges in addition to the three normal keels. The remarkable leaf-cells in *Bryopteris* are hardly paralleled among the the other *Jubuleae*. In *Caudalejeunea Lehmanniana*, to be sure, there are occasionally two or even three intermediate thickenings between two trigones (PLATES 33, FIGURE 7), but this seems to be a somewhat anomalous condition, and the cells are never strongly elongated. In spite of its undoubted affinity with the *Lejeuneae*, *Bryopteris* also has much in common with the *Frullanieae* and especially with the genus *Jubula*. It agrees with this genus in its lack of pigmentation, in the morphology of its vegetative branches, in its pointed leaves and bracts, and in its trigonous perianth with smooth keels. Of course it differs in the structure of its lobules, in its leaf-cells, in its undivided underleaves, and in the absence of subfloral innovations, the last being a character which it shares with *Frullania*.

In the preparation of the present paper the writer is especially indebted to Herr F. Stephani, of Leipzig, Dr. von Keissler, of

Vienna, and Mr. M. B. Slater, of Malton, Yorkshire, for the loan of type specimens and authentic material. Valuable collections for study have also been supplied by the New York Botanical Garden.

YALE UNIVERSITY.

Explanation of plates 31-33

As in the previous papers of this series the figures were drawn by the writer and prepared for publication by Miss Hyatt.

PLATE 31

Symbiezidium transversale (Swartz) Trevis. 1. Part of stem with female branch and perianth, postical view, × 15. 2. Leaf, antical view, × 15. 3. Proliferating male inflorescence borne on a leading branch, postical view, × 15. 4. Two short male inflorescences with limited growth, postical view, × 15. 5. Cells from middle of lobe, × 265. 6, 7. Apices of lobules, showing hyaline papillae, × 200. 8–10. Bracts and bracteole from one involucre, × 25. The figures were all drawn from specimens collected by the writer (*67*).

Symbiezidium barbiflorum (Lindenb. & Gottsche) Evans. 11. Part of stem with female branch and perianth, postical view, × 25. 12–14. Bracts and bracteole from one involucre, × 25. The figures were all drawn from specimens collected by A. A. Heller (*779*).

PLATE 32

Marchesinia brachiata (Swartz) Schiffn. 1. Stem with perianth and two innovations, one of which has been cut off close to the base, postical view, × 9. 2. Part of stem, antical view, × 9. 3. Lobule, postical view, × 35. 4. Cells from middle of lobe, × 265. 5. Cells from apex of lobe, × 200. 6. Apex of lobule, × 200. 7–9. Bracts and bracteole from one involucre, × 15. 10. Subfloral underleaf below same involucre, × 15. 11–13. Bracts and bracteole from an involucre of a second specimen, × 15. 14. Bracteal lobules from an involucre of a third specimen taken from a primary inflorescence, × 15. 15. Bracteal lobules from the two secondary inflorescences borne on the subfloral innovations of the preceding primary inflorescence, × 15. 16. Foliar lobule of a fourth specimen, postical view, × 35. 17. Apex of lobe, × 15. 18–20. Bracts and bracteole from one involucre, × 15. 21. Bracteole from a fifth specimen, × 15. 22, 23. Bract and bracteole from a sixth specimen, × 15. Figs. 1–15 were drawn from specimens collected on John Crow Peak, Jamaica, by L. M. Underwood (*727, 851*) and by the writer (*105*); Figs. 16–18, from Puerto Rico specimens collected by the writer (*59*) and by Heller (*1145*); Figs. 22 and 23, from the specimens distributed in *Hepaticae Cubenses* as *Phragmicoma Bongardiana*.

PLATE 33

Caudalejeunea Lehmanniana (Gottsche) Evans. 1. Branch with perianth, postical view, × 15. 2. Two leaves, postical view, × 15. 3. Part of plant showing a perianth, a female inflorescence, and a male spike, postical view, × 15. 4. Prostrate branch, postical view, × 15. 5. Two leaves, antical view, × 15. 6. Cells from middle of lobe, × 265. 7. Cell from base of lobe, × 265. 8. Apex of lobule, × 200. 9–11. Bracts and bracteole from one involucre, × 15. 12. Transverse section of perianth,

$\times$ 25. Figs. 1 and 2 were drawn from a portion of the original material preserved in the Lindenberg Herbarium at Vienna; the remaining figures were drawn from A. A. Heller's Puerto Rico specimens (*838*).

Bryopteris filicina (Swartz) Nees. 13. Part of stem with bases of two branches, postical view, $\times$ 15. 14. Leaf, antical view, $\times$ 15. 15. Female branch (entire length) with perianth, postical view, $\times$ 25. 16. Part of a branch bearing a male inflorescence, postical view, $\times$ 15. 17. Cells from middle of lobe, $\times$ 265. 18. Cells from base of lobe, $\times$ 265. 19. Cells from antical margin of lobe, $\times$ 265. 20. Margin of lobule with hyaline papilla, $\times$ 265. 21. Leaf immediately behind involucre, $\times$ 25. 22. Transverse section of perianth, $\times$ 25. The figures were all drawn from specimens collected at Old England, Jamaica, by L. M. Underwood (*XX*)

Mosses from tropical America

ROBERT STATHAM WILLIAMS

COLOMBIAN MOSSES COLLECTED BY H. PITTIER

SPHAGNUM MEDIUM PURPURASCENS (Russ.) Warnst.

Paramo de Buena Vista, 3000–3600 meters, January, 1906 (*1138*).

DICRANELLA PERROTTETII (Mont.) Mitt.

Cordoba, Dagua Valley, 30–100 meters, December, 1905 (*551*).

DICRANUM FRIGIDUM C. M.

Paramo de Moras, between Mozoco and Pitayo, 3000–3500 meters, February, 1906 (*1387*).

DICRANUM SPECIOSUM Hook. f. & Wils.

Paramo de Buena Vista, 3000–3600 meters, January, 1906 (*1206*).

CAMPYLOPUS CONCOLOR (Hook.) Mitt.

Around Huila, Rio Paez Valley, 1600–1900 meters, January, 1906 (*1271*).

Campylopus (*Pseudocampylopus*) **Pittieri** sp. nov.

Inflorescence not determined: plants in dense, rather light-green tufts about 1 cm. high, with short, appressed branches and leaves densely imbricated and erect when dry; stem-leaves up to 5 mm. long, tubulose above, gradually narrowed to the denticulate apex formed by the excurrent nerve; costa 4 mm. wide at base, occupying about five-sevenths of the width of leaf-base, in cross-section showing a single row of large cells on upper surface and below about two rows of small, scarcely thicker-walled cells; cells of leaf-blade below, narrowly linear, pale, thin-walled, in about 6 rows, above becoming short and slightly obliquely elongated; perichaetial leaves up to 7 mm. long, convolute below, rather gradually narrowed to a slightly rough, subulute point longer than the sheathing part; seta smooth, 14 mm. long, sinuous above when dry, strongly curved when moist; capsule without stomata, oval, 2 mm. long without lid, dark-red just below mouth, deeply furrowed when dry, the beaked lid about two-thirds length of capsule; calyptra smooth, fimbriate at base; spores rough, up to 16 μ.

Headwaters of Rio Lopez, Rio Palo basin, 2500–3000 meters January 24, 1906, H. Pittier (*1088*).

Dicranodontium setosum sp. nov.

Dioicous: antheridia 0.5 mm. long with paraphyses slightly exceeding them: plants in yellowish-brown, glossy tufts with stems more or less branching at the base and 5 or 6 mm. high (perhaps only young plants); upper stem-leaves up to 11 mm. long, mostly erect-spreading, sometimes slightly curved and secund, gradually narrowed from a broad, not auriculate base, to a setaceous point, sharply denticulate 2 or 3 mm. down from apex and formed by the excurrent costa; costa reddish at base, in cross-section one half up showing one row of large cells on upper side with a narrow band of small, thick-walled cells beneath; leaf-cells above, elongated, more or less rectangular, in margin below narrowly linear, forming a somewhat distinct border, becoming wider toward the costa, and across leaf-base wide and hyaline, forming a more or less distinct group; perichaetial leaves, about the length of upper stem-leaves, with ovate-oblong, sheathing base rather abruptly narrowed to a rough subula about the length of sheathing part; seta erect, twisted above, up to 2 cm. long; capsule, without stomata and annulus, erect, oblong, smooth, without lid 1.75 mm. long, with a slightly obliquely rostrate lid nearly as long; peristome red, split three fourths down or more into slender, terete segments, obliquely striate on outer surface below and papillose above and on inner surface; calyptra entire at base, smooth above; spores slightly rough, up to 18 μ in diameter.

Paramo de Buena Vista, on tree-trunks, 3100 meters, January, 1906, H. Pittier (*2060*).

OCTOBLEPHARUM ALBIDUM (L.) Hedw.

Cordoba, Dagua Valley, 30–100 meters, December, 1905 (*552*).

FUNARIA HYGROMETRICA (L.) Sibth.

Hills of Miraflores above Palmira (*865*, *2063*).

FUNARIA CALVESCENS Schwaegr.

Immature specimens apparently of this species from the locality of preceding species.

BRYUM ARGENTEUM L.

Collected at various localities from 1500 to 3600 meters. (*777*, *1089*, *2061*, *2064*).

BRYUM sp.

Cuesta de Yocotá, 1500-1900 meters, December, 1905 (*778*). A small amount of some *Eubryum*, scarcely sufficient for determination.

RHIZOGONIUM SPINIFORME (L). Bruch.

Around San Andres de la Sierra, 1100-1300 meters, June, 1906 (*2068*).

POLYTRICHADELPHUS CILIATUS (Hook. f. & Wils.) Mitt.

Las Escaleretas, Moras Valley, 2500–3000 meters, February, 1906 (*1377*).

POGONATUM TORTILE (Sw.) Beauv.

Around San Andrés de la Sierra, 1100–1300 meters, June, 1906 (*2073*).

HOOKERIOPSIS GRACILIS (Mitt.) Jaeg.

Around San Andrés de la Sierra, 1100–1300 meters, June, 1906 (*2067*). The roughness of the seta of this species is often so slight just under the capsule as to be scarcely noticeable; the calyptra is not very rough above, and the double-pointed teeth of the leaf-margin are usually quite small.

?SEMATOPHYLLUM SUBSIMPLEX (Hedw.) Mitt.

Around San Andrés de la Sierra, 1100–1300 meters, June, 1906 (*2066*). But a very small amount of this specimen seen and possibly to be referred elsewhere.

MICROTHAMNIUM REPTANS (Sw.) Mitt.

Around San Andrés de la Sierra, 1100–1300 meters, June, 1906 (*2071*).

MICROTHAMNIUM TÜRCKHEIMI C. M.

Paramo de Buena Vista, 3000–3600 meters, January, 1906 (*1190*).

RHYNCHOSTEGIUM CONCHOPHYLLUM (Tayl.) Jaeg.

Headwaters of Rio Lopez, Rio Palo basin, 2500–3000 meters, January, 1906 (*1087*).

GUATEMALAN MOSSES COLLECTED BY H. PITTIER

TIMMIELLA SUBANOMALA (Besch.) Broth.

Volcan de Agua, 1800–3400 meters, March, 1905 (*9*).

Leptodontium perannulatum sp. nov.

Dioicous: ♂ plant slender with bud-like flowers a little over 1 mm. high, the antheridia 0.8 mm. long with rather abundant paraphyses; antheridial leaves costate, smooth, entire, ovate, acutely short-pointed: fertile plants in rather compact tufts with usually slightly branching stems up to 8 cm. high, dark-brown below, yellowish toward apex and with radicles mostly inconspicuous; stem-leaves more or less twisted-carinate, spreading or recurved when dry, recurved from near base when moist, up to 3.5 mm. long, oblong-lanceolate, recurved on the margin below, gradually narrowed to an acute, irregularly serrulate apex with costa nearly percurrent; cross-section of costa showing about 4 large cells with stereid bands of about one row of cells above and two rows below; cells of leaf-base yellow, linear, smooth with sinuously thickened lateral walls, cells above papillose, mostly irregularly oblong with much thickened walls, the median cells about 6 μ by 10 μ; perichaetial leaves up to 10 mm. long, smooth, costate to near apex, sheathing over one half up, gradually narrowed to a flexuous, distantly serrulate apex: pedicel 1 cm. high; capsule ovate-cylindrical, slightly curved and nodding, small-mouthed, 3 mm. long with a stoutly-beaked lid 0.8 mm. long; peristome-teeth lanceolate, 0.2 mm. long, pale golden-brown, glabrous, articulations often indistinct, more or less irregularly split longitudinally; annulus broad persistent, 7 or 8 rows of cells high, the upper rows of loosely cohering cells; spores rough, up to 22 μ in diameter.

Volcan de Agua, on sheltered rocks, 3400–3750 meters, March 22, 1905, H. Pittier (*42*). This species is near *L. brevisetum* Mitt., from which it may be distinguished by the leaf-cells. In *L. brevisetum* the median cells are smaller (mostly 5 μ by 5 to 6 μ) scarcely elongated or often slightly transversely elongated and with cell-walls thinner and straighter. In the Mitten herbarium a few fragments of this apparently undescribed species were found, evidently from the same locality as Pittier's specimens, but without date or collector, and were on the same sheet with *L. brevisetum*.

CUBAN MOSSES COLLECTED BY W. R. MAXON

Holomitrium Maxoni sp. nov.

Inflorescence not determined: plants in rather dark-green tufts with stems, bearing few branches, up to 8 mm. high: leaves, when dry, incurved-imbricated with margins above rolled in, when moist, more or less recurved and widely spreading, in outline nearly linear, up to 2.5 mm. long and 0.4 mm. wide, the apex mostly broadly rounded or somewhat truncate, with excurrent costa forming a stout apiculus and a few coarse, irregular teeth on either side; leaf-cells of upper leaf more or less hexagonal to oblong, about 12 μ wide and 20 to 40 μ long, gradually becoming longer and narrower toward base with cell-walls slightly thickened and pitted throughout; perichaetial leaves up to 7 mm. long, convolute below, gradually narrowed to a short-subulate, slightly serrulate apex formed by the excurrent nerve; pedicel up to 18 mm. long; capsule oblong-cylindrical, erect, 3 mm. long, red at the slightly contracted mouth; peristome-teeth attached about one fourth their length below the mouth, red below, strongly articulate, papillose on both sides and more or less divided along median line, either above or below, or sometimes throughout; spores nearly smooth, up to 12 μ in diameter; lid and calyptra not seen.

* Posesion de Starck, Yateras, Oriente, 500 meters, May 3, 1897, W. R. Maxon (*4427*). Near *H. proliferum* and *H. Wrightii*, but without the flagellate branches of the first and with narrower, longer, thicker-walled basal cells, and differing from the second in the shorter, appressed leaves with more rounded point and teeth extending downward much less on either side.

SYRRHOPODON HOBSONI (Grev.) Mitt.

Monte Verde, Yateras, Oriente, 575 meters, April, 1907 (*4292*).

MACROMITRIUM HUSNOTI Schimp.

Monte Verde, Yateras, Oriente, 575 meters, April, 1907 (*4283*).

RHIZOGONIUM SPINIFORME (L.) Bruch.

Monte Verde, Yateras, Oriente, 575 meters, April, 1907 (*4310*).

ACROCRYPHAEA COFFEAE (C. M.) Par.

Jaguey, Yateras, Oriente, 420 meters, May, 1907 (*4347*).

NECKERA UNDULATA Hedw.

Valley of Rio Bayamita, on rock, 900–1050 meters, April, 1907 (*3977*).

ENTODON MACROPODUS (Hedw.) C. M.

Near Jaguey, Yateras, Oriente, 420 meters, May, 1907 (*4345*, *4359*): Farallones of La Perla, north of Jaguey, 540–585 meters (*4370*).

Cyclodictyon cubense sp. nov.

Synoicous: plants forming low dull-green mats, the stems with complanate leaves 3 mm. wide; lateral leaves broadly ovate-oblong, up to 1.75 mm. long and 0.8 mm. wide, entire, acutely short-pointed with a pale border of one row of cells; median and upper leaf-cells hexagonal, slightly elongated, up to 50 μ long and about 40 μ wide, toward base becoming somewhat narrower and longer; costa forking at base, extending two thirds up, smooth on the back, apices not projecting; perichaetial leaves entire, short and ovate or ovate-lanceolate, with erect, acute apex, the longer about 1 mm. long; seta smooth, 12 mm. high; capsule nodding or pendant, about 1 mm. long, with a conical rostrate lid a little shorter; outer peristome-teeth red, cross-striate below, 65 μ wide at base, with median furrow 8 μ wide and reaching to near base from about two thirds up; inner segments solid, nearly as long as teeth, from a basilar membrane about one third height of teeth; spores smooth, 12 μ in diameter; calyptra smooth.

Finca Las Gracias, Yateras, Oriente, 500 meters, on decayed log, May 5, 1907, W. R. Maxon (*4495*). This species is near *C. limbatum* and *C. Regnellii*, but differs in the pale, entire border of leaf of only one row of cells and in the costa smooth on the back.

HAPLOCLADIUM MICROPHYLLUM (Sw.) Broth. (*Leskea microphylla* (Sw.) Mitt.)

Jaguey, Yateras, Oriente, at base of trees, 420 meters, May, 1907 (*4353*).

SEMATOPHYLLUM ADMISTUM (Sull.) Mitt.

Jaguey, Yateras, Oriente, 420 meters, May, 1907 (*4344*).

MICROTHAMNIUM THELISTEGUM (C. M.) Mitt.

Jaguey, Yateras, Oriente, 420 meters, May, 1907, (*4355*).

INDEX TO AMERICAN BOTANICAL LITERATURE
(1906)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions their kindness will be appreciated.

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Barbour, J. H. Local variations and other notes on blue eyed grass (*Sisyrinchium angustifolium*). Proc. & Trans. Nova Scotian Inst. Sci. **11**: 190–192. 6 Je 1906.

Bush, B. F. Some new Texas plants. Ann. Rep. Missouri Bot. Gard. **17**: 119–125. 6 N 1906.

New species and varieties in *Tracyanthus*, *Allium*, *Psoralea* (2), *Tragia*, *Lobelia*, *Xanthium*, *Antennaria*, and *Silphium*.

Cardot, J. & Thériot, I. On a small collection of mosses from Alaska. Univ. Calif. Publ. Bot. **2**: 297–308. *pl. 27, 28.* 29 D 1906.

Includes new species in *Orthotrichum*, *Bryum* (2), and *Hypnum*.

Clinton, G. P. Downy mildew or blight, *Phytophthora infestans* (Mont.) DeBy., of potatoes.—II. Rep. Conn. Agric. Exp. Sta. **1905**: 304–330. *pl. 23–25.* My 1906.

Clinton, G. P. Downy mildew, *Phytophthora Phaseoli* Thaxt., of lima beans. Rep. Conn. Agric. Exp. Sta. **1905**: 278–303. *pl. 20–22.* My 1906.

Clinton, G. P. Notes on fungous diseases, etc., for 1905. Rep. Conn. Agric. Exp. Sta. **1905**: 263–277. *pl. 13–19.* My 1906.

Demcker, R. Die geographische Verbreitung der amerikanischen Cupuliferen und anderer charakteristischer Baüme des Waldes und der offenen Landschaft. Mitteil. Deuts. Dendr. Gesells. **15**: 157–173. 1906.

Duggar, B. M. The relation of certain marine algae to various salt solutions. Trans. Acad. Sci. St. Louis **16**: 473–489. 21 D 1906.

Dusén, P. Beiträge zur Bryologie der Magellansländer, von Westpatagonien und Südchile. V. Ark. Bot. **6**[10]: 1–32. *pl. 1–6.* 14 D 1906.

Includes new species in *Barbula*, *Tortula* (5), *Grimmia*, *Camptodontium*, and *Rhacomitrium* (4).

Fries, R. E. Systematische Uebersicht der Gattung *Scoparia*. Ark. Bot. **6**[9]: 1–31. *pl. 1–8.* 14 D 1906.

Includes 4 new species, natives of Mexico or South America.

Fries, R. E. Zur Kenntnis der Phanerogamenflora der Grenzgebiete zwischen Bolivia und Argentinien. III. Einige gamopetale Familien. Ark. Bot. **6**[11]: 1–32. *pl. 1–4.* 15 D 1906.

New species in *Acicarpha*, *Sicyos*, *Borreria*, *Gerardia*, *Limnanthemum*, and *Buddleia*.

Giacomelli, E. *Prosopanche Burmeisteri* DeBary. Anal. Soc. Ci. Argent. **62**: 5–22. Jl 1906.

Glover, G. H. Larkspur and other poisonous plants. Colo. Agric. Exp. Sta. Bull. **113**: 1–24. *pl. 1–8.* Je 1906.

Graebener, L. Die in Deutschland winterharten *Rhus*. Mitteil. Deuts. Dendr. Gesells. **15**: 100–107. *pl. 7–12 + map.* 1906.

Chiefly American species.

Harris, J. A. Ascidia in *Gasteria* and *Agave*. Ann. Rep. Missouri Bot. Gard. **17**: 126–132. *f. 1–6.* 6 N 1906.

Harris, J. A. Prolification of the fruit in *Capsicum* and *Passiflora*. Ann. Rep. Missouri Bot. Gard. **17**: 133–145. *f. 1–3.* 6 N 1906.

Harvey, J. C. *Brassavola nodosa* and the calabash tree. Orchid Rev. **14**: 282, 283. S 1906.

Hedgcock, G. G. Studies upon some chromogenic fungi which discolor wood. Ann. Rep. Missouri Bot. Gard. **17**: 59–114. *pl. 3–12.* 27 S 1906.

Includes descriptions of new species in *Ceratostomella* (6), *Graphium* (3), *Hormodendron*, and *Hormiscium*.

Hedgcock, G. G. Zonation in artificial cultures of *Cephalothecium* and other fungi. Ann. Rep. Missouri Bot. Gard. **17**: 115–117. *pl. 13–15.* 27 S 1906.

Hickens, C. M. Observations sur quelques fougères argentines nouvelles ou peu connues. Anal. Soc. Ci. Argent. **62**: 161–176. O 1906; 209–218. *pl.* [*1–8*]. N 1906.

Includes new species in *Nephrodium*, *Pellaea*, and *Hypolepis*, and new varieties in *Polystichum* and *Asplenium*.

Hollick, A. The Cretaceous flora of southern New York and New England. 1–219. *pl. 1–40.* Washington, 1906.

Monog. U. S. Geol. Surv., vol. 50. Includes 32 new species in 28 genera.

Hus, H. T. A. Fasciation in *Oxalis crenata* and experimental production of fasciations. Ann. Rep. Missouri Bot. Gard. **17**: 147–152. *pl. 17–19.* 6 N 1906.

MacKay, A. H. Botanical notes in Nova Scotia. Proc. & Trans. Nova. Scotian Inst. Sci. **11**: 286–288. 6 Je 1906.

MacKay, A. H. Phenological observations in Canada, 1903. Proc. & Trans. Nova Scotian Inst. Sci. **11**: 271–285. 6 Je 1906.

Magnus, P. Auftreten eines einheimischen Rostpilzes auf einer neuen aus Amerika eingeführten Wirtspflanze. Ber. Deuts. Bot. Gesells. **24**: 474–476. 28 N 1906.

Purpus, A. Neue und seltene Gehölze aus dem Botanischen Garten zu Darmstadt. Mitteil. Deuts. Dendr. Gesells. **15**: 30–42. 1906. [Illust.]

Rolfe, R. A. *Epidendrum atrorubens.* Orchid Rev. **14**: 274. S 1906.

Native of Mexico.

Rolfe, R. A. *Gomesa scandens.* Orchid Rev. **14**: 208. Jl 1906.

Native of Brazil.

Schrenk, H. von. Destruction of twigs by the bag worm and incident evidence of growth pressure. Ann. Rep. Missouri Bot. Gard. **17**: 153–181. *pl. 20–26 + f. 1–4 + diagr. 1, 2.* 6 N 1906.

Shimek, B. Notes on some Iowa plants. Proc. Davenport Acad. Sci. **10**: 141–145. 1906.

Smith, R. E. Tomato diseases in California. Calif. Agric. Exp. Sta. Bull. **175**: 1–16. *f. 1–8.* Ja 1906.

Spaulding, P. Studies on the lignin and cellulose of wood. Ann. Rep. Missouri Bot. Gard. **17**: 41–58. *pl. 1, 2.* 31 Au 1906.

Sprague, T. A. *Pontederia cordata* var. *lancifolia.* Curt. Bot. Mag. IV. **2**: *pl. 8108.* 1 D 1906.

Native of temperate America.

Stuckert, T. Distribución geográfica de la flora argentina. Géneros de las familias de las Compuestas. Anal. Mus. Nac. Buenos Aires III. **6**: 303–309. 30 Je 1906.

Stuckert, T. Segunda contribución al conocimiento de las Gramináceas argentinas. Anal. Mus. Nac. Buenos Aires III. **6**: 409–553, 555. 10 D 1906. [Illust.]

Thériot, I. Mousses récoltées aux environs de Bogota (Colombie). Bull. Acad. Internat. Géogr. Bot. **15**: Suppl. 78, 79. 10 D 1906.

Includes 2 new species in *Leptodontium*.

Thornber, J. J. Alfilaria, *Erodium cicutarium*, as a forage plant in Arizona. Ariz. Agric. Exp. Sta. Bull. **52**: 27–58. *pl.* + *f. 1–5*. 21 My 1906.

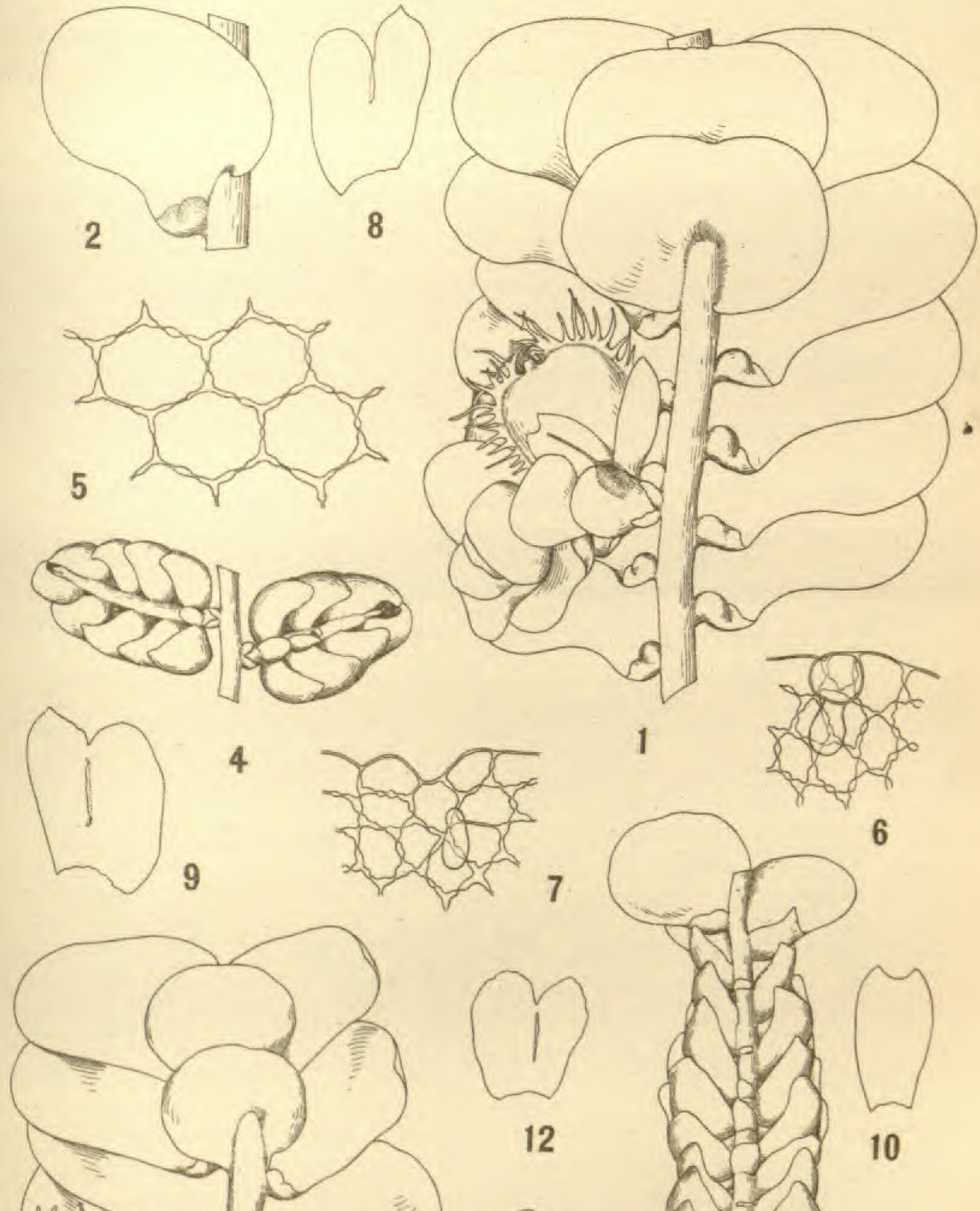
Thornber, J. J. Department of botany [report for 1905–1906]. Ariz. Agric. Exp. Sta. Ann. Rep. **17**: 156–162. 30 D 1906.

Whipple, O. B. Peach mildew. Colo. Agric. Exp. Sta. Bull. **107**: 1–7. *f. 1, 2.* F 1906.

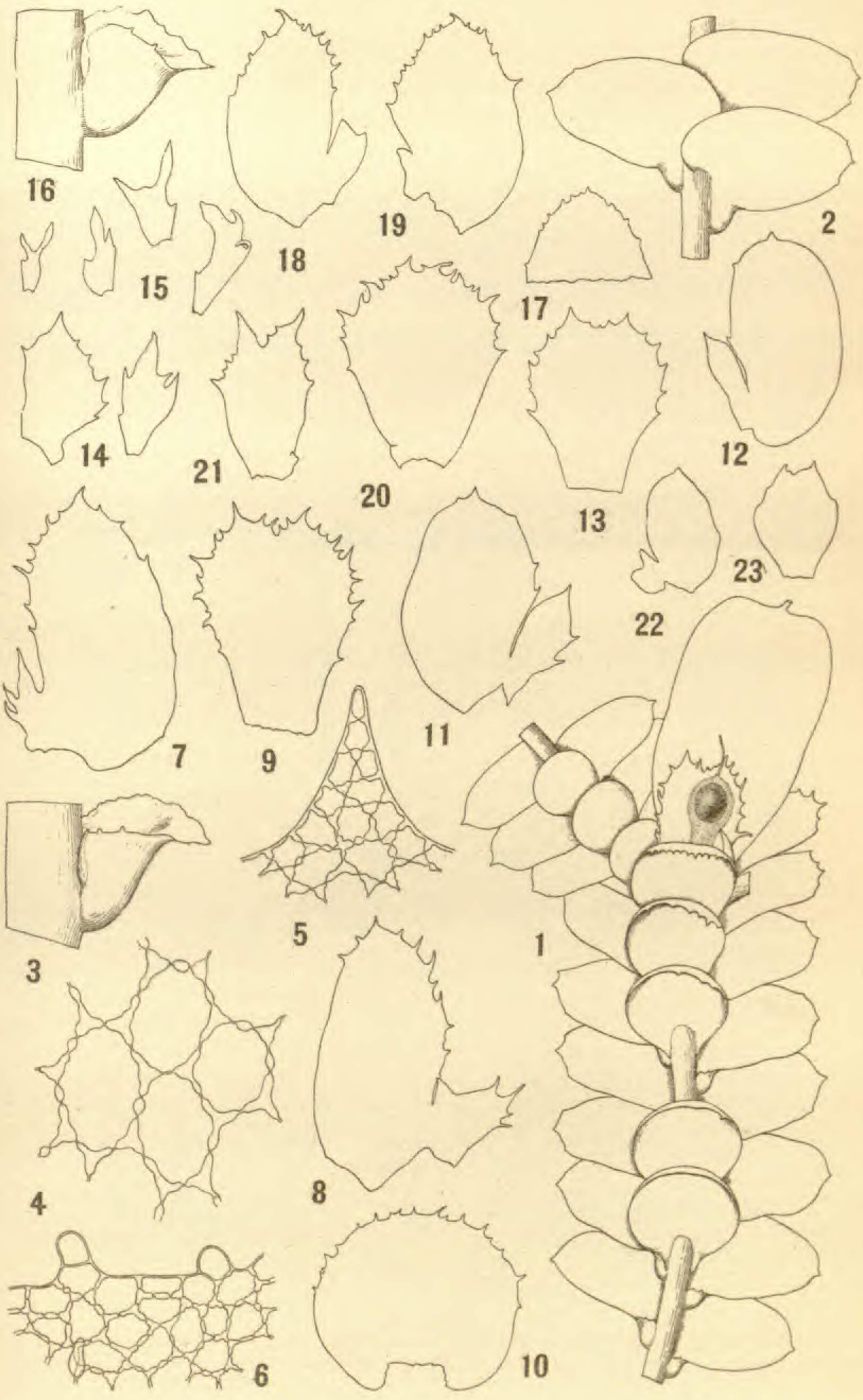
Wilcox, E. M. Diseases of sweet potatoes in Alabama. Ala. Agric. Exp. Sta. Bull. **135**: 1–16. *f. 1–4.* Je 1906.

Wright, C. H. *Aechmea gigas.* Curt. Bot. Mag. IV. **2**: *pl. 8107.* 1 D 1906.

Native of Brazil (?).

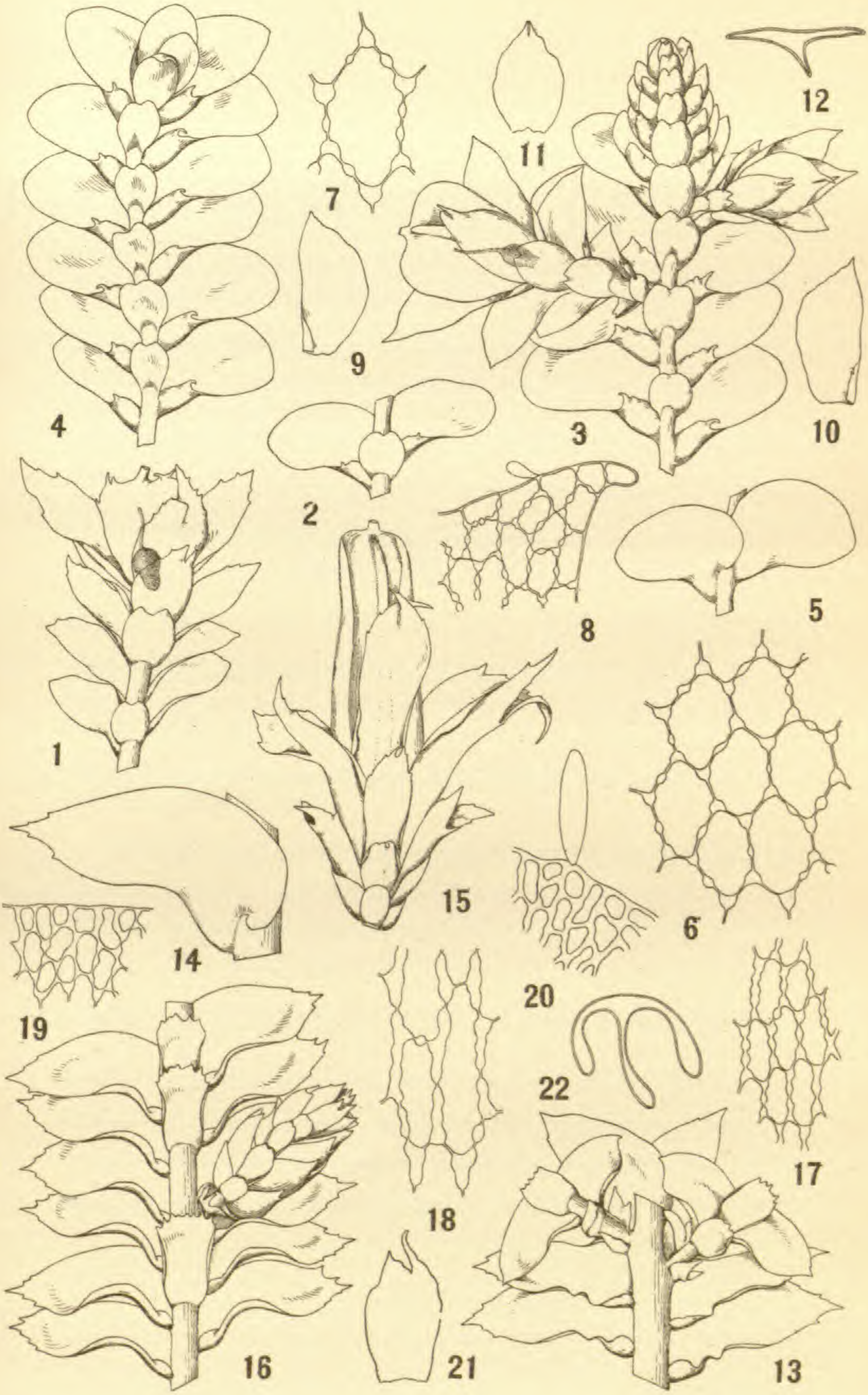


1-10 SYMBIEZIDIUM TRANSVERSALE (Swartz) Trevis.
11-14 SYMBIEZIDIUM BARBIFLORUM (Lindenb. & Gottsche) Evans.



MARCHESINIA BRACHIATA (Swartz) Schiffn.

COCKAYNE, BOSTON



1-12 CAUDALEJEUNEA LEHMANNIANA (Gottsche) Evans.
13-22 BRYOPTERIS FILICINA (Swartz) Nees.

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THIS work is designed to present descriptions of all plants growing independent of cultivation, in North America, here taken to include Greenland, Central America, the Republic of Panama, and the West Indies, except Trinidad, Tobago, and Curaçao and other islands off the north coast of Venezuela, whose flora is essentially South American.

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Spruce, Richard. *Hepaticae* Bolivianae, in Andibus Boliviae orientalis, annis 1885–6, a cl. H. H. Rusby lectae. Pages 113–140. 20 Ja 1890.

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Sturtevant, Edward Lewis. On seedless fruits. Pages 141–187. 30 My 1890.

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Halsted, Byron David. Reserve food-materials in buds and surrounding parts. Pages 1–26, *plates 1, 2.* 10 S 1890.

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Holm, Herman Theodor. Contributions to the knowledge of the germination of some North American plants. Pages 57–108, *plates 5–19.* 15 Ap 1891.

Vol. 2, No. 4; price, 75 cents:

Wheelock, William Efner. The genus *Polygala* in North America. Pages 109–152. 30 D 1891.

Vol. 3, No 1; not furnished separately:

Small, John Kunkel & Heller, Amos Arthur. Flora of western North Carolina and contiguous territory. Pages 1–39. 20 F 1892.

Vol 3, No. 2; price, $2.00:

Morong, Thomas. The *Naiadaceae* of North America [with illustrations of all the species]. Pages 1–65, *plates 20–74.* 15 Mr 1893.

Vol. 3, No. 3; not furnished separately:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. [Part 1.] Pages 1–67. 28 Ap 1893.

Vol. 4, No. 1; not furnished separately:

Underwood, Lucien Marcus. Index *Hepaticarum*. Part I, Bibliography. Pages 1–91. 10 Je 1893.

Vol. 4, No. 2; not furnished separately:

Small, John Kunkel & Vail, Anna Murray. Report on the botanical exploration of southwestern Virginia during the season of 1892. Pages 93–201, *plates 75–82.* 18 N 1893–17 Ap 1894.

Vol. 4, No. 3; price, 50 cents:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 2. Pages 203–274. 10 Mr–17 Ap 1895.

Vol. 4, No. 4; price, 50 cents:

Pettit, Anna Stockton. *Arachis hypogaea* L. Pages 275–296, *plates 83–85* 5 Je 1895.

Vol. 4, No. 5; price, 75 cents:

Rydberg, Per Axel. The North American species of *Physalis* and related genera. Pages 297–374. 15 S 1896.

Vol. 5; price, $3.00:

List of *Pteridophyta* and *Spermatophyta* growing without cultivation in northeastern North America. Pages 1–377. 4 D 1893–31 D 1894.

Vol. 6, No. 1; price, $1.25:

Rusby, Henry Hurd. An enumeration of the plants collected in Bolivia by Miguel Bang. Part 3. Pages 1–130. 17 N 1896.

Vol. 6, No. 2; not furnished separately:

Grout, Abel Joel. A revision of the North American *Isotheciaceae* and *Brachythecia*. Pages 131–210. 30 Jl 1897.

Vol. 6, No. 3; price, 50 cents:

Hazen, Tracy Elliot. The life history of *Sphaerella lacustris* (*Haematococcus pluvialis*). Pages 211–246, *plates 86, 87* (*colored*). 8 Je 1899.

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Underwood, Lucien Marcus. A review of the genera of ferns proposed prior to 1832. Pages 247–283. 1 D 1899.

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CONTENTS

A new Utricularia from Long Island. (Plate 34.) JOHN HENDLEY BARNHART 579
New species of Uredineae, VI . . . . JOSEPH CHARLES ARTHUR 583
Notes on a parasitic Gnomonia . . . . . . CLAUDE WILBUR EDGERTON 593
A synopsis of the New England species of Tetmemorus. JOSEPH AUGUSTINE CUSHMAN 599
Notes on Carex, III. . . . . KENNETH KENT MACKENZIE 603
INDEX TO AMERICAN BOTANICAL LITERATURE. 609
INDEX TO VOLUME 34. 617

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Vol. 34 No. 12

BULLETIN

OF THE

TORREY BOTANICAL CLUB

DECEMBER, 1907

A new Utricularia from Long Island

JOHN HENDLEY BARNHART

(WITH PLATE 34)

One September day, six years ago, while I was walking along the shore of a small pond near Riverhead, on Long Island, I observed a small colony of plants of a terrestrial *Utricularia*. At first sight it appeared different from any species previously reported from the northeastern United States; as a careful study of the fresh material confirmed this view, another visit was made to the locality a few days afterward and the plant collected as liberally as consideration for the perpetuation of the single small patch would permit. The bladderworts, however, are very fickle, appearing and disappearing in a given place from year to year, and several subsequent visits to the original locality have failed to bring this plant to light again.

Although the species was apparently new, and careful notes had been made upon the fresh material and a fair quantity of herbarium material collected, publication was deferred in the hope that further collections might be made. Two years later, Mr. Bicknell brought in from Woodmere, Long Island, for the herbarium of the New York Botanical Garden, specimens of the same *Utricularia*, in flower. Meanwhile my own material had been mislaid, and when it was located again, a few months ago, it seemed best no longer to delay the publication of the novelty.

The species here proposed as new belongs to a group which has comprised, in our northeastern flora, only two species, *U. cornuta* Michx. and *U. juncea* Vahl. They agree in having

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strictly erect scapes, "rooting" in mud (there are no true roots in *Utricularia*, these root-like organs being actually caulome); stems radiating from the bases of the scapes, extremely slender and delicate, so that they usually break off short and are very rarely collected; some of the leaves filiform, root-like, and bladder-bearing, others linear and resembling minute blades of grass; flowers subspicate, the pedicels being shorter than the bracts; bracts trifid; and palate of the corolla laterally compressed, not lobed.

Utricularia virgatula sp. nov.

Stems extremely delicate, radiating from the base of the scape, on or just beneath the surface of the soil: leaves scattered, undivided, linear, 4–8 mm. long, some erect, green-tipped, and bladderless, others root-like, colorless, and bladder-bearing: scapes fixed in the mud, erect, wiry, brownish, 2–20 cm. long; scales several, minute, acute; bracts minute, less than 1 mm. long, trifid, the middle lobe much broader than the lateral ones: flowers 1–6, subsessile: calyx purplish, the upper lobe broadly ovate, acuminate, 4 mm. long, the lower ovate, acute, only half the width of the upper, 2.5 mm. long: corolla yellow; upper lip spatulate, emarginate, barely if at all exceeding the upper calyx-lobe; lower lip about the length of the upper, entire, apiculate, consisting almost wholly of the laterally compressed palate, with a minute tuft of hairs in the throat; spur pendent, conical, acute, 2–3 mm. long: capsule subspherical, 1.5–2 mm. in diameter, purplish, closely invested by the persistent calyx-lobes, and slenderly beaked by the acuminate upper one; placenta spherical, stipitate, seed-bearing throughout: seeds very minute and numerous (about 750 in each capsule), oval in outline, the surface prominently reticulate.

NEW YORK: Near Riverhead, Suffolk County, September 4–13, 1901, *J. H. Barnhart* (type, in the author's herbarium); Woodmere, Nassau County, September 13, 1903, *E. P. Bicknell* (in the herbarium of the New York Botanical Garden).

The following material may also be referred here, with some doubt:

NEW JERSEY: Cold Spring, Cape May County, August 20, 1891, *Stewardson Brown* (in the herbarium of the Academy of Natural Sciences of Philadelphia, sheet no. 502,805).

Of our northeastern species, *U. virgatula* is most closely related to *U. juncea*, its most striking differences being the small size of its scapes, and its miniature corollas, the largest barely exceeding the calyx, while those of *U. juncea* are conspicuous. *U. juncea* is a species of distinctly southern range, and has not been hitherto reported as occurring on Long Island, as far as I am aware. It was found by me, however, in September of the present year (1907), near Riverhead, in a pond adjoining that from which *U. virgatula* was first taken. Its occurrence on Long Island is not at all remarkable, but it is surprising that it has so long escaped detection.

Closer still is the relationship of *U. virgatula* to the *U. simplex* of Charles Wright, first described from Cuba, and since reported from Florida. The resemblance is indeed so close that I am unable to name any character by which they may be distinguished. However, the name *U. simplex* has been in use for nearly a hundred years for an entirely different Australian species (*U. simplex* R. Br.), so that Wright's species is without any tenable name; instead of renaming it, it seems better to refer the material from Cuba and Florida provisionally to *U. virgatula*. If future comparisons should prove that the southern material is distinct, it will then be necessary to assign it a new name.

It might seem unreasonable to suggest that a gamopetalous spermatophyte found in Florida could be conspecific with one found in New Jersey, no intermediate stations being known; yet as a parallel case may be cited another species of the same genus. *U. resupinata* B. D. Greene was discovered about seventy-five years ago in eastern Massachusetts; one by one other localities came to light, until now it has been found in every one of the New England States, New York, New Jersey, Pennsylvania, Michigan, and Indiana. The same species, or one so closely resembling it that no one has yet distinguished it, is now known to be fairly common in Florida, and has been collected in southern Georgia; but no stations are known intermediate between these extreme southern ones and those in New Jersey, Pennsylvania, and Indiana.

In several of his published papers (Bull. Torrey Club **30**: 323, 324; Rhodora **7**: 72, 73), Dr. Roland M. Harper has called attention to similar apparent breaks in the distribution of various other flowering plants, such as *Rynchospora fusca*, *Eleocharis Robbinsii*, *Cladium mariscoides*, *Eriocaulon septangulare*, and *Habenaria blephariglottis*.

NEW YORK BOTANICAL GARDEN.

Explanation of plate 34

UTRICULARIA VIRGATULA sp. nov.

1, 2, 3. Entire plants, natural size.

4, 5. Trifid bract, × 8.

6. Capsule, with sheathing calyx, × 8.

7. Flower, × 8.

8. Corolla, × 8.

9. Gynoecium and androecium, × 8.

10. Portion of stem with two leaves, one bladder-bearing, the other bladderless, × 8.

11. Bladder, × 50.

New species of Uredineae—VI

Joseph Charles Arthur

The following fifteen species of rusts are in part new discoveries, and in part well known forms that have not before been specifically named and characterized. They are placed on record in order to facilitate the work of preparation for the systematic treatment of the order in the North American Flora, the final parts of which are now being written. The kindness of those who have contributed specimens is much appreciated. The hearty coöperation of numerous correspondents tends to insure a reasonably full treatment in the forthcoming work.

An error in the preceding number of this series may be pointed out here. The type specimen of *Uredo Holwayi* (Bull. Torrey Club **33**: 518. 1906) is on *Tsuga heterophylla* (Raf.) Sarg. The error was due to a confusion in the mind of the writer of the characters belonging to the two species of hosts. *T. heterophylla* is the lowland hemlock, which was formerly referred to the eastern *T. canadensis.* Both it and the alpine hemlock are found in the vicinity of Glacier, B. C. Professor Holway, who was in the Selkirks from July to September of 1907, reported the rust at the time very abundant on the lowland species, but rare on the other. He has sent a specimen on *T. Mertensiana*, collected at Glacier, B. C., August 18, 1907.

Puccinia cinerea sp. nov.

O and I. Pycnia and aecia unknown.

II. Uredinia hypophyllous, scattered, oblong, small, 0.1–0.3 mm. wide by 0.5–1.5 mm. long, tardily naked, pulverulent, orange-yellow, ruptured epidermis conspicuous; urediniospores broadly ellipsoid, 18–23 × 23–29 μ, wall pale-brown, about 1.5 μ thick, finely and inconspicuously echinulate, pores 5 or 6, scattered.

III. Telia compound, amphigenous, scattered, oblong, small, 0.1–0.2 mm. wide by 0.5–1 mm. long, long covered by the epidermis, cinereous, surrounded by a thin stroma; teliospores oblong or oblong-clavate, irregular by compression, 16–21 × 40–60 μ, wall dark cinnamon-brown, 1–1.5 μ thick, thicker at apex, 3 5 μ, smooth; pedicel short, tinted.

On *Poa nevadensis* Vasey, Fort McKinney, Wyoming, August, 1898, *Williams & Griffiths* (Griff. W. Am. Fungi *355*; type); *P. arida* Vasey, Wood River, Nebraska, July 28, 1906, *J. M. Bates 3930*, Loup City, Nebraska, June 22, 1907, *J. M. Bates; Poa* sp., Billings, Montana, September, 1898, *Williams & Griffiths* (Griff. W. Am. Fungi *355a*); Piedmont, Wyoming, August 4, 1901, *L. H. Pammel 2179*. The species resembles *Puccinia epiphylla* (L.) Wettst. (*P. Poarum* Niels.), but in the uredinial stage is readily distinguished by the slightly larger spores and absence of paraphyses, and in the telial stage by the more pronounced stroma, paler sori and larger teliospores. Rev. J. M. Bates has found it a number of times growing intermixed with *Oxygraphis Cymbalaria* (Pursh) Prantl, bearing aecia, and suggests that the two forms may be genetically related.

Puccinia perminuta sp. nov.

O and I. Pycnia and aecia unknown.

II. Uredinia amphigenous or only epiphyllous and caulicolous, scattered, oval, small, 0.1–0.3 mm. long, tardily naked, pale-yellow, pulverulent, ruptured epidermis noticeable; urediniospores globoid or broadly ellipsoid, 15–18 × 16–22 μ, wall very pale-yellow, thin, 1 μ or less, sharply echinulate, pores about 6, scattered, obscure.

III. Telia amphigenous or only epiphyllous and caulicolous, oval, small, 0.1–0.3 mm. long, often confluent, covered by the epidermis, blackish; stroma usually wanting; teliospores oblong, 12–16 × 25–39 μ, slightly or not constricted at septum, obtuse at both ends, wall chestnut-brown, smooth, thin, 1–1.5 μ, much thickened above, 5–10 μ, concolorous; pedicel very short, colored.

On *Agrostis hyemalis* (Walt.) B.S.P., Sugar Grove, Ohio, September 23, 1905, *W. A. Kellerman 4299* (type); Houston, Texas, April 17, 1869, *H. W. R*[*avenel*], uredinia only (specimen in herbarium of U. S. Department of Agriculture, said to be on *Trichodium*); *A. perennans* (Walt.) Tuckerm., Durbin, Pocahontas County, West Virginia, August 28, 1902, *W. A. Kellerman 3960*. The species differs from *P. Agrostidis* Plow. in the smaller spores of both sorts, and a less development of stroma, and in other less prominent characters. No one has yet made a suggestion as to its probable aecial connection.

Puccinia praegracilis sp. nov.

O. and I. Pycnia and aecia not definitely known.

II. Uredinia amphigenous, scattered, oblong, small, 0.1–0.2 mm. wide, by 0.2–0.3 mm. long, soon naked, pale-yellow, pulverulent, ruptured epidermis barely noticeable; urediniospores broadly ovoid, 16–19 × 18–21 μ, wall rather thin, about 1 μ, pale-yellow, closely and minutely echinulate, pores about 6, scattered, obscure.

III. Telia amphigenous, oblong or linear, 0.1–0.3 mm. wide, by 0.3–1 mm. long, irregularly confluent, covered by the epidermis, purplish-black; stroma none; teliospores oblong or linear-oblong, 12–13 × 30–42 μ, slightly or not constricted at septum, obtuse or truncate at both ends, coronate with short tubercles above, wall golden-brown, smooth, thin, 1 μ, somewhat thicker above, 2–4 μ exclusive of tubercles, and darker-colored; pedicel broad, very short, concolorous.

On *Agrostis Thurberiana* Hitchc., Glacier, British Columbia, 1200 meters, September 5, 1902 (type); July 29, 1907, *E. W. D. Holway.* This species differs in its smaller and more delicate uredinio- and teliospores from *Puccinia Rhamni* (Pers.) Wettst. (*P. coronata* Corda), to which it bears considerable resemblance, and from other species on *Agrostis* by the coronate teliospores. Collections were made at three or four localities, in the same general region. In each case the rust grew in connection with aecia on *Limnorchis stricta* (Lindl.) Rydb. (*Habenaria gracilis* S. Wats.), and the collector believes the two forms are genetically related. The first collection is accompanied by this note: "This grew adjoining the *Habenaria* aecidium, and nowhere else. There were two localities, one a high meadow where it was quite abundant, and another where only a half dozen plants of the *Habenaria* grew, and between these plants the rust was found, the orchid leaves still showing the old aecidia."

Puccinia Chaetochloae nom. nov.

The uredinial stage of the species was described in the previous paper of this series. Since then the telia have been detected by Dr. Bessey in a specimen gathered at Miami, Florida, January 16, 1907, which makes it possible to transfer the rust to the genus *Puccinia*. It may be described as follows:

II. *Uredo Chaetochloae* Arth. Bull. Torrey Club **33**: 518. 1906.

III. Telia amphigenous, few, scattered, oblong or linear, small, 0.1 mm. wide by 0.5–1 mm. long, tardily naked by a longitudinal slit; teliospores ellipsoid, often irregular, 23–26 × 32–37 μ, rounded at both ends, slightly or not constricted at septum, wall chestnut-brown, concolorous, thin, 1–1.5 μ, rarely thickened slightly at apex, smooth; pedicel colored, short, often obliquely attached.

On *Chaetochloa macrosperma* Scribn. & Merr., Miami, Florida. Telia collected January 16, 1907, *Ernst A. Bessey 59.*

Puccinia panicicola sp. nov.

O and I. Pycnia and aecia unknown.

II. Uredinia amphigenous, numerous, scattered, oval, 0.1–0.3 mm. wide by 0.2–0.4 mm. long, soon naked, pulverulent, dark cinnamon-brown, ruptured epidermis noticeable; urediniospores broadly ellipsoid or obovoid, 23–25 by 26–30 μ, wall dark cinnamon-brown, rather thick, 1.5 μ, closely and strongly echinulate-verrucose with blunt points, pores 3–4, sometimes only 2, equatorial.

III. Telia not seen.

On *Panicum molle* Sw., Santiago de las Vegas, Cuba, March 1, 1907 (type), March 6, 1903, *C. F. Baker;* Cuautla, State of Morelos, Mexico, October 12, 1898, *E. W. D. Holway 3045; Panicum hebotes* Trin., Jalapa, State of Veracruz, Mexico, October 5, 1898, *E. W. D. Holway 3083.* No teliospores have been seen by the writer, but a few were seen by the collector, according to a note in the packet of the last-named collection. The species is much like *P. eslavensis* D. & H., but the urediniospores are smaller, more strongly sculptured, and have thinner walls with fewer pores.

Puccinia quadriporula sp. nov.

O and I. Pycnia and aecia unknown.

II. Uredinia hypophyllous, scattered, roundish or oblong, 0.4–1 mm. long, early naked, somewhat pulverulent, cinnamon-brown, ruptured epidermis inconspicuous; urediniospores broadly ellipsoid or globoid, 17–21 × 22–26 μ, wall cinnamon-brown, medium thin, 1.5–2 μ, finely and evenly echinulate, pores 4, equatorial.

III. Telia hypophyllous, scattered, roundish or oblong, 0.4–1 mm. long, soon naked, somewhat pulvinate, blackish-brown, ruptured epidermis noticeable; teliospores clavate-oblong, 16–21 × 42–48 μ, usually rounded above, rounded or often narrowed below, wall chestnut-brown, concolorous, rather thin, 1–1.5 μ, thicker at apex, 9–10 μ, smooth; pedicel slightly tinted, about one-half length of spore.

On *Carex vulgaris* Fries (*C. Goodenovii* J. Gay), Isle au Haut, Maine, September 25, 1899, *J. C. Arthur* (type); *C. spectabilis* Dewey, Glacier, British Columbia, August, 1907, *E. W. D. Holway*. Only one species of *Puccinia* on *Carex* possessing four equatorial pores in the urediniospores has heretofore been recognized from North America. That species, *Puccinia minuta* Diet., on *C. verrucosa* from Alabama, is easily distinguished by its much larger and more nearly globose urediniospores, and other less evident characters. The two widely separated stations indicate that it is not uncommon in the northern regions, although little material is yet available for study.

Puccinia minutissima sp. nov.

O and I. Pycnia and aecia unknown.

II. Uredinia hypophyllous, scattered, round or nearly so, 0.2–0.3 mm. across, early naked, chestnut-brown, pulverulent, ruptured epidermis conspicuous; urediniospores globoid or broadly ellipsoid, very small, 13–16 × 16–20 μ, wall chestnut-brown, medium thick, 1–1.5 μ, finely echinulate, pores 2, in upper part, evident.

III. Telia hypophyllous, numerous, scattered, round or oblong, 0.2–0.3 mm. wide by 0.2–0.7 mm. long, early naked, pulvinate, blackish-brown, ruptured epidermis conspicuous; teliospores oblong-clavate, 15–22 × 42–64 μ, slightly constricted at septum, apex rounded or obtuse, narrowed below, wall dark chestnut-brown, concolorous, smooth, 1–1.5 μ at sides, much thickened above, 9–13 μ; pedicel one fourth length of spore or less, firm, tinted.

On *Carex filiformis* L., in sphagnum swamp, Lansing, Michigan, September 5, 1885, *J. C. Arthur* (type); in a sphagnum bog, London, Ontario, Canada, October, 1898, *J. Dearness* (Ellis & Ev. Fungi Columb. *1382*); Kewanna, Indiana, October, 1893, *L. M. Underwood* (part of some specimens in Ellis & Ev. Fungi Columb. *258*). The species is especially characterized by the unusually small urediniospores, but is also well marked in other respects.

Prospodium bahamense sp. nov.

O. Pycnia unknown.

II. Urediniospores intermixed with the teliospores, few seen, broadly ellipsoid or globoid, 18–23 × 24–27 μ, walls golden-brown, not noticeably laminate, medium thick, 2.5–3 μ, sparsely and strongly verrucose, pores 2, opposite and equatorial.

III. Telia hypophyllous, minute, scattered, or crowded into seemingly pulvinate groups of 0.2–1 mm. across, early naked, blackish, ruptured epidermis not noticeable; paraphyses numerous, peripheral, united at the bases, terete, 9–10 × 55–64 μ, acuminate, somewhat incurved, wall firm, about 2 μ thick, dark chestnut-brown, smooth; teliospores few in a sorus, broadly ellipsoid, 24–27 × 32–39 μ, rounded at both ends, slightly constricted at the septum, wall chocolate-brown, rather thick, 3.5–4.5 μ, gelatinous layer golden-yellow, not conspicuous except at apex and sometimes at base where it produces an umbo-like thickening of 2–3 μ, closely and rather coarsely verrucose; pedicel pale amber-colored throughout, once to once and a half length of spore, with one whorl of rather large, much branched appendages, near the base.

On *Tecoma bahamensis* Northrop, New Providence, Bahamas, March 12–24, 1907, *Elizabeth G. Britton 6596.* A very distinct species, intermediate in the character of its appendages between *P. appendiculatum* and *P. Amphilophii.* The paraphyses are particularly noteworthy. Being large and stout, and very dark-colored, they are especially conspicuous. But they are unique in the way in which they adhere at the bases to form a circle about the spores. The sorus may be readily separated as a whole from the tissue of the host, with the spores in place. It then appears campanulate, like a partially opened flower, borne on a slender, pale pedicel, which is formed of the greatly compressed portions of the paraphyses and spore-stalks where they pass through the epidermis.

Calliospora Petalostemonis sp. nov.

O. Pycnia chiefly hypophyllous, preceding or accompanying the telia, numerous, scattered, conspicuous, golden-yellow becoming brown, subcuticular, conical, 80–110 μ wide, about half as high; ostiolar filaments 30–50 μ long.

III. Telia hypophyllous, scattered, small, roundish, 0.3–0.6 mm. across, chocolate-brown, somewhat pulverulent, ruptured epidermis somewhat noticeable; teliospores ellipsoid, 23–29 × 35–45 μ, rounded at both ends, slightly or not constricted at septum, wall laminate, inner layer light chestnut-brown, medium thick, 2–2.5 μ, pores two in each cell, lateral and opposite, outer layer gelatinous, pale-yellow, rather thin, 1–1.5 μ, very finely and rather sparsely verrucose; pedicel colorous, about 6 μ in diameter, short and largely deciduous, not swelling in water.

On *Petalostemon oligophyllus* (Torr.) Rydb., Pecos, New Mexico, 1903, *T. D. A. Cockerell.* Both the pycnia and telia of this species are most abundant and conspicuous. It differs from *Uropyxis Petalostemonis* (Farl.) DeToni in the absence of uredinia and paraphyses, and in other less evident characters.

Aecidium Petalostemonis Kellerman & Carleton, sp. nov.

O. Pycnia amphigenous, sparsely disposed in indefinite groups, inconspicuous, subepidermal, globoid, 70–100 μ in diameter by 90–100 μ high; ostiolar filaments 30–45 μ long.

I. Aecia amphigenous, gregarious, irregularly arranged in indefinite groups, on discolored spots occupying all or part of a leaf, short, about 0.2 mm. across; peridium colorless, margin somewhat lacerate, spreading or somewhat recurved, peridial cells rhomboidal, overlapping, outer wall rather thick, 5–7 μ, not conspicuously striate, smooth, inner wall medium thin, 3–4 μ, rather finely verrucose; aeciospores broadly ellipsoid or globoid, 18–24 × 20–28 μ, wall colorless, rather thin, 1–1.5 μ, evenly and rather finely verrucose.

On *Petalostemon candidus* (Willd.) Michx., Manhattan, Kansas, June, 1886, *W. A. Kellerman* (Ellis & Ev. N. Am. Fungi *1845*), Lincoln, Nebraska, May 27, 1902, *John L. Sheldon*; *P. purpureus* (Vent.) Rydb. (*P. violaceus* Michx.), Manhattan, Kansas, June 6, 1887, *Kellerman & Swingle*, Stockton, Kansas, June 6, 1906, *E. Bartholomew* (Bartholomew, Fungi Colum. *2296*); *P. villosus* Nutt., Merriman, Nebraska, July 11, 1899, *J. M. Bates.* It is also recorded on *P. multiflorus* Nutt. from Kansas (Trans. Kansas Acad. Sci. **10**: 91. 1887), and on an undetermined species of *Petalostemon*, above Big Horn, Wyoming (Proc. Davenport Acad. Sci. **7**: 252. 1889). This name was used by Kellerman and Carleton over twenty years ago in a "Second list of Kansas parasitic fungi, together with their host plants," contributed to the tenth volume of the Proceedings of the Kansas Academy of Science, but without a description. The name was written "*Aecidium Petalostemonis* Farl.," and during the year following the type collection was issued in Ellis & Ev. N. Am. Fungi as "*Puccinia Petalostemonis* Farl." Since that time it has been variously ascribed to Farlow and to Kellerman & Carleton, or as "I" of *Puccinia Petalostemonis* or *Uropyxis Petalostemonis.* Under the last name Sydow in his Monog. Uredinearum appends a partial description, but without using a distinctive name or positively referring it to *Uropyxis.*

The form can not belong to the life cycle of *Uropyxis Petalostemonis* for numerous reasons. No aecial stage has yet been discovered for any species of that genus. Should one ever be found, it will doubtless have subcuticular pycnia and aecial paraphyses, having no true peridium, as occurs in *Phragmopyxis*, which is simply *Uropyxis* with three-celled teliospores. Beside, *U. Petalostemonis* is known to have a primary uredo accompanied by pycnia, which excludes the likelihood of an aecial stage. Finally both from structure and analogy the form may be considered as part of some heteroecious grass rust.

Aecidium fluxum sp. nov.

O. Pycnia chiefly epiphyllous, few, inconspicuous, subepidermal, honey-yellow, subglobose, small, 75–90 μ in diameter by 66–80 μ high; ostiolar filaments long, 80–112 μ.

I. Aecia chiefly hypophyllous, few, widely separated in indefinite groups, short, small, 0.1–0.2 mm. in diameter; peridium colorless, irregularly lacerate, recurved, peridial cells rhomboidal in longitudinal section, 27–35 μ long, overlapping, outer wall rather thick, 5–7 μ, transversely striate, smooth, inner wall about half as thick, somewhat striate, finely verrucose; aeciospores globoid, 20–25 μ in diameter, wall pale-yellow, thin, about 1 μ, irregularly and rather prominently verrucose.

On *Amorpha canescens* Pursh, Colorado, 1907, *H. L. Shantz*, communicated by E. W. D. Holway. A delicate and inconspicuous species. It may be remarked that *Aecidium Amorphae* Cooke (Grevillea 6: 137. 1878) is the primary uredo of *Uropyxis Amorphae* (Curt.) Schröt., while the present form is part of a heteroecious species, doubtless one of the grass or sedge rusts.

Aecidium Boehmeriae sp. nov.

O. Pycnia epiphyllous, few in small groups about 1 mm. across, honey-yellow becoming brownish, punctiform, not conspicuous, globose or depressed-globose, small, 70–90 μ in diameter by 50–75 μ high; ostiolar filaments up to 65 μ long.

I. Aecia hypophyllous, gregarious or sometimes in annular groups 2–10 mm. across, on larger discolored spots, short, small, about 0.1 mm. in diameter, rather pale-yellow; peridium colorless, margin erose, recurved, peridial cells rhombic, small, 16–23 μ long, inner wall medium thin, 3–4 μ, moderately verrucose, outer wall medium thick, 5–6 μ, striate, smooth; aeciospores globoid, often angular, very small, 10–13 μ in diameter, wall pale-yellow, very thin, 0.5–1 μ, very finely verrucose, appearing smooth.

On *Boehmeria cylindrica* (L.) Willd., Takoma Park, District of Columbia, June 6, 1898, collector uncertain, fungi of the T. A. Williams collection, distributed by the U. S. National Museum. This species is morphologically similar to the common *Aecidium Urticae*, belonging to *Puccinia Caricis*, but scarcely half the size throughout, and with other distinctions. The fungus has been collected in other localities along the Atlantic coast and in Indiana, but no specimens are in the writer's herbarium.

Caeoma occidentale sp. nov.

O. Pycnia amphigenous, scattered, minute, inconspicuous, subcuticular, honey-yellow, hemispherical, 65–100 μ in diameter by 23–32 μ high.

I. Aecia from a limited mycelium, hypophyllous, sparsely arranged in two rows on yellow spots occupying part or all of a leaf, roundish to oblong, 0.3–1 mm. or more long by 0.3–0.4 mm. wide, soon naked, orange-yellow; peridium wanting; aeciospores catenulate, broadly ellipsoid, 20–24 × 27–32 μ, wall colorless, medium thin, 1.5–2.5 μ, moderately and rather closely verrucose.

On *Pseudotsuga mucronata* (Raf.) Sudw. (*Pseudotsuga Douglasii* Carr., *Abies Douglasii* Lindl.), Beaver River Valley, British Columbia, alt. 860 meters, July 27, 1907, *E. W. D. Holway*. This rust is interesting as the second foliicolous caeoma on *Pinaceae* in North America. The other occurs on *Tsuga canadensis* in the North Atlantic region. The eastern and western species differ greatly in size of spores, and other characters.

Uredo Grayiae sp. nov.

II. Uredinia amphigenous, scattered, sometimes confluent, roundish, 0.5–1 mm. across, soon naked, pulverulent, chocolate-brown, ruptured epidermis somewhat noticeable; urediniospores ellipsoid or obovate-ellipsoid, 19–23 × 32–42 μ, wall dark chestnut-brown, somewhat lighter below, rather thick, 2–2.5 μ, slightly thicker above, 2.5–3.5 μ, moderately verrucose above, smooth along the sides, pores 8 in two transverse zones equidistant from the equator.

On *Grayia spinosa* (Hook.) Moq. (*G. polygaloides* H. & A.), Fallon, Nevada, August 21, 1907, *L. L. Harter 1506*, communicated by C. L. Shear. The species is remarkable in the close resemblance of the spores to those of some species of *Ravenelia.* The upward thickening of the walls, the distribution of color, pores and sculpturing, are characters when taken together that would indicate a member of the subfamily of *Raveneliatae*, but the family of the host is widely removed from any represented in that group of rusts. Its relationship is, consequently, problematical.

Uredo inquirenda sp. nov.

II. Uredinia amphigenous, scattered or in circinating groups, round, 0.5 mm. across, subepidermal, soon naked, dark cinnamon-brown, pulverulent, ruptured epidermis noticeable; urediniospores oval or obovate, $18-23 \times 28-36\,\mu$, wall cinnamon-brown, rather thin, $1-1.5\,\mu$, somewhat thicker above, $1.5-2.5\,\mu$, evenly and strongly echinulate, pores 8, unevenly spaced in two zones of 4 each, equidistant from the equator; pedicels more or less persistent, slender, usually once or more length of spore; paraphyses none.

On undetermined plant, bearing the local name of "Washington Vine," Auburn, Alabama, December 12, 1889, *Geo. F. Atkinson 1051.* This species, like the preceding one, possesses the characters of the *Raveneliatae*, and for this reason has special interest. The rust appears to have been very abundant, all of the leaves of the collection being well covered with sori. The material came into my hands about three years ago among a lot of undetermined specimens, kindly sent from the herbarium of Cornell University for study. Since that time much effort has been expended to ascertain the probable identity of the host, but without making the slightest advance. Dr. E. M. Wilcox and Prof. J. F. Duggar of Auburn, Ala., have made inquiries and can find no trace of the original plant, or of any plant to which the name of "Washington Vine" is now applied. The collector is unable to recall any helpful information, and other botanists familiar with the southern flora do not recognize it. There are only individual leaves in the collection. These are 4–6 cm. long by 1–2 cm. wide, rather thin, green both sides, smooth, entire, lanceolate, sessile, or narrowed into short petioles. It is probable that the plant is not a native of the southern states, but has been cultivated for ornament.

PURCUE UNIVERSITY,
LAFAYETTE, INDIANA

Notes on a parasitic Gnomonia*

Claude Wilbur Edgerton

In the month of July, 1906, while looking for the presence of anthracnose on the canes of the blackberry, *Rubus nigrobaccus*, in the vicinity of Ithaca, New York, I found in the garden of Professor Whetsel a few canes that were affected with a pyrenomycete, a member of the genus *Gnomonia*. Thinking that this might be the perfect stage of the anthracnose, I gathered material and made a study of it. The result of the study showed that the fungus had no connection with the *Gloeosporium*, yet from the fact that it seems to be undescribed in this country and may occasionally cause disease of the blackberry canes, it seems well to make a note of it with drawings and photographs.

The disease evidently made its appearance in the spring, as spots were noticed on the canes at pruning time. But no effect on the canes had been noticed at that time. Leaves developed normally, blossoms appeared on the stems, and the fruit set, so that the plants had the appearance of being perfectly healthy. It was not until the fruit was a little over half grown that the effect of the disease was noticed. Very suddenly, the leaves and the fruit above the spots wilted and dried up. The effect on the plant seemed to be that of girdling. The appearance of the canes was very similar to the cane blight of raspberries caused by a species of *Coniothyrium*, as described by Stewart and Eustace.† The plants were in this condition when they were first observed by the writer. The spots at this time were very evident, being two to five inches in length and completely encircling the stems, somewhat lighter in color than the healthy regions and possessing a dry, dead appearance.

An examination of the spots showed the presence of numerous black perithecial beaks, which appeared to the naked eye as small black setae, protruding through the dead cortex (FIG. 1). The main body of the perithecium was imbedded in the host tissue.

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* Contribution from the Department of Botany, Cornell University, No. 123.

† New York Experiment Station Bulletin no. 226, Geneva, N. Y.

The microscopic characters of the fungus as I have determined them are as follows: The perithecia (FIG. 2) are subglobose, 200–260 × 175–220 μ, filled with the numerous asci. The asci (FIGS. 3*a*, *b*) are long-clavate, 30–50 × 6–9 μ, and contain as a rule but four spores, though occasionally some aborted spores may be seen at

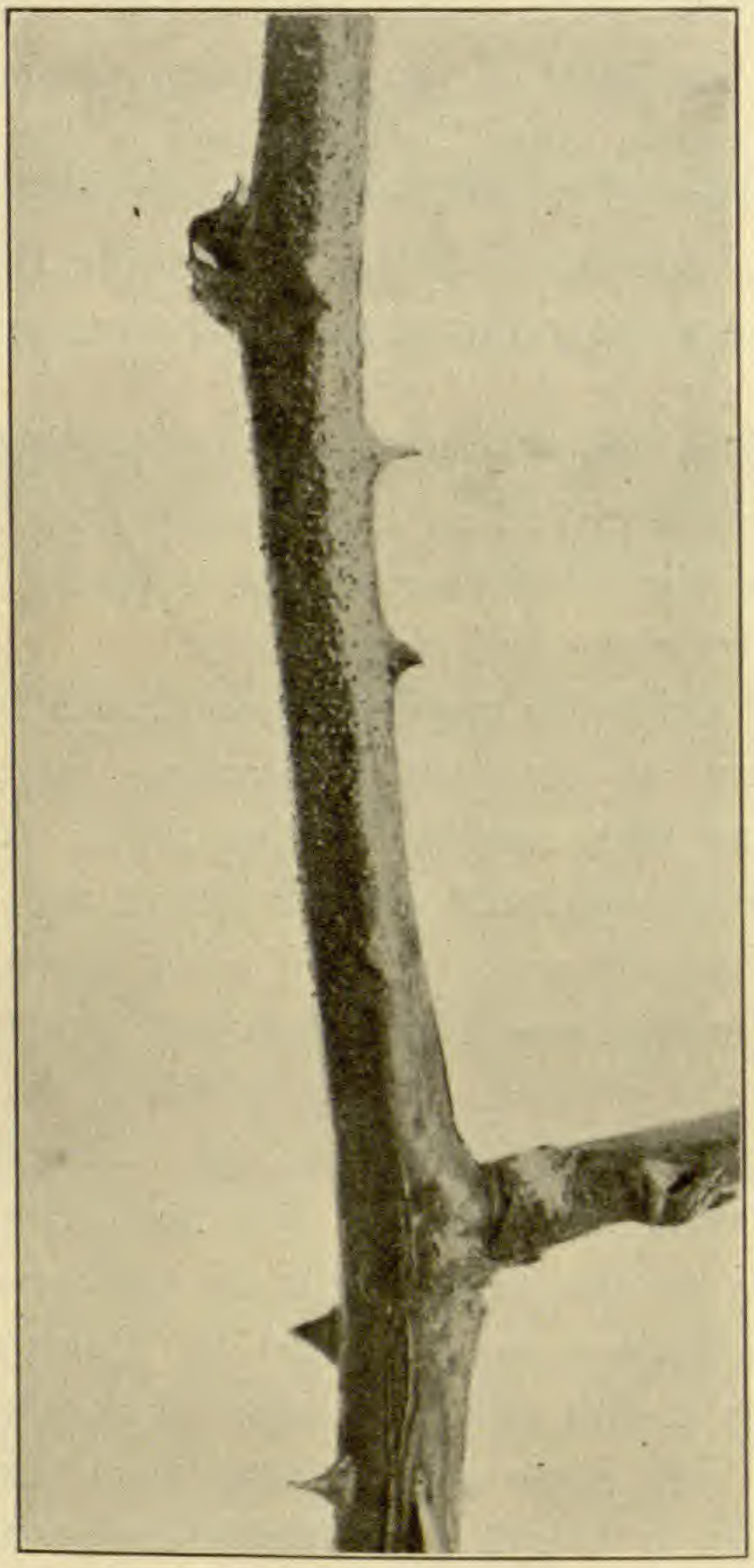

FIG. 1. *Gnomonia Rubi* Rehm on stem of *Rubus nigrobaccus*. Shows the beaks of the perithecia protruding through the cortex.

the base. The pore through which the spores escape, although not as prominent as in some other members of the genus *Gnomonia*, is surrounded by the thickened cellulose ring which appears as a refractive dot on each side of the opening. The spores (FIG. 3*c*) are in one or two series, filling nearly the whole ascus, about

14–19 × 3–5 μ. They are two-celled, the two cells being equal, constricted at the septum, somewhat fusoid, quite often guttulate. Each end of the spore is continued into a long hyaline point, but this falls away very readily so that the end of the spore has a rounded appearance (FIG. 3*d*). Paraphyses are absent.

Cultures of the ascospores were made in bean agar. The spores germinated readily by sending out a germ-tube at each end (FIG. 3*e*). No germ-tube was seen coming from the side of the spore. A much-branched and septate mycelium resulted

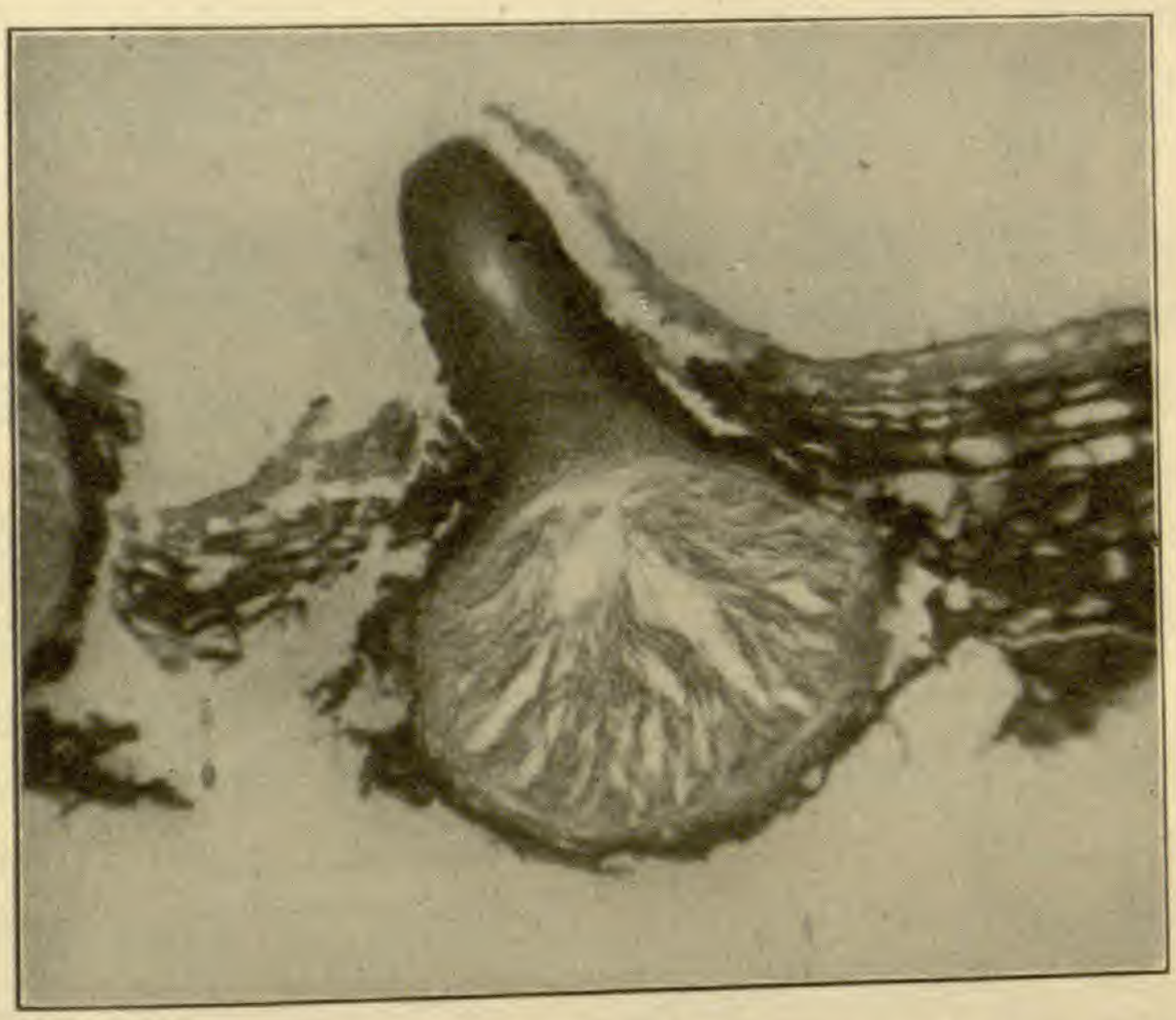

FIG. 2. Photomicrograph of a section of a perithecium of *Gnomonia Rubi*.

which spread rapidly over the agar, forming a very thin submerged growth. Pieces of the agar were transferred to sterilized bean pods and blackberry stems. On both substrata, growth continued rapidly. In about ten to fourteen days, perithecia with the same appearance and structure as those originally found on the blackberry began to form. The only observable difference was in the beak of the perithecium. This was much longer on the perithecia formed in pure culture, and quite often it was bent back in the form of a hook near the apex. This same variation in the length of the beak in pure culture has been noticed by Klebahn * in another member of the genus, *Gnomonia veneta*

* KLEBAHN, H. Ueber einige *Fungi imperfecti* und die zugehörigen Ascomycetenformen. Jahrb. für wissensch. Botanik 41: 519. *f. 4.* 1905.

(Sacc. & Speg.) Kleb. In no culture in the laboratory nor on the material collected on the blackberry was I able to find a trace of a conidial stage.

This fungus was first named by Rehm, *Gnomonia tetraspora* Wint. var. *Rubi* Rehm, but in volume IX of the *Sylloge Fungorum*, Saccardo considers it a good species and uses the name *Gnomonia Rubi* Rehm. The latter name seems to be preferable and will be used here. Some of the material was sent to Rehm and the identification was confirmed by him.

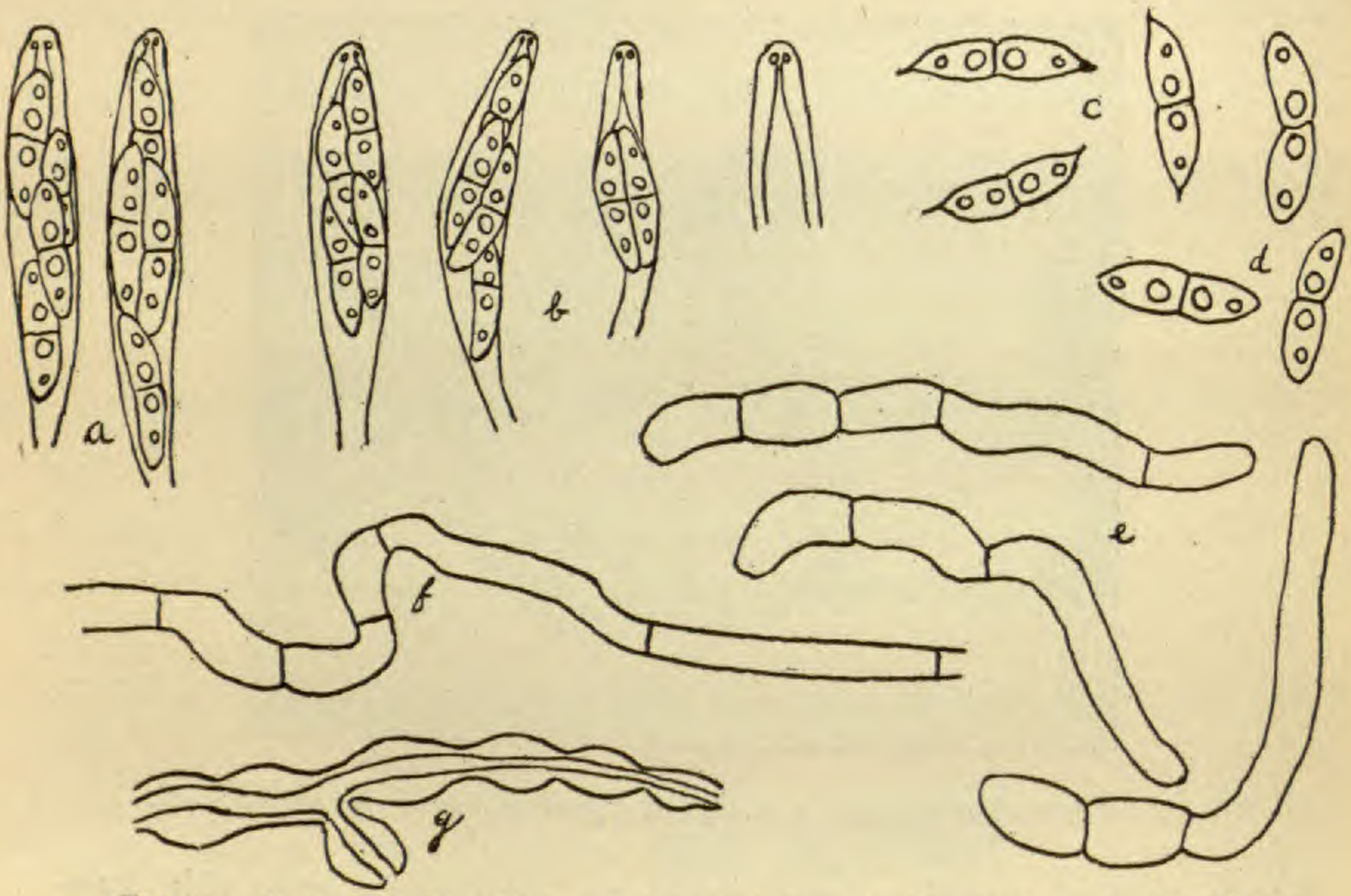

FIG. 3. *Gnomonia Rubi* Rehm. (*a*) Asci from perithecia from the blackberry. (*b*) Asci from perithecia in pure culture. (*c*) Ascospores. (*d*) Ascospores as they appear after losing their appendages. (*e*) Ascospores germinating. (*f*) The same older stage. (*g*) Irregularly thickened mycelial thread, a common condition in old cultures.

To prove the connection of the fungus with the disease on the canes, inoculation experiments were attempted in 1907. Early in the spring, in the greenhouse, some young plants were inoculated with a pure culture of the fungus. The plants were very young, the canes being perfectly green. This inoculation was a failure; the fungus did not seem to be able to attack the young actively growing canes.

Later in the season, on May 9, about ten or twelve blackberry plants growing wild near Ithaca were inoculated, the inoculations being made at various places on the canes. As a result of these inoculations, two plants became infected with the disease. Why the other eight or ten inoculations did not take may possibly have been due to a loss of virulence, caused by growing the fungus for ten months on artificial media. However the wild blackberry plants may be more resistant to the attacks of these forms than the cultivated varieties and this may have had something to do with the poor infection. One of the successful inoculations was on a wound made by cutting off the entire upper third of the plant. The disease followed down the stem and in a few weeks perithecia were produced in abundance. In the other successful inoculation, the pure culture of the fungus was inserted in a wound made by removing one of the small side branches. The disease spread in all directions, finally encircling the stem. The plant was not killed as suddenly as the original plants that were found, but died more gradually. Fruit set on the branches, but most of it dried up before it matured. Perithecia were produced on the diseased portion about three or four months after the inoculation. However, these were not produced in such great abundance as they were on the original plants.

The results of this study seem to show that the fungus *Gnomonia Rubi* Rehm is a weak facultative parasite, a form that will grow rapidly as a saprophyte on the dead canes and will if conditions are suitable adapt itself to the living cane. It does not seem probable that it is a form that is liable to become a serious pest to blackberry canes, but rather one that may appear as a parasite only occasionally, only when the conditions are right.

A synopsis of the New England species of Tetmemorus

JOSEPH AUGUSTINE CUSHMAN

With the present records all four species of *Tetmemorus* found in the British Isles are known from New England. The species of *Tetmemorus* are not striking in their appearance and one studying plankton rarely meets with them. In New England the species appear to be mostly found in sphagnum pools and also as a rule seem to be more common at an elevation, being found very abundantly in certain mountain ponds with sphagnous borders.

The figures given by Wolle were poor and in some cases were referred to the wrong species. The corrected synonymy for the various species is given. The measurements are from New England specimens only. Records for which specimens have been seen are followed by an exclamation point. While based upon New England material this should cover the whole northeastern United States.

TETMEMORUS Ralfs, 1844

Cells usually fusiform-cylindrical, straight, with a slight median constriction, and a narrow incision at the center of the apices: cell circular or elliptical in end view: cell-wall usually punctate or slightly scrobiculate: each semicell with a single chloroplast, with a central row of pyrenoids.

1. TETMEMORUS BRÉBISSONII (Menegh.) Ralfs

Closterium Brébissonii Menegh. Linnaea **14**: 236. 1840.

Tetmemorus Brébissonii Ralfs, Ann. Mag. Nat. Hist. **14**: 257. *pl. 8. f. 1.* 1844. — Brit. Desm. 145. *pl. 24. f. 1, a, b, c.* 1848. — Wolle, Desm. U. S. 91. *pl. 20. f. 1, 2. pl. 50. f. 36.* 1884.

Cells subcylindrical, attenuate toward the apices, much more so in side view, about 6 times as long as wide; apices broadly rounded in both front and side views; cell-wall minutely punctate in longitudinal lines; chloroplasts with 4–5 pyrenoids.

Length 189–236 μ: breadth 34–37 μ: isthmus 20–31 μ.

MAINE: Orono (*W. West*). NEW HAMPSHIRE: North Woodstock! MASSACHUSETTS: Guilder Pond, Mt. Everett, Mount

Washington! Lake Quinsigamond, Worcester (*Stone*); Tewksbury (*Lagerheim*); Waverley (*Johnson*); Bridgewater! Lake Watuppa, Fall River! RHODE ISLAND: Wainskut Pond, North Providence (*Bailey*).

2. TETMEMORUS GRANULATUS (Bréb.) Ralfs

Closterium granulatum Bréb., in Cheval. Microscop. et Usage 272. 1839.

Tetmemorus granulatus Ralfs, Ann. Mag. Nat. Hist. **14**: 257. *pl. 8. f. 2.* 1844. — Brit. Desm. 147. *pl. 24. f. 2. pl. 33. f. 1.* 1848. — Wolle, Desm. U. S. 91. *pl. 50. f. 33, 34.* 1884.

Cells decidedly attenuate toward the apices in both front and side views, about 5½ times as long as wide; apices narrowly rounded; cell-wall scrobiculate in encircling lines at the base of the semicell, becoming irregular and more crowded toward the apex; chloroplasts with 4–5 pyrenoids.

Length 168–260 μ: breadth 34–46 μ: isthmus 22–38 μ.

MAINE: Orono (*W. West*). NEW HAMPSHIRE: Pudding Pond, North Conway! Intervale! Noone's Station! North Woodstock! MASSACHUSETTS: Guilder Pond on Mt. Everett, Mount Washington! Lake Quinsigamond, Worcester (*Stone*); Tewksbury (*Lagerheim*); Pondville! Lake Watuppa, Fall River! Wigwam and Almanac Ponds, Nantucket! RHODE ISLAND: Providence (*Bailey*).

3. TETMEMORUS LAEVIS (Kütz.) Ralfs

Closterium laeve Kütz. Phyc. Germ. 132. 1845.

Tetmemorus laevis Ralfs, Brit. Desm. 146. *pl. 24. f. 3.* 1848. — Wolle, Desm. U. S. 91. *pl. 20. f. 3. pl. 50. f. 35.* 1884.

Tetmemorus minutus Wolle, *pl. 20. f. 7–9.* 1884.

Cells subcylindrical, about 4 times as long as wide, gradually attenuate to the apices, which are broadly rounded; cell-wall minutely punctate; chloroplasts with 3–5 pyrenoids.

Length 70–127 μ: breadth 19–23 μ: isthmus 17–19 μ.

MAINE: Orono (*W. West*). MASSACHUSETTS: Lake Quinsigamond, Worcester (*Stone*); East Bridgewater! Lake Watuppa, Fall River! Sandwich! Chilmark! Nantucket!

4. TETMEMORUS MINUTUS DeBary.

Tetmemorus minutus DeBary, Conj. 41. *pl. 5. f. 10.* 1858.

Cells attenuate toward the apices in both front and side views, more so in the latter, about 3 times as long as wide ; apices broadly rounded; cell-wall slightly punctate ; chloroplasts with 1 or 2 pyrenoids.

Length 65 μ : breadth 19 μ.

MASSACHUSETTS : Guilder Pond, on Mt. Everett, 600 meters, Mount Washington !

A key to the New England species of Tetmemorus

Cells large, usually 5 times as long as wide; cell-wall scrobiculate or punctate in a definite pattern, at least near the base of the semicells.

Scrobiculations or punctulations in definite longitudinal lines ; cells very slightly attenuate from base to apex. 1. *T. Brébissonii.*

Scrobiculations in horizontal lines at the base of the semicell, elsewhere scattered, gradually attenuate from base to apex. 2. *T. granulatus.*

Cells smaller, less than 5 times as long as wide ; cell-wall irregularly punctate.

Cells about 4 times as long as wide ; chloroplast with 3–5 pyrenoids. 3. *T. laevis.*

Cells about 3 times as long as wide ; chloroplasts with 1 or 2 pyrenoids. 4. *T. minutus.*

BOSTON SOCIETY OF NATURAL HISTORY.

Notes on Carex — III

Kenneth Kent Mackenzie

Carex latebrosa sp. nov.

Carex Gayana hyalina Bailey, Proc. Am. Acad. **22**: 135. 1886. Not *Carex hyalina* Boott.

Growing in dense clumps, somewhat stoloniferous, the culms 3–9 dm. high, roughened on the angles, especially above, much exceeding the leaves. Leaves with well-developed blades usually three to six to a culm, all on the lower third, the blades 8–35 cm. long, 1.5–4 mm. wide, flat or somewhat involute, roughened on the margins and towards the apex; spikes linear-elliptic, 1 cm. long or less, from about seven to thirty, aggregated into a linear or linear-oblong head, 2–4 cm. long, 4–8 mm. wide, simple or slightly compound, the lower spikes more or less separate; spikes largely and often entirely staminate, or usually bearing one to several perigynia at or near the base; bracts absent, or the lower occasionally present, shorter than the head, somewhat enlarged at base, acuminate or short-cuspidate; scales ovate-lanceolate, from short-cuspidate to obtusish, usually acutish, straw-colored (without a trace of green at maturity), hyaline, wider and longer than the perigynia which are completely concealed (except where the scales get broken), the whole head appearing as a mass of straw-colored scales, with occasional dark spots, showing the concealed perigynia; perigynia ascending, brownish at maturity, plano-convex, ovate (rather narrowly), 3.5 mm. long, 1.5 mm. wide, broadly rounded at base, tapering into the beak which is about one-half the length of the body, the body slightly spongy at base, nerved on the outer, nerveless but narrowly margined above on the inner surface, the beak serrulate, its apex in age somewhat bidentate; perigynia thin, readily separating from achenes at maturity; achenes lenticular, with suborbicular face, about 1.5 mm. long; stigmas two.

Although referred by Professor Bailey as a variety to the North American plant which has been passing as *Carex Gayana* E. Desv. (*Carex simulata* sp. nov. *infra*), it seems to me that this plant is more closely related to some of the forms of *Carex marcida* Boott. It does not possess the characteristic short-beaked perigynium of the former plant, and this has caused most specimens collected to be referred to the latter plant. However, it is readily distinguished at sight from all forms of *Carex marcida*, and is clearly entitled to specific rank. The most easily noticed points of distinction may be contrasted as follows:

Perigynium very abruptly contracted into a very short beak, about one-fifth the length of the body. *C. simulata.*

Perigynium tapering into a beak, one-half the length of the body or more.

Spikes with one to several inconspicuous perigynia, the head appearing a mass of straw-colored scales; staminate flowers conspicuous; blades 1.5–4 mm. wide. *C. latebrosa.*

Spikes with about ten perigynia concealed by the scales, but conspicuous; scales tinged with green or brown; staminate flowers inconspicuous; blades 1.5 mm. wide. *C. marcida.*

The following specimens of *Carex latebrosa* (all in the Columbia College herbarium except the New Mexico specimens and the fine specimens collected by Palmer) have been seen:

MEXICO: Sonora, *Thurber 652*, 185-(type); Durango, *Palmer 96*, 1896 (N. Y. Bot. Gard.); San Bernardino, Sonora, *Thurber 337*, June, 1851; Camp Tezotal, Sonora, *Schott 4*, 1855.

NEVADA: Unionville Valley, *Watson 1227*, October, 1867; Spring Valley, *Watson 1227*, September, 1868.

NEW MEXICO: Cienega, *E. O. Wooton*, July 12, 1906; Mogollon Creek, Mogollon Mountains, Socorro County, *O. B. Metcalfe*, July 14, 1903. (Both in Herb. N. Mex. Agric. College.)

√ **Carex simulata** sp. nov.

"*Carex Gayana* Desv." Boott, Ill. Car. 3: 126. *pl. 411.*

Culms 3–5 dm. high, from long running rootstocks, roughened on the angles, especially above, much exceeding the leaves. Leaves with well-developed blades two to five to a culm, all on its lower third, the blades erect-ascending, 8–30 cm. long, 2–4 mm. wide, flat, roughened on the margins and towards the apex; spikes 5–15, densely aggregated into a linear-oblong, oblong or ovate-oblong head, 12–25 mm. long, 6–10 mm. wide, the individual spikes not separate, but readily distinguishable, the more strongly pistillate ovate-oblong in outline, 7 mm. long, 3.5 mm. wide, with about ten perigynia at base and the inconspicuous staminate flowers above, while other spikes are almost entirely staminate with an occasional perigynium, whole heads being almost entirely staminate or little staminate, as the case may be; bracts absent, or the lower one or two, if present, shorter than the head, long-cuspidate, enlarged at base; scales brown with hyaline margin, strongly cuspidate, wider and noticeably longer than the perigynia, which are completely concealed; perigynia ascending, brownish at maturity, plano-convex, broadly ovate, 1.8 mm. long, 1.4 mm. wide, broadly rounded at base, abruptly narrowed into a minute bidentate beak about 0.25 mm. long, hardly spongy at base, nerveless or nearly so, not margined, but the upper part of the body and the beak serrulate; achenes lenticular with broadly elliptic face, 1 mm. long; stigmas two.

The earliest description of *Carex Gayana* E. Desv. which I have seen (C. Gay, Fl. Chil. 6: 205) was published in 1854 according to the title-page of the work. However, the plates of this and some other species seem to have been issued in 1853 as *Cyperaceae chilenses* (*Historia de Chile*), and *plate 73, figure 3*, referred to in the description in Gray's work is here found. The specimens on which the species was based were collected in Chile, but Dr. Boott took up the name for a plant found in western North America, known to him from Fendler's *no. 881* and Bourgeau's from "Base of the Rocky Mountains." This last-named specimen is figured by him (*pl. 411*) as "*Carex Gayana* Desv.," and other authors who have had occasion to deal with the North American plant have followed him, although not without misgivings, the North American plant having been collected but little until recently. The real *Carex Gayana*, however, is a plant bearing much the same general resemblance to the North American plant, now named by me *Carex simulata*, that *Carex stenophylla* Wahl. does to *Carex marcida* Boott. The differences noted may be thus contrasted:

Culms 3.5 dm. high; heads 12–25 mm. long, linear-oblong to ovate-oblong; scales cuspidate; heads much exceeding the leaves. *C. simulata.*

Culms 1–2 dm. high; heads 8–18 mm. long, ovate; scales acuminate; heads little exceeding leaves. *C. Gayana.*

Of this species I have seen the following specimens:

WYOMING: Chug Creek, Albany County, *A. Nelson 7316*, June 29, 1900 (type, in Herb. N. Y. Bot. Garden); Headwaters of Clear Creek, *Tweedy 3336*, July–August, 1900; Point of Rocks, *Merrill & Wilcox 665*, June 19, 1901; Clear Creek, *T. A. Williams*, August 12, 1898.

COLORADO: North Park on edge of Wyoming, *Osterhout*, September 1, 1897; Rocky Mts. (Colorado?) *Vasey 595*.

MONTANA: Montana Valley, Madison County, *A. & E. Nelson 6483*, September 3, 1899.

WASHINGTON: Falson Valley, *Suksdorf*, May–July, 1884.

NEW MEXICO: *Fendler 881*, 1847.

Carex perglobosa sp. nov.

"*Carex incurva* Lightf.?" Bailey, in Coulter, Manual Rocky Mountain Region 390.

Culms erect, 12 cm. high, growing in small clumps, from running rootstocks, smooth on the angles, usually exceeding the leaves. Leaves clustered towards the base of the culms, the blades erect or somewhat spreading, 2–8 cm. long, 0.75–1.5 mm. wide, flattened at base, narrow but hardly involute above, slightly roughened towards the apex; head erect, very globular, about 1 cm. in diameter, the spikes entirely undistinguishable, the staminate flowers apical, very inconspicuous; perigynia numerous; bracts absent; scales ovate-orbicular, brownish with silvery hyaline margin, obtusish or acutish, rather wider than, but exceeded at maturity (usually strongly) by, the perigynia; perigynia brownish at maturity, ovate-elliptic, 4 mm. long, 2.25 mm. wide, somewhat inflated and slightly nerved on both faces, rounded at base, gradually tapering into the serrulate bidentate beak which is one third or less of the length of the marginless body; achenes lenticular with oblong-orbicular face, 1.75 mm. long, 1.25 mm. wide; stigmas two.

This species which occurs in the high mountains of Central Colorado has heretofore been referred to the circumboreal *Carex incurva* Lightf., a species which in America extends south in the Canadian Rocky Mountains as far as Banff, but which I have not seen from the United States. The species are, however, clearly distinct, and may be distinguished from one another as well as from *Carex vernacula* Bailey (*C. foetida* Am. authors) as follows:

Leaf-blades 2–3.5 mm. wide; perigynium little exceeding scale at maturity. *C. vernacula.*

Leaf-blades 1.5 mm. wide or less; perigynium much exceeding scale at maturity.

- Head suborbicular to short-oblong, the spikes apparent; perigynium 3 mm. long, 1.5 mm. wide, stipitate, not inflated. *C. incurva.*
- Head orbicular, the spikes not apparent; perigynium 4 mm. long, 2.25 mm. wide, not stipitate, somewhat inflated. *C. perglobosa.*

The following specimens have been examined, all from Colorado:

Mt. Baldy, Summit County, *Mackenzie 167*, August, 1901 (type, in Herbarium K. K. Mackenzie); *Parry 385*, 1861; Gray's Peak and vicinity, *Patterson*, September 2, 1885; Silver Plume, *Rydberg*, August 21, 1895.

Carex agrostoides sp. nov.

Culms 4–8 dm. high, exceeding the leaves, roughened on the angles, the lowermost sheaths bladeless, conspicuous, the rootstalks short. Leaves with well-developed blades two to four to a culm, usually 2–3 dm. long, long-attenuate, 1–2 mm. wide, strongly involute, roughened towards the apex; head decompound, 4–7 cm. long, 8–20 mm. wide, the lower one or two branches more or less separated, the upper closely aggregated; spikes very numerous, closely sessile, distinguishable with difficulty, ovate-oblong, usually 2–5 mm. long, 1.5–2.5 mm. wide, containing one to several perigynia in the middle, the remainder staminate; bracts absent, or few and short (15 mm. long); scales ovate-oblong, obtusish to short-acuminate, brownish, with usually broad, whitish midrib, and conspicuous hyaline margins, wider than but slightly exceeded by the mature perigynia; perigynia lanceolate-cuneate, plano-convex in cross-section, 3 mm. long, 1 mm. wide, rounded-truncate at base, tapering at apex into a beak longer than the body, with serrulate margins and bidentate apex, the body nerveless on inner, nerved on outer, surface; achenes lenticular, 1 mm. long, 0.5 mm. wide; stigmas two.

This species has long been represented in the Columbia College herbarium by two rather fragmentary specimens, but it was not until I received from Prof. E. O. Wooton two fine sheets collected by himself that I felt justified in describing it. Probably most closely allied to *Carex latebrosa* (*supra*), it is readily distinguished not only by the decompound head, but also by the narrow, long-beaked perigynia. The name given to this plant by me owes its origin to the strong resemblance the head has to the dried up, congested panicles of some species of *Agrostis*.

The following specimens have been examined:

NEW MEXICO: Luna, northwest of Mogollon Mountains, Socorro County, altitude 6500 feet, *E. O. Wooton*, July 28, 1900 (type consisting of two sheets in Herb. New Mexico Agricultural College); Mangus Springs, *Rusby 425*, May, 1881 (Columbia College herbarium).

ARIZONA: San Francisco Mountains, *Rusby 426*, April, 1881 (Columbia College herbarium).

INDEX TO AMERICAN BOTANICAL LITERATURE
(1907)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions their kindness will be appreciated.

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Abrams, L. R. A new maple from Southern California. Torreya **7**: 217–219. *f. 1.* 19 N 1907.
Acer bernardinum sp. nov.

Allen, J. A. Mutations and the geographic distribution of nearly related species in plants and animals. Am. Nat. **41**: 653–655. 2 N 1907.

Ascherson, P. & Graebner, P. *Potamogetonaceae.* Das Pflanzenreich 4^{11}: 1–184. *f. 1–36.* 29 O 1907.

Bailey, W. W. Some African flowers. Am. Bot. **13**: 30–33. O 1907.

Bartlett, H. H. Ueber das Vorkommen von *Juncus Dudleyi* Wiegand n Deutschland. Allgem. Bot. Zeits. **13**: 147, 148. S 1907.

Bennett, A. Notes on *Potamogetonaceae.* Jour. Bot. **45**: 373–377. 1 O 1907.

Black, J. M. Habitat of *Odontoglossum crispum.* Orch. Rev. **15**: 326–328. N 1907.

Blankinship, J. W. Plantae Lindheimerianae. Part III. Ann. Rep. Missouri Bot. Gard. **1907**: 123–223. 1907. [Illust.]

Boulenger, G. A. On the variations of the evening primrose (*Oenothera biennis* L.). Jour. Bot. **45**: 353–363. 1 O 1907.

Britton, E. G. Notes on nomenclature VIII. Bryologist **10**: 100, 101. 2 N 1907.

Burrell, W. H. *Leucobryum glaucum* Schp. Bryologist **10**: 107–111. *pl. 12.* 2 N 1907.

Caldwell, O. W. The teaching of botany in the high school. School Rev. **15**: 661–670. 1907.

Campbell, D. H. Studies on some Javanese *Anthocerotaceae*—I. Ann. Bot. **21**: 467–486. *pl. 44–46.* O 1907.

Cannon, W. A. An electric thermoregulator for paraffine baths and incubators. Plant World **10**: 262–264. *f. 53.* N 1907.

Chandler, H. P. Notes on two California Nemophilas. Bot. Gaz. **44**: 381, 382. 16 N 1907.

Clute, W. N. Our prairie sunflowers. Am. Bot. **13**: 25–27. O 1907. [Illust.]

Collins, F. S. Some new green algae. Rhodora **9**: 197–202. *pl. 76.* 26 O 1907.

Includes new species in *Pleurococcus*, *Chaetomorpha*, *Cladophora*, and *Vaucheria* (2), natives of the United States.

Copeland, E. B. Key to the families of vascular plants in the Philippine Islands. Philipp. Bur. Educ. Bull. **24**: 21–34. 1907.

Copeland, E. B. Outline of a year's course in botany. Philipp. Bur. Educ. Bull. **24**: 5–19. 1907.

Crocker, W. Germination of seeds of water plants. Bot. Gaz. **44**: 375–380. 16 N 1907.

Dahlstedt, H. Ueber einige südamerikanische *Taraxaca*. Ark. Bot. **6**^{12}: 1–19. *f. 1–8.* 2 F 1907.

Includes *Taraxacum andinum* and *T. rhusiocarpum* spp. nov., natives respectively of Argentina and Patagonia.

Daufun, M. H. A teratological flower of *Campanula rotundifolia*. Plant World **10**: 265, 266. N 1907.

Dean, B. Notes on Asiatic museums. Pop. Sci. Mo. **71**: 481–497. *f. 1–16.* D 1907.

Demetrio, C. H. A list of the mosses collected in different parts of Missouri. Bryologist **10**: 103–106. 2 N 1907.

Dismier, G. Sur la valeur spécifique des épaississements intralamellaires des dents péristomiales dans les espèces du genre *Philonotis*. Rev. Bryol. **34**: 112–114. N 1907.

Dobbin, F. Concerning willows. Am. Bot. **13**: 33–36. O 1907.

Drummond, J. R. The literature of *Furcraea* with a synopsis of the known species. Ann. Rep. Missouri Bot. Gard. **1907**: 25–75. *pl. 1–4.* 1907.

Dunham, E. M. Mrs. Mary L. Stevens. Bryologist **10**: 106. 2 N 1907.

Eaton, L. O. Notes on plants of Chesterville, Maine. Rhodora **9**: 207, 208. 26 O 1907.

Fernald, M. L. *Salicornia europaea* and its representatives in eastern America. Rhodora **9**: 204–207. 26 O 1907.

Fink, B. Further notes on Cladonias — XIII. *Cladonia cristatella* and *Cladonia coccifera*. Bryologist **10**: 97–100. *pl. 11.* 2 N 1907.

Gager, C. S. The self-pruning of trees. Jour. N. Y. Bot. Gard. **8**: 252–254. N 1907.

Gager, C. S. The tardy defoliation of the trees. Jour. N. Y. Bot. Gard. **8**: 254. N 1907.

Garrett, A. O. Effect of fire on an apple tree. Plant World **10**: 264. N 1907.

Gürke, M. *Cactaceae* Florae Uruguayae auctore J. Arechavaleta. Monats. Kakteenk. **17**: 161–166. 15 N 1907.

Gürke, M. *Cereus anguinus* Gürke n. sp. Monats. Kakteenk. **17**: 166–171. 15 N 1907.

Native of Paraguay.

Gürke, M. *Echinocereus polyacanthus* Engelm. Monats. Kakteenk. **17**: 170, 171. 15 N 1907. [Illust.]

Native of the southwestern United States and Mexico.

Hamet, R. Monographie du genre *Kalanchoe*. Bull. Herb. Boiss. II. **7**: 869–900. 31 O 1907.

Harshberger, J. W. An unusual method of vegetative reproduction in *Dionaea muscipula*. Bot. Gaz. **44**: 382, 383. *f. 1.* 16 N 1907.

Harvey, J. C. Orchid collecting in Mexico. Orch. Rev. **15**: 350, 351. N 1907.

Harvey, L. H. Branching sporangiophores of *Rhizopus*. Bot. Gaz. **44**: 382. *f. 1.* 16 N 1907.

Hassler, E. Plantae paraguarienses novae vel minus cognitae — VI. Bull. Herb. Boiss. II. **7**: 917–931. 31 O 1907.

Includes descriptions of new species in *Peperomia* (3), *Polygala* (2), *Dryopteris* (2), *Polypodium*, *Elaphoglossum* (3), *Cyathea*, *Danaea*, *Odontonema*, *Justicia*, and *Solanum*.

Hebden, T. Some British Columbia lichens. Bryologist **10**: 101, 102. 2 N 1907.

Hemsley, W. B. *Shortia uniflora*. Curt. Bot. Mag. IV. **3**: *pl. 8166.* N 1907.

Native of Japan. Notes appended on several American *Diapensiaceae*.

Holm, T. *Anemonella thalictroides* (L.) Spach; an anatomical study. Am. Jour. Sci. IV. **24**: 243–248. *f. 1–5.* S 1907.

Holm, T. Studies in the *Cyperaceae* — XXV. Notes on *Carex*. Am. Jour. Sci. IV. **23**: 422–432. *f. 1–13.* Je 1907.

Howe, M. A. Phycological studies — III. Further notes on *Halimeda* and *Avrainvillea*. Bull. Torrey Club **34**: 491–516. *pl. 25–30.* 17 D 1907.

Includes *H. simulans* sp. nov., native of the West Indies.

Humphrey, H. B. The marine biological laboratory of the Leland Stanford Jr. University. Plant World **10**: 245–250. *f. 47–49.* N 1907.

Hus, H. T. A. An abnormal *Odontoglossum Cervantesii*. Ann. Rep. Missouri Bot. Gard. **1907**: 95–97. *pl. 9.* 1907.

Hus, H. T. A. The germination of *Hydrastis canadensis*. Ann. Rep. Missouri Bot. Gard. **1907**: 85–94. 1907. [Illust.]

Hus, H. T. A. Virescence of *Oxalis stricta*. Ann. Rep. Missouri Bot. Gard. **1907**: 99–108. *pl. 10, 11 + f. 1–4.* 1907.

Kellerman, W. A. Obituary: Professor A. P. Morgan. Jour. Myc. **13**: 233–236. 30 N 1907. [Illust.]

Kellerman, W. A. Saccardo's recent arrangement and nomenclature of the fungi. Jour. Myc. **13**: 242–246. 30 N 1907.

Kneucker, A. Bemerkungen zu den "*Cyperaceae* (exclus. *Carices*) et *Juncaceae* exsiccatae" VI Lieferung 1907. Allgem. Bot. Zeits. **13**: 29–32. F 1907; 48–51. Mr 1907; 65–67. Ap 1907.

Many American species included.

Knight, O. W. Three plants from Maine. Rhodora **9**: 202–204. 26 O 1907.

Lager, J. E. Collecting orchids. Trans. Mass. Hort. Soc. **1907**: 37–49. 1907.

Leather, J. W. Schreiner and Reed on deleterious excretions by roots. Torreya **7**: 220, 221. 19 N 1907.

Leue, A. List of trees growing in the parks of Cincinnati, arranged according to their natural order. Ann. Rep. Park Dept. Cincinnati **1906**: 46–51. 1907.

Liebelsperger, W. H. Some rare and interesting plants of Berks County, Pennsylvania. Torreya **7**: 214–217. 19 N 1907.

Life, A. C. Effect of light upon the germination of spores and the gametophyte of ferns. Ann. Rep. Missouri Bot. Gard. **1907**: 109–122. *f. 1, 2.* 1907.

Lloyd, F. E. Pima Cañon and Castle Rock in the Santa Catalina Mountains. Plant World **10**: 251–259. *f. 50–52.* N 1907.

Loeske, L. Zur Systematik der europaïschen *Brachythecieae.* Allgem. Bot. Zeits. **13**: 1–3. Ja 1907: 21–23. F 1907.
Contains references to American species.

Lorenz, A. Notes from Waterville, New Hampshire — II. Bryologist **10**: 102, 103. 2 N 1907.

Lovejoy, A. O. The place of Linnaeus in the history of science. Pop. Sci. Mo. **71**: 498–508. D 1907.

Lutz, A. M. A preliminary note on the chromosomes of *Oenothera Lamarckiana* and one of its mutants, *O. gigas.* Science II. **26**: 151, 152. 2 Au 1907. [Illust.]

Mazza, A. Saggio di algologia oceanica. Nuova Notar. **18**: 1–36. Ja 1907; 67–98. Ap 1907; 126–152. Jl 1907; 177–195. O 1907.

Moore, S. L. Alabastra diversa — Part XIV. 4. Note on some South American plants. Jour. Bot. **45**: 404–406. 1 N 1907.
Includes *Jacaranda Roberti* sp. nov., native of Brazil.

Morgan, A. P. North American species of *Agaricaceae.* The *Melanosporae.* Jour. Myc. **13**: 53–62. 30 Ap 1907; 143–153. 25 Jl 1907; 246–255. 30 N 1907.

Murrill, W. A. *Polyporaceae.* N. Am. Fl. **9**: 1–72. 19 D 1907.

Nash, G. V. The Ames collection of orchids. Jour. N. Y. Bot. Gard. **8**: 250–252. N 1907.

Nash, G. V. A visit to Letchworth Park. Torreya **7**: 209–214. 19 N 1907.

Norén, C. O. Zur Entwicklungsgeschichte des *Juniperus communis.* Uppsala Univ. Arsk. Mat. & Natur. **1907**[1]: 1–64. *pl. 1–4.* 1907.

Norton, A. H. The dwarf mistletoe on the southeastern coast of Maine. Rhodora **9**: 208. 26 O 1907.

Pace, L. Fertilization in *Cypripedium.* Bot. Gaz. **44**: 353–374. 16 N 1907. [Illust.]

Petrak, F. Zur Systematik der Gattung *Adoxa.* Allgem. Bot. Zeits. **13**: 92–94. Je 1907.

Ramaley, F. Plant zones in the Rocky Mountains of Colorado. Science II. **26**: 642, 643. 8 N 1907.

Reed, H. S. The value of certain nutritive elements to the plant cell. Ann. Bot. **21**: 501–543. *f. 1, 2.* O 1907.

Reichenbach, F. *Echinocactus Fričii.* Monats. Kakteenk. **17**: 174, 175. 15 N 1907.
Native of Argentina.

Robinson, C. B. Botrychiums in sand. Torreya 7: 219, 220. 19 N 1907.

Rolfe, R. A. *Cattleya labiata.* Orch. Rev. 15: 335, 336. N 1907.
Native of Brazil.

Rolfe, R. A. *Cycnoches Egertonianum.* Orch. Rev. 15: 337–340. *f. 37.* N 1907.
Native of Guatemala.

Rolfe, R. A. *Paphiopedilum* × *Olivia.* Orch. Rev. 15: 297, 298. *f. 33.* O 1907.

Rosenstock, E. Beiträge zur Pteridophytenflora Südbrasiliens. Hedwigia 46: 145–167. 15 F 1907.
Includes descriptions of new species in *Elaphoglossum* (4) and *Danaea* (2).

Saunders, C. F. Flowers of a dry land. Am. Bot. 13: 27–30. O 1907.

Schrenk, H. von. Branch cankers of *Rhododendron.* Ann. Rep. Missouri Bot. Gard. 1907: 77–80. 1907. [Illust.]

Schrenk, H. von. Disease of sycamore trees. Plant World 10: 265. N 1907.

Schrenk, H. von. On frost injuries to sycamore buds. Ann. Rep. Missouri Bot. Gard. 1907: 81–83. *pl. 7.* 1907.

Schuster, J. Zur Systematik von *Castalia* und *Nymphaea.* Bull. Herb. Boiss. II. 7: 853–868. 30 S 1907; 901–916. 31 O 1907.

Setchell, W. A. Two new hypogaeous *Secotiaceae.* Jour. Myc. 13: 236–241. *pl. 107.* 30 N 1907.
Secotium tenuipes and *Elasmomyces russuloides* spp. nov., natives of California.

Stephani, F. Species *Hepaticarum.* Bull. Herb. Boiss. II. 7: 837–852. 30 S 1907.

Stevens, F. L. Two interesting apple fungi. Science II. 26: 724, 725. 22 N 1907.

Stevens, W. C. Plant anatomy from the standpoint of the development and functions of the tissues, and handbook of micro-technic. i–xii. 1–349. *f. 1–136.* Philadelphia, 1907.

Trelease, W. Additions to the genus *Yucca.* Ann. Rep. Missouri Bot. Gard. 1907: 225–230. *pl. 12–17.* 1907.
Includes descriptions of two new species of *Yucca*, natives of Mexico.

Trelease, W. *Agave macroacantha* and allied Euagaves. Ann. Rep. Missouri Bot. Gard. 1907: 231–256. *pl. 18–34.* 1907.

Vinson, A. E. Some observations on the date. Plant World 10: 259–262. N 1907.

Warnstorf, C. Neue europaïschen und aussereuropaïschen Torfmoose. Hedwigia **47**: 76–112. 30 S 1907. [Illust.]

Includes descriptions of 14 new American species of *Sphagnum*.

Whetzel, H. H. Some bacterial diseases of plants: their nature and treatment. Trans. Mass. Hort. Soc. **1907**: 117–130. 1907.

Wilkinson, T. J. Breaking into botany. Am. Bot. **13**: 36, 37. O 1907.

Winslow, E. J. Notes on spore dispersal in *Sphagnum*. Bryologist **10**: 111. 2 N 1907.

Wooton, E. O. & Standley, P. The genus *Androsace* in New Mexico. Bull. Torrey Club **34**: 517–520. 17 D 1907.

Includes descriptions of two new species.

Young, R. T. The forest formations of Boulder County, Colorado. Bot. Gaz. **44**: 321–352. *f. 1–12.* 16 N 1907.

INDEX TO VOLUME 34

New names, and the final members of new combinations, are in **bold face type.**

Abies Douglasii, 591
ABRAMS, L. R. Studies on the flora of Southern California, 263
Acanthorhynchus, 313; **Vaccinii,** 314
Acanthospermum australe, 368
Acer, 284; dasycarpum, 369; platanoides, 234; rubrum, 367; saccharinum, 369
Acerates, 205
Acnida cannabina, 79; tamariscina, 79; tamariscina tuberculata, 78
Acrocryphaea Coffeae, 573
Acropterygium, 250, 251
Acrostichum furcatum, 243, 257
Adenostegia **ciliosa,** 35; ramosa, 35
Adenostoma fasciculatum, 264; fasciculatum densifolium, 263
Aecidium Amorphae, 590; **Boehmeriae,** 590; candidum, 64; **Cannonii,** 210; **fluxum,** 590; Ipomoeae, 69; Ipomoeae-panduranae, 68; **Petalostemonis,** 589; Sarcobati, 210; Urticae, 591
Aeschynomene virginica, 364
Aesculus glabra, 349; Pavia, 352
Agaricus amboinensis, 477; bulbosus, 348; campestris, 302; **Pattersonae,** 347
Ageratum conyzoides, 74
Agrostis, 585, 607; hyemalis, 584; perennans, 584; Thurberiana, 585
Albugo, 61, 63, 65, 73, 77, 82, 84, 387; Bliti, 62, 64, 76, 77, 79, 81, 82; brasiliensis, 74; candida, 61, 63, 64, 68, 69, 77, 81; Cruciferarum, 63; Ipomoeae-panduranae, 61, 64, 68, 81; Lepigoni, 61, 64, 71, 81; **occidentalis,** 62, 64, 80, 81; platensis, 62, 64, 77, 79, 81, 82; Portulacae, 62, 64, 77, 81, 83; quadrata, 64, 76; **sibirica,** 61, 63, 68; Solivae, 74; spinulosa, 73; **Swertiae,** 62, 64, 72, 81; **Tillaeae,** 64, 76; Tragopogonis, 62, 64, 70, 72, 74, 76, 81; **tropica,** 61–63, 68, 81, 82
Albugo, The genus, 61
Alnus rugosa, 367
Alopecurus, 398
Alyssum, 183; macrocarpum, 181
Amaranthus, 77, 82; Bigelovii, 78; blitoides, 78; Blitum, 77, 79; crispus, 79; emarginatus, 78; graecizans, 78; hybridus, 78, 81; hybridus paniculatus, 79; Palmeri, 78; retroflexus, 78; spinosus, 78; tristis, 79; viridis, 79
Amauroderma **Elmerianum,** 475
Ambrosia artemisiaefolia, 75, 364, 404; psilostachya, 75, 404; trifida, 75, 404
Amelanchier, 461; alnifolia, 462, 463; oreophila, 463
America, Mosses from tropical, 569
American botanical literature, Index to (1901–1905), 51; (1906), 105, 267, 575; (1907), 161, 213, 319, 379, 439, 483, 521, 609
American Code of Botanical Nomenclature, 167
American ferns, 243
American fossil mosses, 139
American species of Antrophyum, 445
Amorpha canescens, 590; herbacea, 365
Ampelopsis quinquefolia, 408; Ritchii, 409; Veitchii, 409
Anchistea virginica, 367
Andromeda floribunda, 352; **grandifolia,** 204, 206; latifolia, 204; Novae-Caesareae, 204; Parlatorei, 188, 203, 204, 206
Andropogon tener, 373
Androsace, 517–520; arizonica, 519; diffusa, 517–520; **glandulosa,** 518, 519; occidentalis, 517–520; pinetorum, 517–519; **platysepala,** 518, 519; puberulenta, 518, 519; septentrionalis, 517, 518; subulifera, 518
Androsace in New Mexico, 517
Antennaria plantaginifolia, 76
Anthostomella, 313; **destruens,** 313; Smilacis, 313
Antrophyopsis, 447
Antrophyum, 445–458; anetioides, 449, 455; Boryanum, 447; brasilianum, 448, 449, 452, 454–456; carnosum, 449; cayennense, 448, 449, 453; Desvauxii, 457; discoideum, 448, 449, 454, 455; **Dussianum,** 449, 453; ensiforme, 448–450; falcatum, 449; Feei, 451, 452; Galeottii, 449; giganteum, 457; immersum, 447; **Jenmani,** 449, 453, 454; lanceolatum, 445, 448, 449, 451, 452, 454; lineatum, 448–452; minimum, 457; reticulatum, 445; spathulatum, 452, 453; subsessile, 448, 452–455, 457; Werckleanum, 458

Antrophyum, The genus, 445
Apeibopsis discolor, 199
Arabis, 429; Drummondii alpina, 437; furcata, 65; glabra, 68; longirostris, 429; Lyallii, 437; lyrata, 65; **oreophila,** 437; rostrata, 429; virginica, 65
Aragallus, 423; **angustatus,** 422; argophyllus, 423; **atropurpureus,** 424; Besseyi, 422–424; Blankinshipii, 422–424; collinus, 423, 424; Lagopus, 423; Lambertii, 421–424; monticolus, 424; multiceps, 423; nanus, 423; **patens,** 421; sericeus, 421, 424
Aralia, 201; groenlandica, 201; **Newberryi,** 201, 206; palmata, 201; spinosa, 352, 366
Arenaria marina, 72
Aristida stricta, 351, 365
Armillaria, 104; **ventricosa,** 104
Aronia arbutifolia, 365
Artemisia biennis, 75; canadensis, 76; ludoviciana, 405
ARTHUR, J. C. New species of Uredineae, 583
Asclepias, 221; Cornuti, 239; lanceolata, 364
Asimina triloba, 103
Aspergillus niger, 303
Aster Novae-Angliae, 394; oblongifolius, 394; sagittifolius, 394; squarrosus, 365
Astragalus, 49; atratus, 48; campestris, 49, 50; convallarius, 49; divergens, 417; Haydenianus, 420; multiflorus, 419; tegetarius, 421
Atlantic coastal plain, Mesozoic flora of the, 185
Atriplex, 82
Avena sativa, 286, 287
Avrainvillea, 491, 505–508, 512, 513; laetivirens, 512; levis, 508, 512; longicaulis, 504, 508–512; Mazei, 504, 509, 511, 512; nigricans, 504, 505, 508–512, 515; **Rawsoni,** 508, 510, 511, 516; sordida, 512
Avrainvillea, Further notes on Halimeda and, 491
Aytonia **Evansii,** 57–59; **jamaicensis,** 58, 60
Aytonia from Jamaica, Two new species of, 57
Azolla caroliniana, 364

Barbarea Barbarea, 65
BARNHART, J. H. A new Utricularia from Long Island, 579
Basidiophora, 388, 393; entospora, 393; **Kellermanii,** 393, 394, 405
Batodendron arboreum, 364
Bazzania, 561
BENEDICT, R. C. The genus Antrophyum, 445
BERRY, E. W. Contributions to the Mesozoic flora of the Atlantic coastal plain, 185
Beta, 82
Betula atavina, 193; nigra, 367
Bidens cernua, 404; comosa, 405; connata, 405; frondosa, 404; laevis, 404
Bignonia crucigera, 364
Blitum, 82; capitatum, 81, 82
Boehmeria cylindrica, 591
Boerhaavia anisophylla, 80; decumbens, 80, 81; diffusa, 80; erecta, 80; hirsuta, 80; paniculata, 80; Sonorae, 80; spicata, 80; viscosa, 80; Xanti, 80
Boletus, 86; pavonius, 468
Bonamia, 143, 146, 147; alternifolia, 146; aquatica, 149; grandiflora, 146; humistrata, 148; ovalifolia, 146; Pickeringii, 149
Botanical literature, American (1901–1905), 51; (1906), 105, 267, 575; (1907), 161, 213, 319, 379, 439, 483, 521, 609
Botanical Nomenclature, American Code of, 167
Bothrodiscus, 312; **pinicola,** 313
Botrytis, 498; cana, 408; intestans, 391, 408; macrospora, 401; nivea, 401; viticola, 407, 408; vitis-viticola, 407
Bouteloua oligostachya, 208; prostrata, 208
Brachysteleum, 141
Bradburya virginiana, 364
Brassica, 66; arvensis, 66; campestris, 66; integrifolia, 66; Napus, 68; nigra, 65, 66; oleracea, 68
Breweria, 146, 147; angustifolia, 148; aquatica, 149; Choisyana, 148; grandiflora, 146; humistrata, 148; mexicana, 144; ovalifolia, 146; Pickeringii, 149; rotundifolia, 149; tenella, 148; trichosanthes, 148; villosa, 149
BRITTON, E. G. & HOLLICK, A. American fossil mosses, with description of a new species from Florissant, Colorado, 139
Bruguiera caryophylloides, 272; eriopetala, 272
Bryolejeunea, 558
Bryonia, 222, 330, 339, 340; alba, 222; dioica, 222, 331
Bryonopsis lacunosa erythrocarpa, 414
Bryopteris, 4, 533, 557–559, 561, 564, 566; diffusa, 557–559, 561; filicina, 557–559, 563–566, 568; fruticulosa, 565; Gaudichaudii, 558; tenuicaulis, 559, 565, 566; trinitensis, 566; trinitensis intermedia, 566
Bryum, 571; argenteum, 570

BURLINGHAM, G. S. Some Lactarii from Windham County, Vermont, 85
Bursa, 65; Bursa-pastoris, 65, 66, 68

Caeoma Amaranthi, 77; convolvulatum, 68; **occidentale,** 591
Cakile edentula, 68; maritima, 66
California, Studies on the flora of Southern, 263
Calliospora **Petalostemonis,** 588
Callistolejeunea, 553
Calonyction aculeatum, 70
Calycobolus, 143; **amazonicus,** 145; emarginatus, 144; **ferrugineus,** 145; **glaber,** 145; **Pringlei,** 144, 145; pulchellus, 145; **sericeus,** 144, 145; **spectabilis,** 146; **umbellatus,** 146; **velutinus,** 144, 145
Camelina microcarpa, 65, 66; sativa, 66
Campulosus aromaticus, 363, 365
Campylopus concolor, 569; **Pittieri,** 569
Canadian Rocky Mountains, Two new willows from the, 157
Capnoides **brachycarpum,** 426; Cusickii, 426; **hastatum,** 426
Capsella Bursa-pastoris, 181, 182
Carallia integerrima, 272
Cardamine bulbosa, 66
Carduus, 73; arvensis, 75; lanceolatus, 75; muticus, 75; spinosissimus, 75
Carex, 151, 587; **agrostoides,** 607; australis, 151; **austrina,** 151, 152; **brevisquama,** 152; filiformis, 587; foetida, 606; Gayana, 603–605; Gayana hyalina, 603; glaucescens, 365; Goodenovii, 587; Hookeriana, 153–155; hyalina, 603; incurva, 606; **latebrosa,** 603, 604, 607; marcida, 603–605; Muhlenbergii, 152; Muhlenbergii australis, 151, 152; Muhlenbergii austrina, 151; **neomexicana,** 153, 154; occidentalis, 153, 154; **perglobosa,** 606; **simulata,** 603–605; spectabilis, 587; stenophylla, 605; **tumulicola,** 154, 155; vallicola, 153; vernacula, 606; verrucosa, 587; vulgaris, 587
Carex, Notes on, 151, 603
Carolinas and Virginia, A midsummer journey through the coastal plain of the, 351
Carpinites microphyllus, 193
Cassia, 230; tomentosa, 239
Castalia odorata, 183, 364
Castanea dentata, 306
Castilleja **ampliflora,** 39; **arcuata,** 35; Bradburyi, 39; cognata, 36; desertorum, 37, 41; fasciculata, 41; **gracillima,** 39; hispida, 39; **humilis,** 37; lanceolata, 37, 38; lauta, 37; **Leonardi,** 36; linariaefolia, 36; lutea, 40; lutescens, 37, 41; **magna,** 36; miniata, 38; occidentalis, 40; pallida, 40; **parvula,** 40; **Pecten,** 41; **pulchella,** 40, 41; **purpurascens,** 38; rhexifolia, 36, 37; rupicola, 39; Suksdorfii, 36; Tweedyi, 38; **variabilis,** 37; **viscida,** 38; **Vreelandii,** 38
Castasetum maculatum, 120; maculatum luteopurpuratum, 120
Caudalejeunea, 533, 553, 557; Cresentiae, 554, 556; Haenkeana, 554; harpaphylla, 554; **Lehmanniana,** 554, 557, 566, 567; Leiboldii, 554, 556, 557
Caulanthus, 428, 436; crassicaulis, 436; hastatus, 436
Celastrophyllum crenatum, 197, 206; Newberryanum, 197; undulatum, 197
Celtis occidentalis, 416
Centaurea, 405
Ceratolejeunea, 8, 10, 15, 17, 22; Breutelii, 13; brevinerivis, 7, 15; **portoricensis,** 15, 17, 33; valida, 15
Ceratophyllum submersum, 183
Cercis canadensis, 364
Ceriops Candolleana, 272
Ceuthospora, 312; **lunata,** 312
Chaetochloa italica, 396; macrosperma, 586; verticillata, 397; viridis, 396
Chamaebatia **australis,** 263; foliosa australis, 263
Chamaecyparis thyoides, 377
Cheiranthus, 68; asper, 66; pacificum, 66
Chenopodium, 82; rubrum, 82
Chloris elegans, 207, 397
Chlorocrambe, 435; **hastata,** 436
Chloroplegma, 508
Chondrophora nudata, 365
Chondrophyllum Nordenskioeldii, 198, 206; orbiculatum, 198
Cinnamomum, 200; Heerii, 188, 200, 206; intermedium, 200
Cissites acuminatus, 200; affinis, 200; Brownii, 200; harkerianus, 200; Heerii, 200
Citrullus vulgaris, 414
Cladium mariscoides, 581
Cladocephalus, 513; scoparius, 513
Cladosporium **Oxycocci,** 306
Cladothrix lanuginosa, 79
Clavaria amethystina, 102; **amethystinoides,** 102; Schaefferi, 102
Claytonia linearis, 317
Clethra alnifolia, 367
Cliftonia, 352, 358; monophylla, 361
Clinterium, 309, 310; obturatum, 309
Clitocybe **nobilis,** 97

Closterium Brebissonii, 599; granulatum, 600; laeve, 600
Coastal plain of the Carolinas and Virginia, A midsummer journey through the, 351
Cobaea, 226, 230; scandens, 239
Coccinia indica, 414
Code of Botanical Nomenclature, American, 167
Collybia dryophila, 345; **hirticeps,** 98; **subsulphurea,** 345; zonata, 98
Colocasia antiquorum, 390
Cololejeunea, 3, 5, 8; floccosa, 12
Colorado, Description of new fossil moss from, 139
Coltricia cinnamomea, 465; perennis, 466
Colura, 533
Comptonia vindobonensis, 192
Concerning some West American fungi, 207
Coniosporium, 84
Coniothyrium, 593
Contributions to the Mesozoic flora of the Atlantic coastal plain, 185
Convolvulaceae, Studies in the North American, 143
Convolvulus aquaticus, 149; erianthus, 149; humistratus, 147, 148; incanus, 70; Pickeringii, 149; sepium, 71; Sherardi, 148; tenellus, 148; trichosanthes, 148
COOK, M. T. The embryology of Rhizophora Mangle, 271; The embryology of Rhytidophyllum, 179
Corallina discoidea, 495; incrassata, 501; Flabellum, 495; tridens, 501
Coriolopsis **aneba,** 466; **badia,** 466; **dermatodes,** 466; occidentalis, 466; **phocina,** 466; **semilaccata,** 466
Coriolus, 468; abietinus, 467; atypus, 467; **cuneatiformis,** 467; elongatus, 467; **maximus,** 467; **murinus,** 467; **vernicipes,** 468
Cornus florida, 366
Coronopus, 68
Cortinarius, 86
Corydalis Brandegei, 426
Corymbis flava, 114
Costa Rican orchids, 113
Crataegus Cerronis, 462; punctata, 311; saligna, 462
Credneria, 199, 200; denticulata, 199; Zenkeri, 199
Cressa, 143
Crucianella, 228
Cucumis angulatus, 414; Anguria, 415; Melo, 414; odoratissimus, 414; sativus, 333, 415
Cucurbita, 222, 342; maxima, 415; moschata, 225; ovifera, 415; Pepo, 222, 225, 415
Cucurbitaceae, Some features of pollen-formation in the, 221
Cucurbitaria, 349; **erratica,** 349; Sorbi, 349
CUSHMAN, J. A. A synopsis of the New England species of Tetmemorus, 599
Cyathula lappulacea, 79
Cyclanthera, 222, 224, 225, 237, 241, 334; explodens, 223; Hystrix, 406; pedata, 222
Cyclodictyon **cubense,** 574; limbatum, 574; Regnellii, 574
Cyclomycetella, 468
Cycloporellus, 468; **cichoriaceus,** 468; **microcyclus,** 468
Cycnoches Rossianum, 121; Warscewiczii, 121
Cynodon dactylon, 208
Cyperus Iria, 364; rotundus, 364
Cyrilla, 352; racemiflora, 365, 370
Cystispora endophylla, 312
Cystopus, 63; Amaranthacearum, 77; Amaranthi, 77; argentinus, 71, 72; Bliti, 77; brasiliensis, 73; candidus, 64, 69; Convolvulacearum, 69; Convolvulacearum Swertiae, 72; cubicus, 73; Cyathulae, 77; Euphorbiae, 84; Ipomoeae-panduranae, 69; Lepigoni, 71; Mikaniae, 73, 74; platensis, 79; Portulaceae, 83; pulverulentus, 73, 74; Salsolae, 84; Schlechteri, 84; sibiricus, 68; spinulosus, 73, 74; Tillaeae, 76; Tragopogonis, 69, 74; Tragopogonis spinulosus, 73; tropicus, 68

Daedalea amanitoides, 480; applanata, 480; Hobsoni, 480; Palisoti, 480; repanda, 480; sanguinea, 468
Dendroalsia abietina, 12
Dendrolejeunea, 552
Dentaria diphylla, 65, 66; laciniata, 66
Dewalquea groenlandica, 194
Dichromena latifolia, 365
Dicranella Perrottetii, 569
Dicranodontium **setosum,** 570
Dicranolejeunea, 4
Dicranopteris, 243–247, 250; **arachnoides,** 249; **Bancroftii,** 251-253, 258; **bicolor,** 251, 252; **Brunei,** 251, 253; **costaricensis,** 251, 253; **cubensis,** 251, 253; dichotoma, 257; **farinosa,** 252, 254; **flexuosa,** 251, 254; **fulva,** 252, 255, 256; **furcata,** 252, 257; **gigantea,** 249; **glabra,** 249; **glauca,** 249; **intermedia,** 252, 258; **jamaicensis,** 251, 258; **linearis,** 250, 255; lon-

gissima, 249; **mellifera,** 251, 259; **orthoclada,** 251, 259, 261; **palmata,** 252, 259; **pectinata,** 247, 250, 251, 260; **pteridella,** 251, 260; **retroflexa,** 251, 260; **strictissima,** 252, 261
Dicranostyles, 143; scandens, 143
Dicranum frigidum, 569; speciosum, 569
Dicrypta iridifolia, 121
Dictyogramme ensiformis, 449; lanceolata, 451
Diholcos Haydenianus, 420; **micranthus,** 420
Dinema paleaceum, 118
Diospyros primaeva, 188, 204
Diplasiolejeunea, 3
Diplopterygium, 249, 251
Dothiorella **aberrans,** 103; Asiminae, 103
Draba caroliniana, 68
Drepanolejeunea, 22
Dufourea, 144; glabra, 145; sericea, 144

Earliella **corrugata,** 468
Ecballium, 337
Eccilia Acus, 100; **cinericola,** 347; **Subacus,** 100; **unicolor,** 99
Echinochloa colona, 364
Echinospermum Lappula, 68
EDGERTON, C. W. Notes on a parasitic Gnomonia, 593
Eleocharis Robbinsii, 581
Elfvingia **Elmeri,** 476; tornata, 476
Elleanthus **caricoides,** 119, 124
Embryo of Zea Mays, An occurrence of glands in the, 125
Embryology of Rhizophora Mangle, The, 271
Embryology of Rhytidophyllum, The, 179
Entodon macropodus, 573
Entoloma **deminutivum,** 99; **modestum,** 347; **murinum,** 98; Peckianum, 99; sericeum, 99
Epidendrum auritum, 118; cochleatum, 117; lineare, 116; ochraceum, 118; paleaceum, 118; Stamfordianum, 118
Epilobium, 401
Equisetum, 226, 231, 240, 398
Erechtites hieracifolia, 404
Erigeron annuus, 404; philadelphicus, 394, 404; ramosus, 394
Eriocaulon decangulare, 365; septangulare, 581
Erysibe sphaerica Caryophyllacearum, 71
Eucalyptus, 202; attenuata, 203; Geinitzi, 201–203, 206; **linearifolia,** 203; nervosa, 203
Euosmolejeunea, 20; trifaria, 32
Eupatorium, 404; ageratoides, 404; compositifolium, 364; purpureum, 404, 406; rotundifolium, 366
Euphorbia eriogonoides, 364, 370; maculata, 364, 370
Eurotia lanata, 211
EVANS, A. W. Hepaticae of Puerto Rico, 1, 533
Evolvulus, 143, 149; ovalifolius, 146; prostratus, 149; rotundifolius, 149
Excretions by roots, The production of deleterious, 279

Fagus americana, 364, 366, 372
Favolus tenuis, 469; Wightii, 469
Features of pollen-formation in the Cucurbitaceae, 221
Ferns, Amercian, 243
Fevillea, 223–225, 237, 241; cordifolia, 223
Ficus, 199; daphnogenoides, 188, 194, 206; inaequalis, 194, 206; Woolsoni, 194, 206
Flabellaria luteofusca, 513
Flammula **betulina,** 100
Flora of Southern California, Studies on the, 263
Florissant, New species of fossil moss from, 139
Fomes Cornu-bovis, 478; **luzonensis,** 476; melanoporoides, 478; **philippinensis,** 477; pullus, 479; pyrrhocreas, 478; semilaccatus, 466; semitostus, 477
Fontinalis, 140; pristina, 139, 142
Fossil mosses, American, 139
Fouquieria splendens, 210
Fradelia, 508; fuliginosa, 508
Franseria tenuifolia, 75
Frasera, 72
Fraxinus caroliniana, 364
Frullania, 2, 4, 7, 539, 558, 566; dichotoma, 558; diffusa, 558; filicina, 558, 563; spathulistipa, 558
Fuckelia, 313
Funalia **philippinensis,** 469; **versatilis,** 469
Funaria calvescens, 570; hygrometrica, 570
Fungi, Concerning some West American, 207
Fungi, New species of, 97, 305, 345
Further notes on Halimeda and Avrainvillea, 491

Gaertneria acanthocarpa, 75; discolor, 76
GAGER, C. S. An occurrence of glands in the embryo of Zea Mays, 125
Ganoderma amboinense, 477; **subtor-**

natum, 477; **Williamsianum,** 478
Genus Albugo, The, 61
Genus Androsace in New Mexico, The, 517
Genus Antrophyum, The, 445
Geranium carolinianum, 400; dissectum, 400; maculatum, 400; pusillum, 400; Richardsonii, 400; Robertianum, 400
Gibbera, 310; obturata, 310
Glands in the embryo of Zea Mays, An occurrence of, 125
Gleditsia aquatica, 364
Gleichenia, 243, 244, 247, 260; axialis, 258; Bancroftii, 252, 258; bicolor, 252; bifida, 249; brevipubis, 262; Brunei, 253; dichotoma, 248, 255; farinosa, 254; flexuosa, 254; furcata, 257, 260; gigantea, 249; glaucina, 261; intermedia, 258, 261; intermedia dissitifolia, 259; intermedia flexuosa, 260; Liebmanni, 261; linearis, 250; longissima, 248, 249; Matthewsii, 259; mellifera, 259; orthoclada, 259; palmata, 259; pectinata, 248, 260; pteridella, 260; pubescens, 248–250, 253, 260; retroflexa, 260; revoluta, 253; rigida, 255; strictissma, 261; trachyrhizoma, 262
Gleicheniaceae, Preliminary review of the North American, 243
Gloephyllum **edule,** 480
Gloeosporium, 593; **minus,** 315
Glomerella, 315; rufomaculans **Vaccinii,** 314, 316
Glottidium vesicarium, 364
Glyphomitrium, 141; **Cockerelleae,** 140, 142
Glyptostrobus Ungeri, 140
Gnaphalium purpureum, 404; spathulatum, 404
Gnomonia, 593–597; Rubi, 594–597; tetraspora Rubi, 596; veneta, 595
Gnomonia, Notes on a parasitic, 593
Gomontia polyrhiza, 507
Gonolobus, 411, 412
Gordonia Lasianthus, 365, 369
Gossypium, 230
Grayia polygaloides, 591; spinosa, 591
GRIFFITHS, D. Concerning some West American fungi, 207
Guignardia Bidwellii, 316; **Vaccinii,** 316
Guillenia, 429, 430; longirostris, 430; rostrata, 429
Gutierrhezia **bracteata,** 265; divergens, 265
Gymnosporangium, 459; **Betheli,** 459, 462; clavipes, 461; **durum,**460; globosum, 461; **inconspicuum,** 461, 463; Libocedri, 463
Gymnosporangium and Roestelia, New western species of, 459
Gyrotheca tinctoria, 365

Habenaria, 585; blepharigottis, 365, 581; cristata, 365; gracilis, 585
Halimeda, 491, 493, 495, 496, 499; cuneata, 494, 498, 499; discoidea, 495–500, 514, 515; favulosa, 501, 502, 504; gracilis, 491, 500; incrassata, 501, 503; incrassata ovata, 503; Lessonii, 497; macroloba, 491, 496; Monile, 499, 501, 502, 504; Opuntia, 494, 499; papyracea, 495–497; platydisca, 491, 497, 500; scabra, 492, 494, 500, 502, 504; **simulans,** 503, 504, 516; tridens, 493, 494, 501–504, 515; Tuna, 491–500, 502, 504, 514, 515; Tuna f. platydisca, 497
Halimeda and Avrainvillea, Further notes on, 491
Hamosa **atrata,** 48; **atratiformis,** 48
Hapalopilus gilvus, 470; licnoides, 470; **subrubidus,** 470
Haplocladium microphyllum, 574
Haplosporella, 103
HARPER, R. M. A midsummer journey through the coastal plain of the Carolinas and Virginia, 351
HAYNES, C. C. Two new species of Aytonia from Jamaica, 57
Hecisopteris **minima,** 457, 458; pumila, 458; Werckleana, 458
Hedera, 198, 201; primordialis, 201, 206
Hedysarum Mackenzii, 425; **utahense,** 424
Helianthus, 404–406; annuus, 404; divaricatus, 404; doronicoides, 405; grosseserratus, 405; hirsutus, 405; Maximiliani, 405; occidentalis, 405; scaberrimus, 405; strumosus, 405; trachaelifolius, 405; tuberosus, 127, 135, 136, 405
Helicosporium **Tiliae,** 103
Heliocarpus, 402; americanus, 402
Helminthosporium **inaequale,** 307
Helvella, 102
Hemionitis, 445; brasiliana, 452; cajanensis, 453; gigantea, 457; lanceolata, 451; lineata, 450
Hepaticae of Puerto Rico, 1, 533
Herberta, 561, 562
Herpestis verticillaris, 76
Hesperidanthus, 431, 434; **linearifolius,** 434
Hesperis, 430; matronalis, 66
Heteropterygium, 250, 251
Heterothrix, 432, 435; **longifolia,** 435; **micrantha,** 435
Hexagona cervinoplumbea, 469; ciliata,

470; cucullata, 470; orbiculata, 469; Thwaitesii, 469; **vibecinoides**, 470; Wightii, 469
Hibiscus, militaris, 364, 369, 373
Hibiscus militaris, 364, 369, 373
HOLLICK, A. & BRITTON, E. G. American fossil mosses, with description of a new species from Florissant, Colorado, 139
Holomitrium **Maxoni**, 572; proliferum, 573; Wrightii, 573
Holopterygium, 249–251
Homalobus brachycarpus, 49; campestris, 49, 50, 417; camporum, 50, 417, 418; decurrens, 50, 418; dispar, 419; **divergens**, 50, 417, 418; hylophilus, 50; **humilis**, 417; junceus, 49; junciformis, 49; **microcarpus**, 417; **oblongifolius**, 50, 418; **paucijugus**, 418; simplicifolius, 49; **stipitatus**, 419; **strigulosus**, 419, 420; tenellus, 418–420; tenuifolius, 50; **uniflorus**, 49
Homalolejeunea, 544
Hookeriopsis gracilis, 571
Hordeum vulgare, 135
HOUSE, H. D. Studies in the North American Convolvulaceae, 143
HOWE, M. A. Phycological studies, 491
Hydnum **Kauffmani**, 348; **sulcatipes**, 101
Hymenophyllum, 12; ciliatum, 11
Hypericum fasciculatum, 364
Hypnum, 140; Brownii, 139, 142; columbianum, 140, 142; Haydenii, 139, 140, 142
Hypocopra, 314

Ibervillea, 329–335, 339, 340; Sonorae, 329, 330, 338, 340, 343
Ibervillea Sonorae, The stem of, 329
Ilex glabra, 367
Impatiens, 403; aurea, 403; biflora, 403; Nolitangere, 403
Index to American botanical literature (1901–1905), 51; (1906), 105, 267, 575; (1907), 161, 213, 319, 379, 439, 483, 521, 609
Inocybe **decipientoides**, 100; decipiens, 101
Inonotus **Elmerianus**, 471
Inula salicina, 74
Iodanthus linearifolius, 430, 434; pinnatifidus, 66
Ipomoea Batatas, 70; carolina, 70; incarnata, 71; Jalapa, 71; lacunosa, 70; leptophylla, 70; mexicana, 70; pandurana, 71; pandurata, 71, 81; Pes-caprae, 71; simulans, 71; triloba, 71
Irpex maximus, 467
Isochilus linearis, 116
Iva, 405; ambrosiaefolia, 75; ciliata, 75; xanthiifolia, 395, 405

Jamaica, Two new species of Aytonia from, 57
Journey through the coastal plain of the Carolinas and Virginia, A midsummer, 351
Jubula, 4, 566
Juglandites, 192
Juglans cinerea, 284
Juncus biflorus, 374; effusus, 364; scirpoides compositus, 374
Jungermannia, 557; birotunda, 18; brachiata, 546; cucullata, 12; dilatata, 558; filicina, 557, 558, 563–565; filiformis, 18; geminiflora, 18; granulata, 539; incrassata, 540; Mackaii, 543; spathulistipa, 558; squamata, 5; subfusca, 26; Tamarisci, 558; transversalis, 534, 537; trinitensis, 566
Juniperus californica utahensis, 460, 461; communis, 140; scopulorum, 460; virginiana, 364

Kalmia, 204; Brittoniana, 204
Kawakamia, 393
Kentrophyta **minima**, 420; **tegetaria**, 421; Wolfii, 421
KERN, F. D. New western species of Gymnosporangium and Roestelia, 459
KIRKWOOD, J. E. Some features of pollen-formation in the Cucurbitaceae, 221
KNOX, A. A. The stem of Ibervillea Sonorae, 329
Koeleria, 209

Lactarii from Vermont, Some, 85
Lactarius, 85–95; affinis, 90, 94; alpinus, 90, 94; **aspideoides**, 87, 93; aspideus, 87; **Bensleyae**, 87, 95; camphoratus, 90, 95; Chelidonium, 93; cilicioides, 94; cinereus, 90, 94; circellatus, 86, 90, 94; deceptivus, 86, 90, 95; deliciosus, 90, 93; distans, 95; flexuosus, 90, 95; fuliginosus, 91, 93; Gerardii, 91, 95; griseus, 88, 91, 95; hysginus, 91, 94; Indigo, 93; insulsus, 94; **isabellinus**, 88, 93; ligniotus, 91, 93; **minusculus**, 88, 94; **nitidus**, 89, 95; **oculatus**, 86, 89, 95; pallidus, 95; paludinellus, 91, 95; pargamenus, 94; parvus, 91, 94; piperatus, 86, 94; pyrogalus, 91, 94; regalis, 86; resimus, 86, 91, 93; rimosellus, 86, 91, 95; **rufulus**, 346; rufus, 94, 346; subdulcis, 86, 89–91, 95; subdulcis oculatus, 89; subpurpureus, 91, 93;

theiogalus, 92, 93; torminosus, 92, 93; trivialis, 94; turpis, 92, 94; uvidus, 92, 93, 102; vellereus, 92, 95; volemus, 92, 95; **xanthogalactus**, 346; zonarius, 94
Laelia acuminata, 118; peduncularis, 118; rubescens, 118
Lagenaria vulgaris, 415
Larix, 226–228, 231, 237, 239
Lathyrus **brachycalyx**, 425; decapetalus, 425
Laurophyllum, 189
Laurus, 188, 189
Lavatera, 230, 239
Lejeunea, 4, 18, 533, 558; barbiflora, 540; Bongardiana, 546, 548, 549; brachiata, 546, 548; Breutelii, 7, 8, 13; catenulata, 7, 8, 10–12; complicata, 546; Crescentiae, 554, 556, 557; eulopha, 22; filicina, 563; filiformis, 18; floccosa, 12; geminiflora, 18; granulata, 539; Guilleminiana, 546, 548, 549; Haenkeana, 554; harpaphylla, 553, 554, 556, 557; incrassata, 540, 542; Lehmanniana, 553, 554, 556; Leiboldii, 554; Mariei, 30, 32; Montagnei, 20; Muelleriana, 27, 29, 30; portoricensis, 8, 10, 15; Sagraeana, 30; seminervis, 7, 8; squamata, 5; subfusca, 26, 27, 30; taeniopsis, 539, 540; tenuifolia, 18; transversalis, 537; transversalis Hookeriana, 540; vincentina, 542
Lemna, 364; minor, 302
Lentinus, 104; ventricosus, 104
Lenzites applanata, 480; Palisoti, 480; pallida, 480; platypoda, 480; repanda, 480
Leotia chlorocephala, 103; **punctipes**, 102
Lepidium alyssoides, 427; Bourgeauanum, 428; **brachybotryum**, 427; campestre, 65, 68; **Crandallii**, 427; densiflorum, 66, 428; Eastwoodiae, 427; **Fletcheri**, 428; Jonesii, 427; montanum, 427; ruderale, 428; sativum, 68; scopulorum, 427; virginicum, 66
Lepigonum medium, 81
Lepiota cepaestipes, 97; **xylophila**, 97
Leptilon canadense, 394
Leptochloa mucronata, 208; viscida, 208
Leptodontium brevisetum, 572; **perannulatum**, 572
Leptothyrium **Oxycocci**, 311
Leskea microphylla, 574
Lilium, 228, 231; Catesbaei, 365
Limnobium Spongia, 364
Limnorchis stricta, 585
Limonium, 368; carolinianum, 368; Nashii, 368
Lindera, 189
Liquidambar styraciflua, 367
Liriodendron, 196, 197; **dubium**, 196, 206; Meekii, 196; oblongifolium, 196; primaevum, 196, 197; semialatum, 196; Tulipifera, 206, 367
Liriodendropsis, 196, 197; angustifolia, 196; simplex, 196
Literature, American botanical (1901–1905), 51; (1906), 105, 267, 575; (1907), 161, 213, 319, 379, 439, 483, 521, 609
Long Island, A new Utricularia from, 579
Lophodermium melaleucum, 309; Oxycocci, 309
Lopholejeunea, 1, 21–23, 29, 32, 535, 536, 550, 553, 557; Anderssonii, 21; dentistipula, 32; eulopha, 22, 32; fimbriata, 32; **Howei**, 30, 32, 34; Muelleriana, 24, 27, 29, 30, 32, 34; Sagraeana, 24, 26–30, 32, 33
Loxogramme, 445; lineata, 450
Ludwigia maritima, 368; suffruticosa, 364; virgata, 369
Lupinus amplus, 41, argenteus, 43, 45; argenteus argophyllus, 43; Bakeri, 44; brevicaulis, 45; canescens, 43; decumbens, 44; dichrous, 44; **flavicaulis**, 43; foliosus stenophyllus, 42; holosericeus, 43; laxiflorus, 41, 42; **laxispicatus**, 42; leucophyllus, 44; Lyallii, 45; **Macounii**, 42; **macrostachys**, 44; **marianus**, 41; oreophilus, 43; ornatus glabratus, 41; pseudoparviflorus, 41; pusillus, 45, 46; **roseolus**, 44; **rubens**, 45; **scaposus**, 45; Scheuberae, 42; **stenophyllus**, 42; **subulatus**, 43; tenellus, 42
Lycopersicon Lycopersicon, 392
Lycopodium, 139, 140; rupestre, 377
Lysiostyles, 143; scandens, 143

MACKENZIE, K. K. Notes on Carex, 151, 603
Macromitrium Husnoti, 573
Macrophoma **tiliacea**, 348
Macropodium, 429; laciniatum, 429; nivale, 429
Madia sativa, 405
Magnolia, 188; amplifolia, 195; Capellinii, 188, 195, 206; glauca, 367, 371; grandiflora, 364, 371; longifolia, 195; macrophylla, 196; **Newberryi**, 195, 206; obtusata, 195
Malapoenna, 189
Malvastrum densiflorum, 264, 265; **viscidum**, 264
Marasmius, 98
Marchantia polymorpha, 240

Marchesinia, 533, 543–546; Bongardiana, 546; brachiata, 546, 548, 549, 567; Guilleminiana, 546; Mackaii, 544, 545; robusta, 546
Marshallia graminifolia, 365
Mastigolejeunea, 533, 549, 550, 552, 557, 559; auriculata, 549, 551, 552; crispula, 550
Matricaria, 73; matricarioides, 75
Maxillaria iridifolia, 121; **Valenzuelana,** 121
Maximowiczia, 330, 334; Sonorae, 330
Melica imperfecta, 209
Melothria, 225, 237; scabra, 415
Mertensia, 243, 260; arachnoides, 249; farinosa, 254; flexuosa, 254; fulva, 255; furcata, 257; glabra, 249; glaucescens, 250; gleichenioides, 261; grandis, 257, 258; palmata, 259; pectinata, 260; pubescens, 255; rigida, 254; subtrisperma, 254
Mesosorus, 243
Mesozoic flora of the Atlantic coastal plain, 185
Micrampelis, 223, 225, 227–229, 231, 234, 236, 237, 241, 242; lobata, 223, 406, 415
Microchloa indica, 208
Microporellus **subdealbatus,** 471
Microporus Perula, 472
Microthamnium reptans, 571; thelistegum, 574; Tuerckheimii, 571
Midsummer journey through the coastal plain of the Carolinas and Virginia, 351
Momordica balsamina, 415; charantia, 415
Montia linearis, 317; minor, 317
Mosses, Fossil, 139
Mosses from tropical America, 569
Mukia scabrella, 415
MURRILL, W. A. Some Philippine Polyporaceae, 465
Myrica, 191, 192; acuta, 191; brookensis, 191; callicomaefolia, 192; carolinensis, 373, 374; cerifera, 367, 373, 374; **elegans,** 191, 206; Gale, 374; Newberryana, 191; praecox, 191; pumila, 365; raritensis, 191; rigida, 192
Myrtophyllum, 202; Geinitzi, 201, 202; Warderi, 202, 203
Myrtus caryophyllata, 1

NASH, G. V. Costa Rican orchids, 113
Naucoria semiorbicularis, 101; **sororia,** 101; tabacina **bicolor,** 347
Neckera abietina, 11, 12; undulata, 573
Neottia flava, 114
Neslia paniculata, 67
Neurolejeunea, 1, 3, 5, 7, 8, 10, 15, 17; **Breutelii,** 13, 15, 33; catenulata, 9, 10, 12, 13, 15, 17, 33; portoricensis, 15; seminervis, 15
New England species of Tetmemorus, 599
New Mexico, The genus Androsace in, 517
New species of Aytonia from Jamaica, 57
New species of fossil moss from Florissant, 139
New species of fungi, 97, 305, 345
New species of Uredineae, 583
New Utricularia from Long Island, 579
New western species of Gymnosporangium and Roestelia, 459
New willows from the Canadian Rocky Mountains, 157
Nigrofomes melanoporus, 478
Nigroporus **durus,** 471; vinosus, 471
Nitrophila, 210; occidentalis, 210
Nomenclature, American Code of Botanical, 167
North American Convolvulaceae, 143
North American Gleicheniaceae, 243
North American Peronosporales, 61, 387
North Carolina, Contributions to the Mesozoic flora of, 185
Notarisia, 141
Notes on Carex, 151, 603
Notes on Halimeda and Avrainvillea, 491
Notes on a parasitic Gnomonia, 593
Nymphaea advena, 183; fluviatilis, 371
Nyssa biflora, 352, 367; Ogeche, 358; sylvatica, 352; uniflora, 367

Occurrence of glands in the embryo of Zea Mays, 125
Octoblepharum albidum, 570
Odontolejeunea, 2, 5, 536, 537
Oidium, 408
Omphalanthus, 1, 17, 18, 20; filiformis, 18, 20, 21, 33; geminiflorus, 18, 21
Omphalia, 98; **curvipes,** 345; grisea, 98; integrella, 345; pusillissima, 345; **serotina,** 98; **vestita,** 345
Omphalolejeunea, 18
Onoclea polypodioides, 243
Orchids, Costa Rican, 113
Ornithocephalus, 123
Orobus dispar, 419
Oxalis Wrightii, 264
Oxydendrum arboreum, 366
Oxygraphis Cymbalaria, 584
Oxypolis filiformis, 364
Oxytropis argentata, 424; Besseyi, 422, 424; monticola, 424
Ozonium auricomum, 305; **omnivorum,** 305

Pachypodium, 429, 430; integrifolium, 429, 433; laciniatum, 429; lineari-folium, 434; sagittatum, 429
Panicum caespitosum, 209; digitarioides, 364; hebotes, 586; molle, 586
Parasitic Gnomonia, Notes on a, 593
Parietaria pennsylvanica, 407
Parthenium, 73; integrifolium, 75; repens, 75
Parthenocissus quinquefolia, 408; tricuspidata, 409
Passiflora incarnata, 364
PECK, C. H. New species of fungi, 97, 345
Peckiella hymenii, 102; **hymenioides,** 102
Pedicularis bracteosa, 35; Canbyi, 35; **siifolia,** 35
Peltandra undulata, 239
Peltolejeunea, 20
Penicillus, 513
Peperomia pellucida, 68, 81
Peronoplasmopara, 412, 413; Celtidis, 415; cubensis, 413
Peronospora, 395, 398, 399, 412, 413; australis, 406; Cactorum, 390; Celtidis, 415; conglomerata, 400; Conii, 401; cubensis, 412, 413; entospora, 393; Epilobii, 401; Geranii, 399; Gonolobi, 411; graminicola, 396; graminicola Setariae-italicae, 396; Halstedii, 403; Halstedii Ambrosiae, 403; illinoensis, 407; Impatientis, 402, 403; infestans, 389, 391; Kellermanii, 394; macrocarpa, 401; macrospora, 401; nivea, 401; nivea Geranii, 399; obducens, 402; ribicola, 410; sicyicola, 406; simplex, 394; Umbelliferarum, 401; viticola, 398, 407
Peronosporales, North American, 61, 387
Petalostemon, 589; candidus, 589; multiflorus, 589; oligophyllus, 589; purpureus, 589; villosus, 589; violaceus, 589
Phacidium, 308
Phalaris arundinacea, 398
Pharbitis hederacea, 71; purpurea, 71
Phaseolus lunatus, 390
Philippine Polyporaceae, 465
Phoenix dactylifera, 136
Phoma cystisporea, 312; leptidea, 308
Phoradendron flavescens, 367
Phragmicoma, 543; Bongardiana, 546, 548, 567; catenulata, 10, 12; catenulata incompleta, 12; filiformis, 18; granulata, 539; Guilleminiana, 546, 548; Haenkeana, 554, 556, 557; ocellulata, 5; transversalis, 537
Phragmites, 190, 191, 206
Phragmolejeunea, 552
Phragmopyxis, 590
Phycological studies, 491
Phyllosticta **putrefaciens,** 307
Phytophthora, 388, 389, 391; Cactorum, 389, 390; Colocasiae, 389, 390; infestans, 389, 391, 392, 408; Nicotianae, 389, 390; omnivora, 391; Phaseoli, 389, 390; **Thalictri,** 389, 392
Pieris floribunda, 352; nitida, 352
Pinckneya, 358
Pinus, 284; echinata, 366, 367; Elliottii, 360–362, 364, 373, 375; insularis, 481; palustris, 351, 360, 361, 375, 376; rigida, 376; serotina, 351, 362, 367, 376; Taeda, 358, 360, 361, 367, 375, 376; virginiana, 313
Pisum, 231
Plagiochasma elongatum, 58; Wrightii, 59
Plagiorhabdus, 310; **Crataegi,** 310, 311; **Oxycocci,** 311
Planera, 193, 373; aquatica, 364, 372; betuloides, 193; **cretacea,** 193, 206; Ungeri, 193
Plasmopara, 394, 395, 398, 399, 412, 413; australis, 406; Celtidis, 415; cubensis, 413; entospora, 394, 395; Epilobii, 401; Geranii, 399; Gonolobi, 411; Halstedii, 403; Heliocarpi, 402; Impatientis, 402; Kellermanii, 394; nivea, 401; obducens, 402; pusilla, 400; ribicola, 410; Viburni, 410; Vincetoxici, 411, 412; viticola, 408
Platanus, 373; affinis, 200; Heerii, 200; occidentalis, 364, 370, 372
Platylejeunea, 534; granulata, 539; transversalis, 537; vincentina, 542
Platyzoma, 243, 244
Pleurophragma, 431, 433; **gracilipes,** 433; **integrifolium,** 433, 434; **platypodum,** 434
Pleurothallis minax, 115, 116; plumosa, 115, 116; polyliria, 115; Valenzuelana, 121, 122
Poa, 584; arida, 584; nevadensis, 584
Poacites, 190
Pogonatum tortile, 571
Pollen-formation in the Cucurbitaceae, 221
Polygala cymosa, 364; lutea, 365, 370; ramosa, 365
Polymnia Uvedalia, 364
Polypodium dichotomum, 243, 250, 255; furcatum, 257; glaucum, 249; lineare, 250, 255
Polyporaceae, Some Philippine, 465
Polyporus affinis, 472; albomarginatus, 478; anebus, 466; atypus, 467; aureomarginatus, 470; australis, 476;

bicolor, 466; bivalvis, 469; brevi-porus, 470; brunneolus, 467; caligi-nosus, 478; carneoniger, 472; cele-bicus, 471; cervino-gilvus, 466; cinereofuscus, 478; **coracinus,** 471; corrugatus, 468; dermatodes, 466; discipes, 470; durus, 471; elongatus, 467; endotheius, 478; fastuosus, 479; fuscobadius, 468; grammocephalus, 472; holosclerus, 470; incomptus, 472; intybaceus, 468; iodinus, 468; Kermes, 478; laeticolor, 478; lanatus, 466; mariannus, 468; Meyenii, 467; microcyclus, 468; murinus, 467; ostreaeformis, 474; **palensis,** 472; pectinatus, 479; Peradeniae, 466; Perula, 472; phocinus, 466; poly-chrous, 472; scabrosus, 468; scorteus, 466; setiporus, 468; spadiceus, 470; surinamensis, 473; tornatus, 476; vernicipes, 468; vibecinoides, 470; vibecinus, 473; Wightii, 469; xan-thopus, 472; zonalis, 473; zonalis semilaccatus, 466
Polypremum procumbens, 364
Polystictus badius, 466; cichoriaceus, 468; cilicioides, 470; Didrichsenii, 467; Persoonii, 468
Polytaenium, 447–449; lanceolatum, 450; lineatum, 450
Polytrichadelphus ciliatus, 571
Ponera amethystina, 116
Pontederia cordata, 364
Populites affinis, 200
Populus 364, 373; deltoides, 373
Porana, 143; velutina, 144
Portulaca oleracea, 81, 83
Potentilla, 284; fruticosa, 284
Preliminary review of the North American Gleicheniaceae, 243
Prevostea, 143, 144; amazonica, 145; ferruginea, 145; glabra, 145; sericea, 144, 145; spectabilis, 146; umbellata, 146; velutina, 144
Production of deleterious excretions by roots, 279
Prospodium Amphilophii, 588; appen-diculatum, 588; **bahamense,** 587
Protomyces graminicola, 396
Prunus, 284
Psathyrella **betulina,** 101; **caespi-tosa,** 348
Pseudoperonospora, 389, 399, 412, 413; **Celtidis,** 407, 413, 415; cubensis, 406, 413
Pseudoplasmopara, 413
Pseudotsuga Douglasii, 591; mucronata, 591
Pteridium aquilinum, 367
Pteris dichotoma, 243, 257
Pterocaulon undulatum, 365
Pterospermites, 188, 199; **carolinen-sis,** 198, 206; cordifolius, 199; **credneriifolius,** 199, 206; modestus, 199
Ptychanthus, 4, 566
Ptychocoleus, 543
Ptychomitrium, 141
Puccinia, 585, 587; Agrostidis, 584; Caricis, 591; **Chaetochloae,** 585; **cinerea,** 583; coronata, 585; epi-phylla, 584; eslavensis, 586; **Euro-tiae,** 210; Gonolobi, 411; minuta, 587; **minutissima,** 587; **panici-cola,** 586; **perminuta,** 584; Petal-ostemonis, 589; Poarum, 584; **prae-gracilis,** 585; **quadriporula,** 586; Rhamni, 585
Puerto Rico, Hepaticae of, 1, 533
Pycnoporus sanguineus, 473
Pyropolyporus **albomarginatus,** 478; **caliginosus,** 478; **endotheius,** 478; **fastuosus,** 479; **lamaensis,** 479; **Merrillii,** 479; **pectinatus,** 479; **Williamsii,** 479

Quamoclit Quamoclit, 71
Quercophyllum, 193
Quercus, 188, 192, 193; alba, 366; Catesbaei, 351, 367, 372; cinerea, 365; coccinea, 306; digitata, 367; Ellsworthiana, 192; geminata, 361; Johnstrupi, 192, 193; Marioni, 192; marylandica, 367; minor, 366; Phel-los, 366, 367; **Pratti,** 192, 206; sphenobasis, 192; virginiana, 364; Wardiana, 192

Raphanus sativus, 65, 67, 81
Ravenelia, 592
Reboulia hemisphaerica, 58
REED, H. S. & SCHREINER, O. The production of deleterious excretions by roots, 279
Reinwardtia, 144; glabra, 145; sericea, 145
Reseda, 65
Review of the North American Glei-cheniaceae, 243
Rhabdospora **Oxycocci,** 311
Rhexia Alifanus, 365
Rhinotrichum **Sumstinei,** 103
Rhipilia longicaulis, 508–510; Rawsoni, 510; tomentosa, 512
Rhizogonium spiniforme, 571, 573
Rhizophora Mangle, 271; mucronata, 272
Rhizophora Mangle, The embryology of, 271
Rhizopus, 285

Rhus, 192; acuminata, 192; copallina, 366
Rhynchostegium conchophyllum, 571; Knowltoni, 140, 142
Rhysotheca, 389, 398, 399, 413; **australis,** 399, 406, 407; **Epilobii,** 399, 401; **Geranii,** 399; **Gonolobi,** 399, 411; **Halstedii,** 399, 403; **Heliocarpi,** 399, 402; **illinoensis,** 399, 407; **obducens,** 399, 402; **ribicola,** 399, 410; **Umbelliferarum,** 399, 401; **Viburni,** 399, 410; **viticola,** 399, 407
Rhytidophyllum, 179; crenulatum, 179, 183, 184; tomentosum, 179, 183, 184
Rhytidophyllum, The embryology of, 179
Ribes albinervum, 411; divaricatum, 411; hirtellum, 411; oxycanthoides, 411; prostratum, 411; rotundifolium, 411; rubrum, 411; rubrum subglandulosum, 411
Ricinus, 128; communis, 135
Rigidoporus **surinamensis,** 473
Rocky Mountain flora, Studies on the, 35, 417
Rocky Mountains, Two new willows from the Canadian, 157
Roestelia, 459; **Betheli,** 461; **Harknessiana,** 462, 463; **Harknessianoides,** 463
Roestelia, New western species of, 459
Roots, The production of deleterious excretions by, 279
Roripa Armoracia, 65, 67; hispida, 67; Nasturtium, 68; obtusa, 67; palustris, 67; sessiliflora, 67; Walteri, 67
Rowlee, W. W. Two new willows from the Canadian Rocky Mountains, 157
Rubus nigrobaccus, 593, 594
Rudbeckia fulgida, 394; laciniata, 405; triloba, 405
Russula, 86
Rydberg, P. A. Studies on the Rocky Mountain flora, 35, 417
Rynchospora corniculata, 364; fusca, 581; semiplumosa, 375

Sabal glabra, 364
Sabbatia campanulata, 364; lanceolata, 365
Sabina scopulorum, 460; utahensis, 460, 461
Sagittaria variabilis, 183
Salix, 157, 189; **albertana,** 157, 158; Barrattiana, 158; Barrattiana angustifolia, 158; glaucops, 159; lucida, 159; **Maccalliana,** 158; nigra, 367; Tweedyi, 158; wyomingensis, 157
Sambucus canadensis, 364
Sarcobatus, 210
Sarracenia flava, 365, 371; minor, 365
Sassafras, 201; acutilobum, 201; harkerianum, 200; hastatum, 201; variifolium, 369
Saururus cernuus, 183
Schoenocrambe linifolium, 67
Schomburgkia, 118
Schreiner, O. & Reed, H. S. The production of deleterious excretions by roots, 279
Sclerospora, 388, 395; **Farlowii,** 207, 396, 397; graminicola, 396, 397; Kriegeriana, 398; macrospora, 398; Magnusiana, 398
Scoliosorus, 447–450; ensiformis, 449
Secale, 221
Selaginella acanthonota, 377
Sematophyllum admistum, 574; subsimplex, 571
Senecio, 73; aureus, 76; cymbalaroides, 75; Hartianus, 75; lugens, 76; oblanceolatus, 76; peninsularis, 76; serra, 76; serra integriusculus, 76; tomentosus, 367
Septoria **longispora,** 308
Sequoia heterophylla, 188, 189
Serapias flava, 114
Serenoa, 358; serrulata, 361
Shear, C. L. New species of fungi, 305
Sicydium, 330; Lindheimeri, 330
Sicyos angulatus, 406, 415
Sida rhombifolia, 364
Silphium, 221, 239; integrifolium, 405; laciniatum, 405; perfoliatum, 405; terebinthinaceum, 405; trifoliatum, 405
Sinapis alba, 68
Sisymbrium officinale, 67
Smilax lanceolata, 364; laurifolia, 365
Solanum tuberosum, 392
Solidago canadensis, 405; Riddellii, 405; rigida, 394
Some features of pollen-formation in the Cucurbitaceae, 221
Some Lactarii from Vermont, 85
Some Philippine Polyporaceae, 465
Some West American fungi, 207
Sophia andrenarum, 209; brachycarpa, 436; filipes, 436; Hartwegiana, 67; incisa, 67, 436; intermedia, 436; **magna,** 436; millefolia, 67; **Nelsonii,** 436; pinnata, 65, 67, 437
Sordaria, 314
Sorosporium Eriochloae, 209; Montiae, 317; **ovarium,** 209
Southern California, Studies on the flora of, 263

Spartina glabra, 367
Species of Antrophyum, American, 445
Species of Aytonia from Jamaica, 57
Species of fungi, New, 97, 305, 345
Species of Gymnosporangium and Roestelia, New western, 459
Species of Uredineae, New, 583
Sphaeria obturata, 309, 310; obturata epiphylla, 309; obtusata, 309; Sclerotium, 310
Sphaeronema **pomorum,** 307
Sphaeropsis, 309; Asiminae, 103
Sphagnum, 92; medium purpurascens, 569
Spongipellis **luzonensis,** 473
Sporonema, 310; **epiphyllum,** 309; obturatum epiphyllum, 309; **Oxycocci,** 308; phacidioides, 310; **pulvinatum,** 308
Sporotrichum **Quercuum,** 306; sulphureum, 306; sulphureum f. Quercuum, 306
STANDLEY, P. & WOOTON, E. O. The genus Androsace in New Mexico, 517
Stanfordia, 428
Stanleya, 431
Stanleyella, 431, 435; **Wrightii,** 435
Statice caroliniana, 368; Limonium, 368
Stem of Ibervillea Sonorae, 329
Sterculia Saportanea, 200
Stictolejeunea, 1–5, 9, 10, 536, 545, 560; Kunzeana, 1, 3, 7; squamata, 1–3, 5, 7, 13, 33
Streptanthus, 428, 430, 431; linearifolius, 430, 434; longifolius, 435; longirostris, 430; maculatus, 431; micranthus, 435; wyomingensis, 431, 432
Streptochaeta, 126
Stromatopteris, 243, 244
Studies, Phycological, 491
Studies in North American Convolvulaceae, 143
Studies in North American Peronosporales, 61, 387
Studies on the flora of Southern California, 263
Studies on the Rocky Mountain flora, 35, 417
Stylisma, 143, 147, 149; **angustifolia,** 147, 148; aquatica, 148, 149; elliptica, 149; evolvuloides, 148; evolvuloides angustifolia, 149; humistrata, 147, 148; peduncularis, 147, 148; Pickeringii, 148, 149; **rotundifolia,** 148, 149; **trichosanthes,** 147, 148; **villosa,** 148, 149
Swertia, 72; connata, 72, 81
Symbiezidium, 533–535, 537, 544, 545, 550; **barbiflorum,** 540, 542, 567; Breutelii, 13; catenulatum, 10; granulatum, 539, 540; squamatum, 5; transversale, 534, 537, 538, 540–543, 567; vincentinum, 542, 543
Symplocarpus, 228; foetidus, 239
Synopsis of the New England species of Tetmemorus, 599
Syrrhopodon Hobsoni, 573

Taxilejeunea, 18
Taxodium distichum, 352, 367; imbricarium, 364, 376
Tecoma bahamensis, 588; radicans, 364
Tetmemorus, 599–601; Brebissonii, 599, 601; granulatus, 600, 601; laevis, 600, 601; minutus, 600, 601
Tetmemorus, A synopsis of the New England species of, 599
Thalictrum, 234; purpurascens, 234, 392
Thelypodiopsis, 431, 432; **aurea,** 432; **Bakeri,** 432; **elegans,** 432, **wyomingensis,** 432
Thelypodium, 428–431; aureum, 430, 432; Bakeri, 430, 432; elegans, 430, 432; integrifolium, 430, 433, 434; integrifolium gracilipes, 433; laciniatum, 429, 433; lasiophyllum, 429, 430; **leptosepalum,** 432; lilacinum, 434; linearifolium, 430, 434; longifolium, 431, 435; micranthum, 431, 435; **Palmeri,** 432; sagittatum, 433; utahense, 429; Wrightii, 431, 434, 435
Thladiantha, 330, 337, 339, 340
Thlaspi Bursa-pastoris, 68; glaucum, 67; Nuttallii, 67
Thyella tamnifolia, 71
Thysananthus, 552, 557, 558, 560, 566
Tilia americana, 103, 348
Tillaea rubescens, 76
Tillandsia usneoides, 364, 375
Timmiella subanomala, 571
Tissa leucantha, 72; marina, 72
Tium sparsiflorum, 48; **variegatum,** 47
Tofieldia racemosa, 365
Torula, 84
Tragopogon porrifolius, 76, 81
Trametes Aurora, 467; badia, 466; bicolor, 468; **caespitosa,** 473; colliculosa, 480; dermatodes, 466; **lamaensis,** 474; **luzonensis,** 474; Muelleri, 474; nitida, 468; **ostreaeformis,** 474; **subacuta,** 474; versatilis, 469; **Williamsii,** 475
Trichantha, 146
Trichodium, 584
Trichosanthes colubrina, 415

Trichostema lanatum, 265; lanatum denudatum, 265; Parishii, 265
Trifolium **Aitonii,** 46; **confusum,** 46; dasyphyllum, 47; **inaequale,** 47; latifolium, 46; longipes, 46; montanense, 47; Parryi, 47; pedunculatum, 46; Rusbyi, 46; Rydbergii, 46; **uintense,** 47
Triticum, 221; vulgare, 286, 398
Tropical America, Mosses from, 569
Tsuga canadensis, 583, 591; heterophylla, 583; Mertensiana, 583
Two new species of Aytonia from Jamaica, 57
Two new willows from the Canadian Rocky Mountains, 157
Typha latifolia, 364
Tyromyces **Elmeri,** 475

Udotea, 495, 512, 513; conglutinata, 513; Desfontainei, 513; flabellata, 495; Flabellum, 495; luteofusca, 513; tomentosa, 512
UNDERWOOD, L. M. American ferns, 243
Uredineae, New species of, 583
Uredo, 63; Bliti, 77; candida, 63, 64; candida Tragopogi, 72; Chaetochloae, 585; Cheiranthi, 64; Convolvulae, 68; **Grayiae,** 591; Holwayi, 583; **inquirenda,** 592; Portulacae, 83; Tragopogi, 72
Urocystis Agropyri, 209; **Sophiae,** 209
Uropyxis, 589, 590; Amorphae, 590; Petalostemonis, 589, 590
Ustilago Boutelouae, 208; Calandriniae, 317; **Claytoniae,** 317; Cynodontis, 208; heterogena, 208; hypodites, 208; **Microchloae,** 207
Utricularia, 579, 580; cornuta, 579; juncea, 579–581; resupinata, 581; simplex, 581; **virgatula,** 580–582
Utricularia from Long Island, A new, 579

Vaccinium crassifolium, 365; macrocarpum, 307–309, 311, 312, 314–316
Vaucheria geminata, 507; hamata, 507
Verbesina encelioides, 405
Vermont, Some Lactarii from, 85
Vernonia angustifolia, 365; Baldwinii, 405; noveboracensis, 405, 406
Viburnum acerifolium, 410; dentatum, 410; nudum, 410; Opulus, 410; pubescens, 410
Vigna Catjang, 287
Vignea, 151
Vincetoxicum gonocarpos, 412; hirsutum, 411, 412; suberosum, 412
Virginia, A midsummer journey through the coastal plain of, 351
Vitis, 404, 409; aestivalis, 408, 409; bicolor, 409; californica, 409; cinerea, 409; cordifolia, 409; labrusca, 409; riparia, 409; rotundifolia, 364, 409; vinifera, 409; vulpina, 409
Vittaria, 451, 457, 458; costata, 457; lanceolata, 450; lineata, 458

Warscewiczella Wendlandii discolor, 123
Wedelia incarnata, 80
West American fungi, 207
Western species of Gymnosporangium and Roestelia, New, 459
Widdringtonia helvetica, 140
Wilberforcia, 144
WILLIAMS, R. S. Mosses from tropical America, 569
Willows from the Canadian Rocky Mountains, New, 157
WILSON, G. W. Studies in North American Peronosporales, 61, 387
Windham County, Some Lactarii from, 85
WOOTON, E. O. & STANDLEY, P. The genus Androsace in New Mexico, 517

Xanthium canadense, 405
Xanthoxalis **californica,** 264; **Wrightii,** 264
Xylobium foveatum, 121
Xylophacos amphioxys, 49; **aragalloides,** 48
Xylothermia montana **tomentosa,** 263

Zea Mays, 125, 132, 136, 287
Zea Mays, An occurrence of glands in the embryo of, 125
Zostera, 221; marina, 240
Zygadenus glaberrimus, 365
Zygostates, 123; **costaricensis,** 122, 124

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