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NOTES ON AMERICAN RORIPPA (CRUCIFERAE)

Reed C. Rollins

One of the most distinctive American species of *Rorippa* is *R. sinuata* (Nutt.) Hitchcock. This is because of the perennial habit and the fact that the trichomes are unusual, being somewhat vesicular and hemispherical in shape rather than elongated and pointed. On dried specimens, the trichomes appear to be flat and scale-like because they are collapsed. These are present rather sparsely along the midribs of the under sides of the leaves and on the stems on specimens from the plains states, but an increase in the abundance of trichomes and a more extensive coverage of the plants occur on material from extreme western Texas to Arizona and northward through the Rocky Mountains and to the westward in the Columbia River valley (with certain exceptions mentioned below) and in the Great Basin region. Evidently these hemispherical-shaped trichomes are not wholly persistent, for they may be seen on the young foliage and pedicels of some specimens where they are completely absent from the mature leaves and pedicels. Ordinarily, the siliques are glabrous but plants with the greatest density of trichomes have them extending to the fruits, where they may be restricted to the valve edges next to the replum or they may extend to cover the entire valve surface. A specimen from southwestern Colorado collected by T. S. Brandegee apparently impressed Gray (1876) because of the roughness produced by the dense covering of trichomes on the siliques. This specimen became the type of *Nasturtium trachycarpum* Gray. According to Kearney and Peebles (1951) only the pubescent-fruited form occurs in Arizona.

However, neither the extent nor the abundance of these peculiar vesicular trichomes is a safe basis for any taxonomic separations and, accordingly, *N. trachycarpum* should be treated as a straight synonym of *Rorippa sinuata.*

Rorippa sinuata occurs in patches, due to the spreading of the plants by underground roots. The species appears to be adapted to disturbed soils and finds roadsides and railroad banks suitable for vigorous growth. It is not certain that it is actively increasing its geographic range but it could easily be doing so because such excellent pathways as transcontinental highways are open to it. The geographic range of *R. sinuata* appears to be from Saskatchewan and Minnesota south to Arkansas and Texas, west to Arizona and north to Washington. Munz and Keck (1959) cited it from Little Lake, Inyo County, and Modoc County, California, and these are likely areas in which to find plants of more easterly and northerly distribution. However, I have not personally seen California specimens of *R. sinuata.*

THE TYPE OF RORIPPA SINUATA

Nasturtium sinuatum was published by Torrey and Gray (1838) from Nuttall's manuscript, where "banks of the Oregon and its tributaries; also in Arkansas" are given as source localities. On the sheet bearing the type in the British Museum, two collections are present. One of these is marked "Sisymbrium sinuatum Arkansas", the other, "Nasturtium sinuatum Columbia River & Arkansas." The specimen marked "Arkansas" and the sterile shoot on the right [one of three fragments] of the second designation resemble very closely modern material from Arkansas, Oklahoma and Texas that is regularly referred to *R. sinuata.* The other two fragments are similar to modern specimens from the Columbia River valley but, in contrast to most of the material of *R. sinuata,* they are nearly glabrous. Unfortunately, I used only a hand-lens in examining these specimens while I was at the British Museum in 1950 and I cannot now say with certainty that there are absolutely none of the characteristic vesicular trichomes present on them. In other respects, the Arkansas and Columbia River specimens appear to be similar enough to represent but a single species. However, it was disturbing to find that the Nuttall specimen in the British Museum marked "Nasturtium curvisiliqua Columbia Shores" does have a conspicuous covering of vesicular trichomes and it certainly represents the species we think of as *Rorippa sinuata.* A Nuttall collection in the Gray Herbarium marked "Nasturtium *curvisiliqua.* Sisymbrium Hooker. Oregon River", in Nuttall's handwriting, has two fragments; one is *Rorippa sinuata,* the other not determinable with certainty but definitely not *R. sinuata.* These latter must be the specimens mentioned by Torrey and Gray (l.c.) as differing from the description of *Sisymbrium curvisiliquum* Hooker. It appears to me that Nuttall either made mixed collections of *Rorippa* along the Columbia River or his collections were subsequently mixed. We know from Nuttall's own collection and from *Suksdorf 2430* near Bingen, with vesicular trichomes, and *Suksdorf 2103,* W. Klickitat County (glabrous or nearly so) that both types occur along the lower Columbia in Washington. I am satisfied that the two Suksdorf collections should be accommodated in the same species and it appears that no real difficulties will arise from accepting the Columbia River specimens on the type sheet at the British Museum as the holotype of *R. sinuata.* However, it does mean that the holotype is somewhat atypical of the species as a whole.

One source of some confusion, with regard to the typification of *Rorippa curvisiliqua,* is Torrey and Gray's (l.c.) treatment of *Nasturtium curvisiliqua* in such a way that their intent was not made clear. Nuttall was merely given credit for the transfer of *Sisymbrium curvisiliqua* Hooker to the genus *Nasturtium.* Thus, Howell (1897) assumed that *Nasturtium curvisiliqua* of Nuttall was the basionym of *Rorippa curvisiliqua* rather than the rightful *Sisymbrium curvisiliquum* of Hooker. Actually Nuttall did not intend to publish *Nasturtium curvisiliqua* as a new species and this was not done for Nuttall by Torrey and Gray.

OTHER SPECIES WITH VESICULAR TRICHOMES

One reason for a careful review of the variation and distribution of *Rorippa sinuata,* as given above, was to provide the basis for a proper assessment of specimens from Mexico that share many technical characteristics with it, including the possession of vesicular trichomes. A critical comparison of the Mexican material with *R. sinuata* shows that the specimens do not belong to it but represent a closely related undescribed species.

Rorippa ramosa Rollins, sp. nov.

Prostrate dense perennial, up to 10 dm. in diameter; stems numerous, highly branched, sparsely pubescent with vesicular trichomes, 3-6 dm. long, branches present in the axil of nearly all leaves from base to apex of each stem; more generally pubescent than principal stems; leaves numerous, sessile, auriculate, thick, greyish-green, oblong to broadly lanceolate, pinnately lobed, 3-5 cm. long, 5-12 mm. wide, lobes confluent toward base; midrib prominent on lower surface of leaf, pubescent with vesicular trichomes; inflorescences short, mostly less than 5 cm. long; sepals oblong, glabrous or with a few trichomes present on the dorsal surface, hyaline-margined, non-saccate, 2-2.5 mm. long; petals pale yellow, spatulate, not differentiated into blade and claw, 2.5-3 mm. long, 0.75-1 mm. wide; pedicels widely spreading to ascending, straight to slightly curved outward, sparsely covered with trichomes, 3-5 mm. long, expanded at summit; siliques divaricately spreading to erect, slightly curved inward, oblong to lanceolate, plump, obtuse below, tapering above, 6-10 mm. long, valves densely covered with vesicular trichomes along their margins; styles glabrous, 1.5-2.5 mm. long; ovules numerous, funiculi slender; seeds plump, cordiform, ca. 1.5 mm. in diameter, seed coat colliculate (cf. Murley, 1951) and lustrous; cotyledons accumbent. Fig. A-C.

Herba perennis procumbens, caulibus numerosis ramosis 3-6 dm. longis; foliis crassis sessilibus auriculatis oblongis vel late lanceolatis pinnatilobatis costatis 2-3 cm. longis 4-12 mm. latis sparse pubescentibus; sepalis non-saccatis oblongis 2-2.5 mm. longis; petalis flavis spathulatis 2.5-3 mm. longis; pedicellis divaricatis vel adscendentibus sparse pubescentibus 3-5 mm. longis; siliquis oblongis vel lanceolatis ad basi obtusis 6-10 mm. longis sparse pubescentibus; stylis glabris 1.5-2.5 mm. longis; ovulis numerosis; seminibus cordiformibus colliculatis; cotyledonibus accumbentibus.

Type in the Gray Herbarium, collected in a dry arroyo, 3 miles northwest of Ceballos, Durango, Mexico, May 4, 1959, *D. S. Correll* and *I. M. Johnston 21449*. Isotype in the Lundell Herbarium of the Texas Research Foundation.

An additional collection of *Rorippa ramosa* is: San Lorenzo de Laguna, 70 miles south of Parras, Coahuila, May, 1880, *E. Palmer 34* (GH, US).

The general habit of growth of *Rorippa ramosa* is that of a densely leafy, highly ramified, flat, nearly circular plant.

FIG. A-C. *Rorippa ramosa*. FIG. A. habit sketch, × ½. FIG. B. silique × 2. FIG. C. replum showing numerous funiculi, × 2. Drawings by C. S. Tsao.

It is possible that there are basal leaves on the young plants but none are evident on the mature specimens I have studied. It is more probable that a truly basal rosette of leaves is not a characteristic of the species. The illustration, fig. 1A, even though it shows only a portion of two main stems, gives an approximate idea of the intricate branching present.

In habit alone, *R. ramosa* differs strikingly from *R. sinuata*. I have collected *R. sinuata* four times in Kansas, Colorado and Wyoming and in each instance colonies were found with the individual plants interconnected underground. Usually a single stem, or at most three or four, emerges at a given locus. In contrast to this, *R. ramosa* has numerous stems arising at the summit of what appears on the specimens to be a tap-root. An important difference between the two species is in the size of the flowers. Those of *R. sinuata* are more than twice the size of the flowers of *R. ramosa*, the petals being over twice the width. The outer sepals of *R. sinuata* are saccate while those of *R. ramosa* are non-saccate. Other differences include the shorter, more erect and stouter pedicels, more lanceolate-shaped fruits, shorter styles, less angular seeds and more prominently colliculate seed-coats of *R. ramosa* as compared with *R. sinuata*. The leafiness of the branches, relatively short infructescences and repeated branching give *R. ramosa* a distinctive overall appearance.

Rorippa ramosa is unquestionably related to *R. sinuata* from which it is geographically isolated. I have not seen any other material from Mexico that falls into this alliance within the genus.

Rorippa Walteri (Ell.) Mohr, Bull. Torr. Bot. Club 24: 23, 1897.

A photograph of the type of *Sisymbrium Walteri* Elliott in the Gray Herbarium leaves no doubt as to the application of this name to plants that have at times been placed under *Nasturtium tanacetifolium* H. and A. (cf. Schulz, 1933). The type of *S. Walteri* is in the Charleston Museum of Charleston, South Carolina. There seems little doubt that Elliott's renaming of the plants tentatively identified as

Sisymbrium tanacetifolium by Walter (1788) provides the first available name clearly applied to this species. The only justification for taking up the specific name *tanacetifolium* would be to consider it to have been newly proposed by Hooker and Arnott, as has been done quite often, as a renaming in another genus of the Walter described species. Hooker and Arnott (1834) did cite Walter and it is clear that they had his description in mind. However, if the name were to date from their work, it would even then not take priority over Elliott's *Walteri*. Walter did not cite Linnaeus as the author of *Sisymbrium tanacetifolium* in his book but he did use a question mark after *tanacetifolium*. It is inconceivable that he would have questioned the application of a name he was himself proposing.

Rorippa Walteri occurs from South Carolina southward to Florida and westward, largely on the coastal plain, through Texas; on the eastern and western lowlands of Mexico and at least in Nicaragua in Central America. For the present study, I have not tried to determine the total geographic range of the species. It is possible that *R. Walteri* has been carried by man somewhat outside of its natural range in Mexico and Central America because it is used as a salad plant, and it may be seen in the local markets of western Mexico. As in most species of *Rorippa*, there is considerable variation in the leaf-pattern and habit of growth. These features are strongly influenced by the conditions of moisture and light under which the plants grow.

Vesicular trichomes, somewhat longer and more constricted toward the base than those in *Rorippa sinuata*, are found on plants of *R. Walteri*, especially on the lower portions of the stems. The abundance decreases upward, often resulting in glabrousness on the upper parts of the plant. This distribution of trichomes is characteristic of specimens from the Atlantic slope of Mexico to South Carolina but most of the material from the Pacific slope of Mexico shows a different trichome distribution. Specimens from Nayarit to Sonora, and the single specimen I have seen from Nicaragua, have glabrous stems but vesicular trichomes are present on the siliques. Specimens from Colima and Oaxaca are similar to those of the eastern range of the species. There appears to be a trend toward shorter pedicels and more unevenly divided leaves in the western Mexican material. Furthermore, it seems that drier habitats are the rule in the western as compared to the eastern part of the range. All of these correlated characteristics, coupled with geographic segregation, suggest a divergent trend that may eventually result in separable taxa. At the present time, evidences of continuity throughout the species are found in a variety of structures and it seems wise to view the whole as a single species, although the addition of new knowledge might well require a revision in the direction of a recognition of a larger number of entities.

Rorippa Walteri is most easily recognized by the pinnately compound lower leaves with the leaflets at least dentate and often deeply lobed; the short (1-3 mm.) divaricate pedicels; minute flowers; terete, divaricately ascending siliques; prominent styles and the distinctive, somewhat clavate vesicular trichomes either on the stems or the siliques or occasionally on both. A selection of specimens is cited below to aid in interpreting this species.

UNITED STATES. **South Carolina:** Beaufort, *J. R. Churchill 432* (GH); St. Johns, Berkeley, *H. W. Ravenel s. n.* (GH). **Florida:** 4 miles n. Crawfordville, Wakulla Co., *Godfrey and Almodovar 52975* (GH); dried bottom of Lake Jackson, Leon Co., *Hunnewell 13048* (GH); near Jacksonville, Duval Co., *A. H. Curtiss 4589* (GH). **Mississippi:** 3 miles from Laurel, Jones Co., *Cooley and Pease 3104* (GH); near Natchez, *Sullivant s. n.* (GH). **Louisiana:** New Orleans, *T. Drummond 18* (GH). **Oklahoma:** Sapulpa, *B. F. Bush 1233* (GH). **Texas:** Conquista Crossing, between Falls City and Deweesville, Karnes Co., *Johnston 1462* (GH); Corpus Christi, Nueces Co., *Heller 1487* (GH); Bastrop, Bastrop Co., *E. J. Palmer 33381* (GH); Santa Elena Canyon, Brewster Co., *Goodman and Waterfall 4653* (GH). MEXICO. **Tamaulipas:** near Matamoros, April, 1831, *Berlandier 879* (GH). **Vera Cruz:** Jalapa, *Pringle 8087* (GH, US); Cordoba, *Orcutt 3134* (GH, US). **Sonora:** vicinity of Alamos, *Rose, Standley and Russell 13012* (GH, US); vicinity of Culiacán, *Rose, Standley and Russell 14974* (GH, US); 12 miles west of Culiacán, *Gentry 7004* (GH). **Nayarit:** vicinity of Acaponeta, *Rose, Standley and Russell 14246* (US). **Colima:** Manzanillo, *Palmer 1344* (GH). NICARAGUA. **Zelaya:** Rio Grande, *Antonio Molina R. 2172* (US).

Rorippa portoricensis (Sprengel) Stehlé, Rev. Bot. Appliq. **26**: 103. 1946.

This name is based on *Nasturtium portoricensis* Sprengel (1825) which appears to have been described from the same Bertero collection cited from Puerto Rico as that used by De Candolle (1821) as the basis for *Nasturtium palustre* var. *brevipes*. De Candolle's var. *brevipes* was first raised to specific rank by Grisebach in 1860 and the name *Nasturtium brevipes* (DC.) Griseb. was used by Schulz in various papers on the Cruciferae of the West Indies. However, the oldest and the correct specific name appears to be *portoricensis*.

The relationship of *R. portoricensis* to *R. Walteri* is a very close one and there is some question as to whether an interpretation of the existing evidence as indicating a single species, probably with the recognition of a West Indian variety, is not more realistic than the acceptance of two species. Watson, in the Synoptical Flora of North America (1895), did treat the West Indian material as *Nasturtium tanacetifolium* var. *insularum*. At that time, *N. tanacetifolium* was in common use for the species now known as *Rorippa Walteri*. However, a broader and more detailed study of the genus *Rorippa* than is at present possible is much needed, and should be looked to fòr the settling of many such difficult questions of taxonomic interpretation as that posed by *R. portoricensis*.

Assuming for the present that *R. portoricensis* is a good species, the material I have seen shows it to be present in Cuba, the Dominican Republic and Puerto Rico. The principal differences from *R. Walteri* are shown by the siliques, which are shorter with a nearly sessile stigma instead of a definite style, and the shorter, more ascending pedicels. Vesicular trichomes similar to those of *R. Walteri* are present on the lower stems and usually the valve-margins of the Cuban specimens and at least along the valve-margins of the siliques (only occasionally on the lower stems) of the material from the Dominican Republic and Puerto Rico. These are the same two trichome distribution patterns found in *R. Walteri*. The following specimens have been determined as *R. portoricensis* in the present study.

CUBA. *F. Rugel 235* (GH); **Pinar del Rio:** Galafre, *Britton and Cowell 9826* (GH); Las Guaaimas, *O'Donovan 4687* (GH); Santa Catarine, *C. Wright*, Feb. 1860 (GH); "in Cuba Orientali". *C. Wright 1562* (GH). DOMINICAN REPUBLIC: Pontezuela, *Jiménez 2565* (US); Constanza, *Türckheim 3031* (GH, US); La Estancia, *Ekman 12124* (A, US); La Cumbre, *Raunkier 1084* (US). PUERTO RICO: Cabo-Rojo, *Sintenis 699* (GH); Adjuntas, *Sintenis 4033* (US); Añasco, *Sintenis 5625* (GH). — GRAY HERBARIUM OF HARVARD UNIVERSITY.

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A RE-EVALUATION OF THE GENERIC STATUS OF ASCYRUM AND CROOKEA (GUTTIFERAE)

WILLIAM P. ADAMS AND NORMAN K. B. ROBSON

Recent intensive studies of the floral anatomy and taxonomy of *Hypericum* and the segregates *Ascyrum* and *Crookea* have led to a re-evaluation of the generic status of these groups. A general review and study of the floral anatomy of *Hypericum* and related genera by Robson (1956) indicates that the species belonging to *Ascyrum*, *Crookea* and the sections *Myriandra* and *Brathydium* of *Hypericum* are closely related to each other. Recent studies by Adams (1959) in the taxonomy of these species appear to confirm Robson's idea that they form a very natural group. In the following discussion we will present evidence supporting the reduction of the genera *Ascyrum* and *Crookea* to the more inclusive genus *Hypericum*.

Financial support of the senior author's studies in the taxonomy of *Hypericum* was provided by the following sources: the Fernald Fund for Study in Systematic Botany at Harvard University, established by Mr. F. W. Hunnewell of Wellesley, Massachusetts; a National Institute of Health grant-in-aid through the Department of Biology, Harvard University; and a research grant (RG-6305) to Dr. R. K. Godfrey of Florida State University from the Division of General Medical Studies, Public Health Service.

Ascyrum L., Gen. Pl. ed. 5. 342. 1754. Since it was first described by Linnaeus the genus *Ascyrum* has included those species having a tetramerous calyx and corolla, with two unequal pairs of sepals. The large genus *Hypericum* has long included those species with pentamerous corolla and calyx. Apparently the first author to challenge this classification was Crantz (1766) who transferred the *Ascyrum* species to the larger genus. Later authors, however, maintained *Ascyrum* as a distinct genus. During the past sixty years several taxonomists have questioned this segregation but, with the exception of Keller (1895), no one has attempted to revise the traditional classification. Coulter, in his treatment of the *Hypericaceae* for the *Synoptical Flora of North America* (1897), stated: "The propriety of a generic separation from *Hypericum* is very doubtful." In 1895 Keller treated *Ascyrum* as a section of *Hypericum*. Thirty years later, however, Keller (1925) reconsidered the problem and gave *Ascyrum* generic status but apparently with some misgivings for he remarked: "Die Gattung ist jedenfalls nur künstlich von *Hypericum* zu trennen." Recently, in a revision of the *Ascyrum* species by Adams (1957), the question was briefly discussed but it was decided to treat the species as members of *Ascyrum* until the closely related species of *Crookea* and *Hypericum* § *Myriandra* could be studied.

EVIDENCE FOR A MERGER OF ASCYRUM WITH HYPERICUM

THE FLOWER. The tetramerous calyx and corolla, characters which have been traditionally used to distinguish *Ascyrum* as a genus, occur not infrequently in many *Hypericum* species. In § *Myriandra*, 4-parted flowers have been observed in *H. ellipticum* Hook., *H. myrtifolium* Lam. and *H. galioides* Lam. and doubtless occur occasionally in other species. According to Milne-Redhead (1953), 4 sepals and petals may sometimes be found in the African *H. kiboense* Oliv. (§ *Humifusoideum*). Tetramery appears to be the normal condition in *H. filicaule* Dyer ex Hook. f. a species of *Hypericum* from the Sikkim Himalaya which Dyer considered to belong to *Ascyrum*. Robson (1956), however, showed it to be closely related to other Himalayan species in that section.

Flowers with pentamerous corollas, a characteristic which has been long used to separate *Hypericum* from *Ascyrum*, occur in *Ascyrum pumilum* Michx. Pentasepalous flowers have not yet been observed in *Ascyrum* although they occur not infrequently in *Crookea* (see below).

The genus *Ascyrum* has been further characterized by the presence of two unequal pairs of sepals. This condition is not uncommon in many species of *Hypericum* in which the sepals are unequal because of their quincuncial development. The first (or exterior) two are almost opposite and more or less equal, the third (with one margin exterior and the other interior) is smaller, and the fourth and fifth sepals (or interior ones) are smaller still and nearly equal in size and shape. Unequal sepals are characteristic of *H. macrosepalum* Rehder, *H. humifusum* L., *H. androsaemum* L., *H. filicaule*, and several species in *Hypericum* § *Myriandra*.

Floral characteristics common to *Ascyrum* and certain species of *Hypericum* include: persistent sepals and stamens; short to long styles; minute stigmas; lack of sepal articulation; petals which are yellow, convolute in the bud and usually quickly deciduous; numerous afascicular stamens; versatile anthers which dehisce laterally by longitudinal slits; 3 or 2 carpels; parietal placentation; dry, septicidal capsule; numerous small seeds; and an inflorescence which is obviously reduced to a single flower from a simple, 3-parted dichasium.

ANATOMY OF THE FLOWER. Except for tetramery, the anatomy of the flower in *Ascyrum* is very similar to that found in various species of *Hypericum* § *Myriandra*. The inner (smaller) sepals have unilacunar (not trilacunar) traces, but this is a common effect of reduction in the width of insertion of a foliage member (Robson, 1956).

VEGETATIVE BODY. In growth habit the species of *Ascyrum* are not unlike various members of *Hypericum* § *Myriandra.* The low, bushy, suffruticose form of *A. pumilum* Michx. and *A. multicaule* Michx. is paralleled by that of *H. buckleyi* S. Wats. The erect, shrubby nature of *A. stans* Michx. and *A. tetrapetalum* (Lam.) Vail is very similar to that of *H. cistifolium* Lam. and *H. myrtifolium* Lam.

Winged stems are present in *Ascyrum* species and occur in practically all sections of the genus *Hypericum.*

In *Ascyrum,* as well as in § *Myriandra* of *Hypericum,* the secretory structures in the leaves, sepals and stems are composed of translucent or pellucid-punctate glands which take the form of dots or vittae (elongate tube-like sacs). The black punctate glands which are typical of such herbaceous species as *H. punctatum* Lam. and *H. perforatum* L. are absent from these groups, however.

The leaves (as well as the sepals) of *Ascyrum* do not have a basal groove or articulation, a feature lacking in its closest relatives among the species of *Hypericum* § *Myriandra* as well. The leaf margin in *Ascyrum* is narrowed abruptly into a thin hyaline zone which is easily seen in living plants but becomes obscure in dried material. This characteristic is also present in several species of *Hypericum* § *Myriandra.*

ANATOMY OF THE STEM. A comparative study of the stem anatomy by Vestal (1937) showed that *Ascyrum* species differ very little, if any, from the woody members of the genus *Hypericum.* Furthermore, Vestal found "a very constant homogeneity" with "no segregation of anatomical groups possible" among the one hundred or more species of *Hypericum* which he studied.

CHROMOSOMES. The haploid number of nine is present in five of the six species of *Ascyrum* for which counts have been made (Adams, 1959). The same haploid number is present in at least eighteen members of *Hypericum* § *Myriandra* (Hoar and Haertl, 1932; Adams, 1959). It has been found also in several species of sections *Hypericum,* and *Triadenioidea.* In size and shape the meiotic chromosomes of *Ascyrum* and of § *Myriandra* are remarkably similar. No detailed karyotype analysis has been attempted on these species, however.

GEOGRAPHIC DISTRIBUTION. *Ascyrum* and its closest relatives in *Hypericum* § *Myriandra* are native only in eastern North America, especially the southeastern portion. Moreover, the other members of the section occur only in the same region.

Crookea Small, Fl. Southeastern U. S. 786, 1335. 1903. The single species comprising the genus *Crookea* was first described by Torrey and Gray (1838) as *Ascyrum microsepalum.* That it occupied an anomalous position in this genus was suggested by their remark: "This species differs from all the others of the genus in the somewhat equal and very small sepals, as well as in the long style: it has the habit of Hypericum." Many years later Sereno Watson (1878) transferred it to *Hypericum.* Coulter (1897) agreed with Watson, noting that this species showed very close affinity with *Hypericum* in all characteristics except, of course, the tetramerous flowers. In order better to accommodate this rather anomalous species, Small (1903) distinguished the monotypic genus *Crookea.* Later Keller (1925) treated it again as an *Ascyrum.* Recent studies (see below) suggest that both *Crookea* and *Ascyrum* are very closely related to § *Myriandra* of *Hypericum.*

EVIDENCE FOR A MERGER OF CROOKEA WITH HYPERICUM

THE FLOWER. The flowers of *Crookea* are like *Ascyrum* in being tetramerous, but the nearly equal size and shape of its two pairs of sepals are definitely suggestive of *Hypericum.*

Sepal and petal number in *Crookea* are very variable even in flowers on a single plant. Many individual plants may have only 4-parted flowers. Not infrequently, however, plants are found which have typical hypericaceous pentamerous flowers. The same plants may possess flowers which are "intermediate" in sepal and petal number, size, and shape. As regards the total number of perianth parts, flowers with 4 sepals and 5 petals, or 5 sepals and 5 petals have been observed. The sepals and petals of a single flower may differ in size and shape and one or more may be much smaller than the others; not infrequently, two petals or two sepals may be partially fused, presenting a doubled appearance. A detailed analysis of the flower variation in *Crookea* will be presented by the senior author in a forthcoming taxonomic study of its single species and its relatives in *Hypericum* § *Myriandra*.

All the other floral and vegetative morphological characteristics of *Crookea* occur as well in various *Hypericum* species. These include its low, bushy growth habit, winged stems, translucent secretory glands, numerous small seeds, absence of leaf and sepal articulation, rounded leaf margins, parietal placentation, and a haploid chromosome number of nine.

SUMMARY

To recognize *Crookea, Ascyrum* and *Hypericum* as distinct genera appears to us to require the use of rather arbitrary criteria as a means of delimiting these genera. An analysis of the constellation of morphological characteristics common to the species of *Crookea, Ascyrum* and certain species of *Hypericum* which suggest close genetic affinity indicates that they should be included in a single genus of which *Crookea* and *Ascyrum* represent extreme evolutionary developments.

The reduction of the genera *Crookea* and *Ascyrum* to *Hypericum* makes necessary the following nomenclatural changes:

Hypericum edisonianum (Small) Adams and Robson, comb. nov. Based on *Ascyrum edisonianum* Small, Man. Southeastern Fl. 868. 1933 [as *Edisonianum*].

Hypericum hypericoides (L.) Crantz, Institut. rei herbariae. 2:520. 1766. *Ascyrum Hypericoides* L., Sp. Pl. 2:788. 1753.

Hypericum microsepalum (T. & G.) Gray ex S. Wats., Biblio. index to N. Am. botany. 1:456. 1878. *Ascyrum microsepalum* T. & G., Fl. N. Am. 1:157. *Crookea microsepala* (T. & G.) Small, Fl. Southeastern U. S. 786, 1335. 1903.

Hypericum suffructicosum Adams and Robson, nom. nov. Based on *Ascyrum pumilum* Michx., Fl. Bor.-Am. 2:77. 1803. *Non Hypericum pumilum* Sesse & Moc., Fl. Mexic. ed. 2:177. 1894 [as *pumillum*].

Hypericum stans (Michx.) Adams and Robson, comb. nov. Based on *Ascyrum stans* Michx., Fl. Bor.-Am. 2:77. 1803.

Hypericum stragulum Adams and Robson, nom. nov. Based on *Ascyrum multicaule* Michx., Fl. Bor.-Am. 2:77. 1803. *Non Hypericum multicaule* Lam., Encyc. 4:178. 1797. *Ascyrum spathulatum* Spach, Hist. Nat. Vég. 5:462. 1836. *Non Hypericum spathulatum* (Spach) Steud., Nomencl. ed 2, 1:789. 1840, which was based on *Myriandra spathulata*.

Hypericum tetrapetalum Lam., Encyc. 4:153. 1797. *Ascyrum tetrapetalum* (Lam.) Vail in Small, Fl. Southeastern U. S. 785. 1903.

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CHROMOSOME NUMBERS OF SOME BRAZILIAN LEGUMINOSAE[1]

B. L. TURNER AND H. S. IRWIN

The junior author of this paper spent 5 months during 1958-59 in south-central Brazil collecting *Cassia* material in connection with a doctoral thesis problem. Since he was routinely collecting bud material of various species of this genus and shipping these air mail to the senior author for meiotic examination, he was able to include, as time and opportunity permitted, occasional bud collections of other

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taxa of the family Leguminosae. The present contribution summarizes the results of a study of this latter material.

Chromosome counts were made by the squash technique essentially as outlined by Turner (1956). Voucher specimens are deposited at The University of Texas Herbarium, the United States National Herbarium and elsewhere.

FIGURES 1-4. Camera lucida drawings of meiotic figures. FIG. 1. *Camptosema tomentosum* ($n = 11$). FIG. 2. *Centrosema coriaceum* ($n = 11$). FIG. 3. *Galactia martii* $n = 10$). FIG. 4. *Periandra mediterranea* var. *mucronata* ($n = 11$). All figures x ca. 2000.

TABLE 1. SPECIES OF BRAZILIAN LEGUMINOSAE EXAMINED FOR CHROMOSOME NUMBERS.

Species	Voucher collection	n number
CAESALPINIOIDEAE		
Bauhinia aff. *mollis* (Bong.) Walp.	GOIAS: *Irwin 2584.*	$n = 14$
Bauhinia rufa Steud.	MINAS GERAIS: *Irwin 2395.*	$n = 14$
Caesalpinia ferrea Mart.	MINAS GERAIS: *Irwin 2368.*	$n = 12$
Caesalpinia spinosa (Molina) Ktze.	MINAS GERAIS: *Irwin 2329.*	$n = 12$
Caesalpinia sp.	MINAS GERAIS: *Irwin 2331.*	$n = 12$
Copaifera langsdorffii Desf.	MINAS GERAIS: *Irwin 2394.*	$n = 12$
PAPILIONOIDEAE		
Aeschynomene elegans S. & C.	MINAS GERAIS: *Irwin 2081.*	$n = 10$
Camptosema tomentosum Benth.	MINAS GERAIS: *Irwin 2481.*	$n = 11$ (Fig. 1)
Centrosema coriaceum Benth.	MINAS GERAIS: *Irwin 2503.*	$n = 11$
Centrosema coriaceum Benth.	MINAS GERAIS: *Irwin 2366.*	$n = 11$ (Fig. 2)
Crotalaria stipularia Desv.	MINAS GERAIS: *Irwin 2006.*	$n = 16$
Crotalaria striata Schrank	MINAS GERAIS: *Irwin 2018.*	$2n = 16$
Crotalaria sp.	MINAS GERAIS: *Irwin 2463.*	$n = 8$
Galactia martii DC.	MINAS GERAIS: *Irwin 2406.*	$n = 10$ (Fig. 3)
Galactia martii DC.	MINAS GERAIS: *Irwin 2506.*	.. $n = 10$
Indigofera cf. *truxillensis* H.B.K.	MINAS GERAIS: *Irwin 2176.*	$n = 8$
Periandra mediterranea (Vell.) Taub.	MINAS GERAIS: *Irwin 2504.*	$n = 11$
Periandra mediterranea var. *mucronata* (Benth.) Burk.	MINAS GERAIS: *Irwin 2393.*	$n = 11$ (Fig. 4)

CAESALPINIOIDEAE — Chromosome counts for species in the genus *Bauhinia* ($n = 14$) and *Caesalpinia* ($n = 12$) are consistent with reports for other species in these taxa (Darlington and Wylie, 1956). Including the present (Table 1), only 3 species of *Copaifera* have counts reported for them, 2 from South America and one from Africa (Mangenot and Mangenot, 1957). All were diploid with $n = 12$.

PAPILIONOIDEAE — Chromosome counts for species of *Aeschynomene* ($n = 10$), *Crotalaria* ($n = 8$), *Galactia* ($n = 10$) and *Indigofera* ($n = 8$) are consistent with the basic numbers already established for these genera. The chromosome number of *Centrosema coriaceum* ($n = 11$; fig. 2) differs from that of the other three species of the genus reported. All of the latter are diploid with $n = 10$ (Frahm-Leliveld, 1957).

Chromosome counts for taxa of *Camptosema* ($n = 11$) and *Periandra* ($n = 11$) are first reports for these genera.

SUMMARY

Chromosome counts for 17 taxa of Brazilian Leguminosae are reported, these include first reports for 15 species and two genera (*Periandra*, $x = 11$, and *Camptosema*, $x = 11$). *Centrosema coriaceum* ($n = 11$) was found to have a different basic number than has been previously reported for the genus. — BOTANY DEPARTMENT AND THE PLANT RESEARCH INSTITUTE, UNIVERSITY OF TEXAS, AUSTIN.

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A DECADE OF BOTANIZING IN ILLINOIS

ROBERT H. MOHLENBROCK

The publication of Flora of Illinois, Second Edition (Jones, 1950) brought up to date the vascular plants known to occur in the state and at the same time fortunately paved the way for intensive botanizing throughout the state. As documentation for this renewed research on the Illinois flora, no less than eighty publications have appeared since 1950, many of them recording species previously unreported from Illinois. Efforts have been concentrated throughout the state — in the Chicago region by Steyermark, Swink, and Thieret, in the northwestern section by E. W. Fell, in the east central area by Jones and Ahles, in the west central section by V. Chase, Dobbs, Rexroat, and Winterringer, and in southern Illinois by Voigt and the writer. In addition, Evers has collected extensively throughout the state.

Flora of Illinois (l.c.) enumerated 730 genera and 2202 species. In the subsequent decade, 71 genera and 350 species have been added, representing a thirteen per cent increase in the species total. Of these, 64 are species which are considered native to Illinois. It is these latter that are considered the most significant new finds to Illinois, since they denote natural range extensions. The area of greatest concentration of these newly found Illinois plants is across the extreme southern portion of Illinois, in or near the vicinity of the Shawnee Hills. Fifty-three of the 64 are known from 10 extreme southern counties.

Several of the species fill in previously existing gaps in the distribution, while others mark extensions in the ranges. These are enumerated below according to their distribution.

In addition, two endemics have been described from Illinois since 1950. These are *Aster chasei* G. N. Jones from Marshall, Peoria, and Tazewell counties and *Cyperus grayioides* Mohlenbrock from Mason and Whiteside counties.

NATIVE SPECIES FILLING IN GAPS IN DISTRIBUTION

Asplenium bradleyi
Glyceria pallida
Carex austrina
Carex atherodes
Carex caroliniana
Carex digitalis
Carex swanii
Carex torta
Carex texensis
Carex debilis
Lemna valdiviana
Juncus diffusissimus
Juncus secundus
Polygonatum biflorum
Smilax herbacea
Pilea fontana
Draba cuneifolia
Rubus alumnus
Vitis lincecumii
Penstemon alluviorum
Dicliptera brachiata
Ruellia caroliniensis
Eupatorium fistulosum
Rudbeckia bicolor
Solidago buckleyi
Solidago rugosa

NATIVE SPECIES EXTENDING RANGE TO THE NORTH

Scirpus koilolepis
Carex oxylepis
Carex physorhyncha
Allium mutabile
Aristolochia nashii
Crataegus collina
Prunus mexicana
Hypericum lobocarpum
Heliotropium tenellum
Gerardia fasciculata
Galium virgatum

NATIVE SPECIES EXTENDING RANGE TO THE NORTHWEST

Carex decomposita
Carex striatula
Carex styloflexa
Arisaema pusilla
Wolffiella floridana
Trillium cuneatum
Tipularia discolor
Gaura filipes
Solidago boottii

NATIVE SPECIES EXTENDING RANGE TO THE NORTHEAST

Isoetes butleri
Ranunculus harveyi
Jussiaea leptocarpa
Penstemon arkansanus
Solidago strigosa

NATIVE SPECIES EXTENDING RANGE TO THE EAST

Talinum calycinum
Viola viarum
Vernonia crinita

NATIVE SPECIES EXTENDING RANGE TO THE SOUTHEAST

Pilea opaca

NATIVE SPECIES EXTENDING RANGE TO THE SOUTHWEST

Lycopodium flabelliforme
Carex emmonsii
Trillium erectum
Solidago uliginosa

NATIVE SPECIES EXTENDING RANGE TO THE WEST

Rubus enslenii

NATIVE SPECIES SHOWING DISJUNCT DISTRIBUTIONS

Bromus nottowayanus
Lipocarpha maculata
Scleria reticularis
Cimicifuga cordifolia

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NEW COMBINATIONS IN GRASSES[1]

JULIAN A. STEYERMARK AND C. L. KUCERA

During the course of study of the grass flora of Missouri, the authors have found it necessary to change the categories of several taxa, resulting in the following new combinations:

Glyceria septentrionalis Hitchc. var. **arkansana** (Fern.) Steyerm. & Kucera, comb. nov., based on *Glyceria arkansana* Fern., Rhodora 31: 49. 1929.

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[1] Work on this paper was completed during the period when the senior author received grants-in-aid (G 5623, 7117) from the National Science Foundation.

Muhlenbergia Schreberi Gmel. var. **curtisetosa** (Scribn.) Steyerm. & Kucera, comb. nov., based on *M. Schreberi curtisetosa* Scribn., Rhodora **9**: 17. 1907 (as subspecies); *M. curtisetosa* (Scribn.) Bush, Am. Midl. Nat. **6**:35. 1919.

As suggested by Gleason (New Ill. Fl. **1**: 174. 1952), *M. curtisetosa* appears to be of doubtful taxonomic status as a species, and seems better regarded as a variety of *M. Schreberi,* which it closely resembles in general appearance.

Sporobolus clandestinus (Bieler) Hitchc. var. **canovirens** (Nash) Steyerm. & Kucera, comb. nov., based on *Sporobolus canovirens* Nash, in Britton, Man. 1042. 1901; *S. asper* var. *canovirens* (Nash) Shinners, Rhodora **56**: 30. 1954.

There is intergradation in spikelet length, relative length of palea and lemma, and degree of prolongation of the palea between *S. clandestinus* and *S. canovirens.* In the extremes of their variation, the two taxa appear quite distinct, but the frequent occurrence of transitional specimens which are difficult to place would indicate the reduction to varietal rank. Since both *S. clandestinus* var. *clandestinus* and var. *canovirens* possess pubescent lemmas, it is believed that this character warrants their being treated as varieties of *S. clandestinus,* rather than merged, as Shinners has done, as varieties of *S. asper,* which possesses glabrous lemmas.

Sporobolus neglectus Nash var. **ozarkanus** (Fern.) Steyerm. & Kucera, comb. nov., based on *Sporobolus ozarkanus* Fern., Rhodora **35**: 109. 1933; *S. vaginiflorus* var. *ozarkanus* (Fern.) Shinners, Rhodora **56**: 29. 1954.

The glabrous and short, pointed lemmas, together with the relatively less elongated apex of the palea apparently relate *S. ozarkanus* more closely to *S. neglectus* than to *S. vaginiflorus.* The relatively longer spikelets of *S. ozarkanus,* together with the strongly ciliate orifices of the leaf-sheaths, are points of resemblance between *S. ozarkanus* and *S. vaginiflorus,* but occasional specimens of *S. neglectus* var. *neglectus* also exhibit ciliate orifices. The strongly ciliate orifices of the leaf-sheaths, believed by Fernald to be characteristic of *S. ozarkanus,* cannot be considered a distinguishing feature of that taxon.

Leptochloa filiformis (Lam.) Beauv. var. **attenuata** (Nutt.) Steyerm. & Kucera, comb. nov. based on *Oxydenia attenuata* Nutt. Gen. Pl. 1: 76. 1818; *Leptochloa attenuata* (Nutt.) Steud., Syn. Pl. Glum. 1: 209. 1854.

In their extremes, *Leptochloa filiformis* and *L. attenuata* appear to be distinct. However, many intergradations are found among specimens in Missouri with both types sometimes appearing together. In general, *L. filiformis* var. *filiformis* is taller, attaining 1.2 m. in height, and the inflorescence is often larger with 20-100 stiff spikes, while *L. filiformis* var. *attenuata* is usually of shorter stature, and the inflorescence is usually smaller with only 10-30 flexuous spikes. Unfortunately, tall-growing plants, characteristic of *L. filiformis* var. *filiformis*, are found with the aristate glumes and smaller lemmas characteristic of *L. filiformis* var. *attenuata*, while low-growing plants, characteristic of *L. filiformis* var. *attenuata*, occur with the acute glumes and larger lemmas characteristic of *L. filiformis* var. *filiformis*. The same lack of correlation is noted occasionally between the greater or lesser length of the glumes with respect to the upper floret and the height of the plant. Deam (Grasses of Indiana, p. 198. 1929) also had difficulty in determining whether a specimen placed by him in *Leptochloa attenuata* should warrant specific or varietal status. — INSTITUTO BOTANICO DEL MINISTERIO DE AGRICULTURA Y CRIA, CARACAS, VENEZUELA, AND UNIVERSITY OF MISSOURI, COLUMBIA, MISSOURI.

RHODODENDRON MAXIMUM IN HOPKINTON AND HARRISVILLE, NEW HAMPSHIRE

A. R. Hodgdon and Radcliffe Pike[1]

It becomes apparent that some of the many early reports by non-botanists of Rhododendron colonies in New Hampshire may be accurate, the occurrence in Hopkinton being a case in point. In 1874, C. S. Hitchcock stated that *Rhododendron maximum* grew in that township. On page 543 of volume I of his "Geology of New Hampshire" he made

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[1] Published with the approval of the Director of the New Hampshire Agricultural Experiment Station as Scientific Contribution No. 249.

the following comment as part of a general discussion of the few and scattered colonies of the species in the State, "— I have got traces of it in Hopkinton and Hooksett." It is certain from Hitchcock's other comments that he knew the plant well. But it is by no means clear that he had more than verbal assurance that it grew wild in these two townships; nor does he state who his informants were. We have been inclined to rule out of consideration all such reports because in our own experience we have found that most of the general public in Maine and New Hampshire do not know *R. maximum.* In this instance however, the report of a station in Hopkinton proves to be authentic.

Early in March 1959, Mr. Henry Mock, a senior at the University of New Hampshire and a resident of Contoocook brought us a specimen from a small wild colony which he stated grew on the farm of a Mr. Frank Kimball in Hopkinton. On June 2 we were shown the colony by Mr. Mock and Mr. Kimball. The stand is particularly vigorous and luxuriant with rather uniform stems some of the tallest of which were 12 or more feet high. There were few flower-buds for the current season and there were no seedlings nor small plants in the area, in this respect differing markedly from most of the other stands in both Maine and New Hampshire where seedlings and young plants are often numerous. The colony is rectangular in shape and is about 50 feet wide by 150 feet long. The regular shape of the colony, the uniform growth and the absence of young plants made it seem planted rather than wild. However, Mr. Kimball convinced us that the colony was quite natural. He recalled his father Herbert Kimball, who was born about 1862, stating that in his youth, the colony was vigorous, but that somewhat later (about 65 years ago according to Frank Kimball), the bigger protecting trees were cut off for lumber, after which the Rhododendrons declined seriously. In recent years with the growth of suitable species of shading and protecting trees in the vicinity of the stand it has made a remarkable recovery.

The Harrisville Rhododendrons to our knowledge have not been reported previously. Mr. Tudor Richards of Dublin first learned of this colony from local residents a few months ago and made arrangement with Mr. Merle Jones of Hancock who guided Mr. Richards and the senior author to the station on June 9, 1960. This part of Harrisville and adjacent Hancock is heavily wooded with considerable swampland and intervening rocky upland. The colony is very close to the Hancock line and is about three quarters of a mile east of Skatutakee Lake.

Rhododendron plants are found over a total area of about one half acre. A dense growth of middle-sized to large shrubs occupies the wetter places while an equal quarter acre of drier footing on the eastern side has some isolated large plants as well as some scattered small individuals which must have started as seedlings in recent years. While a few plants are close to 10 feet in height, most of them fall short of this. It is evident that the plants comprising this colony have not yet attained their full growth: at least in other colonies that we have studied the biggest plants have nearly always been considerably taller than those in Harrisville. Here the older plants of earlier times presumably have been replaced by seedlings or rejuvenated sprout growth. This is a colony that undoubtedly will be improving during the next few years.

This makes a total of 11 townships in which we have observed wild stands of Rhododendron in New Hampshire. These are Albany, Pittsfield, Barnstead, Hopkinton, Grantham, Manchester, Mason, Wilton, Fitzwilliam, Harrisville and Richmond. Are there still other stations in New Hampshire? In "The History of Weare" by William Little published in 1888 there is mention of the occurence of both Mountain laurel and Rhododendron in the township. Leander W. Cogswell in 1880 in his "History of the Town of Henniker" states that "rhododendron or river laurel adorns banks of Contoocook" which might refer to *Kalmia latifolia.* We have been told of a colony near the eastern end of Squam Lake probably in Sandwich. Thus there may be other stations but it seems to us that we have now a fairly complete list of Rhododendron colonies in New Hampshire. Several years of diligent sleuthing on our part have resulted in disclosing only one New Hampshire station (Harrisville) that had not been reported in some published work. And this stand was well enough known locally to be a topic of conversation at a party. — DEPARTMENT OF BOTANY AND DEPARTMENT OF HORTICULTURE, UNIVERSITY OF NEW HAMPSHIRE, DURHAM, NEW HAMPSHIRE.

CAMPANULAR PERSISTENCE. — While walking on the railroad in Randolph, N. H., near the former station of Appalachia, in the summer of 1920, I observed, on a gravelly embankment, one good-sized clump, about six inches in diameter and the same in height, of a many-stemmed *Campanula,* with small pale blue flowers on naked flexuous peduncles. Leaving most of the plant undisturbed, I placed a portion in the herbarium of the New England Botanical Club *(Pease 18093),* and by analysis and comparison with specimens in the Gray Herbarium identified the plant as *Campanula divaricata* Michx., which is now described in the eighth edition of Gray's *Manual* as growing "in dry woods and rocky slopes, w. Md.,W.Va. and Ky.,s. to. Ga. and Ala." In my *Vascular Flora of Coös County, N. H.* (1924), p. 345, I have reported the plant as rarely adventive and persistent in 1923.

Over the years from 1923 to the present I have watched the fate of this little pilgrim, and several years ago, when the railroad track was heavily reballasted with unpromising gravel, found its site deeply buried. For several years I considered it as gone beyond recovery, but then it rose again from the gravel, and my annual visits recommenced. Then came another calamity; some four or five years ago the track was again reballasted, this time with even more unpromising cinders, and I had again to mourn the loss of the *Campanula.* This summer (1960) it occurred to me to look again, and lo! there again it was at its accustomed place, rising through cinders as it had previously through gravel.

Forty years, then, at least — for I do not know how long before 1920 it was first established here — this delicate little plant has survived an austere diet and violent attacks upon its security. It shows no disposition to increase, but whether this may be due to a lack of the insects needed to fertilize it or to other causes I know not.

Mr. Walter Deane reported to the Botanical Club (RHODORA 4:243-244; 10:203-204) on the persistence of *Cephalanthus occidentalis* L. for 43 years in a pig-sty at Shelburne, N. H.; equally or perhaps even more notable is the experience of this delicate little wild-flower, about eight feet from a heavily ballasted railroad track and at least five hundred miles from its natural home. — ARTHUR STANLEY PEASE, RANDOLPH, N. H.

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NOTES ON LESSER ANTILLEAN FERNS

GEORGE R. PROCTOR

During the current preparation of a volume on the Pteridophytes for the forthcoming "Flora of the Lesser Antilles"[1], at least five new species have come to light, and a number of new combinations have become necessary. The purpose of the present paper is to describe three of these new species,[2] and to make a total of 17 new combinations.

HYMENOPHYLLACEAE

Trichomanes trigonum Desv., var. **fimbriatum** (Backh.) Proctor, comb. nov., based on *Trichomanes fimbriatum* Backh., Cat. 12. 1861; Gard. Chron. 1862:44. Syn. *T. superbum* v.d.B., Ned. Kr. Arch. 5^3:203. 1863 (not Backh., 1862).

CYATHEACEAE

Cyathea hodgeana Proctor, sp. nov.

Caudex 5 m. altus, 7.5 cm. diametro, gemma apicali squamis brunnescentibus nitidis eroso-ciliatis dense obtecta. Stipites atrobrunnei minutissime et sparse puberuli, inermes, basi paleis deciduis eis gemmae apicalis similibus obtecti. Laminae ovatae, bipinnato-pinnatifidae, ca. 1 m. longae. Rhachides primariae et secundariae brunneae et dense pallido-brunneo-furfuraceae; rhachidibus secundariis et costis

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[1] This research supported by Grant No. G-4441 from the National Science Foundation, Division of Biological and Medical Sciences, for work on the flora of the Lesser Antilles in cooperation with Dr. Richard A. Howard of the Arnold Arboretum, Harvard University.

[2] Special thanks are due to Dr. L. M. Perry of the Arnold Arboretum, Harvard University for the preparation of the three Latin diagnoses.

supra dense brunneo-pubescentibus, subtus costis brunneas planas paleas numerosas ferentibus, et costulis minutas bullatas paleas pallido-brunneas ferentibus. Pinnae articulatae, anguste oblongae, usque ad 30 cm. longae et 11 cm. latae acuminatae, longe petiolulatae (petiolulis usque ad 1.5 cm. longis). Pinnulae lineari-oblongae, pinnatifidae, usque ad 5.5 cm. longae et 1.1 cm. latae, acutae vel subacuminatae, petiolulatae (petiolulis 1-2 mm. longis). Segmenta oblonga, usque ad 4 mm. longa et 2.5 mm. lata, apice rotundata vel obtusa, crenulata. Venae 4-5 ad latera, simplices vel uni-furcatae. Sori supramediani, lamina supra eis scrobiculata. Indusium nullum. Receptaculum parvum, capitatum, paraphyses capillares ferens.

TYPE from moist forests bordering the Pegoua River in vicinity of Deux Branches, Dominica, West Indies, *W. H. & Barbara T. Hodge 3420*, collected May 6 & 7, 1940 (Holotype in the Gray Herbarium, consisting of 3 sheets).

Cyathea imrayana Hook., var. **caribaea** (Jenm.) Proctor, comb. nov., based on *Cyathea caribaea* Jenm., Ferns B.W.I. & Guiana 57. 1898.

Cnemidaria grandifolia (Willd.) Proctor, comb. nov., based on *Cyathea grandifolia* Willd., Sp. Pl. 5:490. 1810.

POLYPODIACEAE

Nephrolepis falcata (Cav.)C.Chr., forma **furcans** (Moore in Nicholson) Proctor, comb. nov., based on *N. davallioides* [var. ?] *furcans* Moore in Nicholson, Dict. Gard. 2:445, *fig. 682.* 1885; Schneider, Book of Choice Ferns 2: 590-592, *fig. 144.* 1893. ?Syn. *N. exaltata* var. *monstruosa* v.A.v.R., Malayan Ferns 162. 1908. This entity is usually filed in herbaria as a form of *N. biserrata*, but the present writer considers this identification to be incorrect. It is now associated with *N. falcata* on the basis of comparison with New Guinea specimens identified as that species in the herbarium of the Arnold Arboretum. However, it should be noted that the type of *N. falcata* came from the Philippines, and differs from the New Guinea material in having a scaly rachis. A monographic study of these plants will probably demonstrate that the New Guinea and Philippines populations are at least varietally distinct. Forma *furcans* is definitely allied with the New Guinea taxon. According to Schneider, forma *furcans* was first introduced into European cultivation from Australia; the West Indian plants probably originated from descendants of these Australian plants cultivated in England.

Thelypteris muscicola Proctor, sp. nov.

Rhizoma erectum apice paleaceum, paleis ligulato-attenuatis, usque ad 8 mm. longis, 1-1.5 mm. latis, brunneis, sparse pubescentibus. Stipes plerumque 9-15 cm. longus, glaber. Lamina pinnato-pinnatifida, oblongo-lanceolata vel lanceolata, 45-80 cm. longa, 15-22 cm. lata, apice acuminata, basi abrupte angustata, cum pinnis perreductis 2-4-jugis. Rhachis et costae supra strigillosae, subtus fere glabrae; pilis omnibus acicularibus, non hamatis. Pinnae lineari-lanceolatae usque ad 2 cm. latae, sessiles, alte pinnatifidae. Segmenta oblonga, rotunda vel apice subacuta, plana, 3-4 mm. lata. Venae 6-10-jugae, simplices, segmentis basalibus exceptis. Sori supramediales ovales. Indusium ciliatum erectum margini longo cum vena conjunctum. Sporangia glabra.

TYPE from mossy woodland on upper west slope of Nevis Peak, Nevis, West Indies, elev. 2500-3000 ft., *Proctor 19354*, collected March 5, 1959 (Holotype in the Arnold Arboretum Herbarium; isotypes at the Institute of Jamaica and the State University of Utrecht).

This species differs from *T. germaniana* by its glabrous stipes and tissue beneath, by the lack of hamate hairs, and by the elongate, laterally-attached indusium. It differs from *T. hydrophila* by its very much greater size; by the longer, darker, less hairy rhizome-scales; by the rachis being nearly glabrous beneath, and lacking aerophores at the bases of the pinnae; and by the smaller indusium which lacks minute capitate glands. To no other West Indian species does it bear any near resemblance.

Thelypteris antillana Proctor, sp. nov.

Rhizoma breve erectum dense paleaceum; paleis anguste deltoideo-lanceolatis, usque ad 8 mm. longis, spadiceis, pubescentibus aliquando dentatis. Stipes plerumque 5-22 cm. longus, basi paleaceo, undique puberulus et minute capitato-glandulosus. Lamina pinnato-pinnatifida, lanceolata usque ad 50 cm. longa, 17 cm. lata, apice acuminata, basi abrupte angustata, cum pinnis perreductis 1-3-jugis. Rhachis minute capitato-glandulosa; partibus omnibus undique minute pubescentibus, subtus pilis in parte hamatis. Pinnae lineari-lanceolatae, usque ad 1.5 cm. latae acuminatae, sessiles, alte pinnatifidae. Segmenta numerosa anguste oblonga acuta, margine revoluto 2-3 mm. lato. Venae 7-10-jugae, integrae. Sori rotundi, mediales vel supramediales. Indusium persistens, dense longi-ciliatum. Sporangia glabra.

TYPE from stunted elfin woodland on upper southwest spur of Verchild's Mountain, below Dodans (Dos D'Ans) Pond, St. Kitts, West Indies, elev. 2500-2700 ft., *Proctor 19587*, collected March 19, 1959

(Holotype in the Arnold Arboretum Herbarium; isotype at the Institute of Jamaica). Additional material: ST. KITTS, *Britton & Cowell 529*, from summit of Mt. Misery, collected in 1901 (NY, US); this number was reported with doubt as *Dryopteris oligocarpa* by C. Christensen, Smiths. Misc. Coll. **52**: 371. 1909. A duplicate at the U. S. National Herbarium (perhaps the same sheet seen by Christensen) has been identified by C. V. Morton as *D. hydrophila*, but this material differs from the latter species in a number of significant details. DOMINICA, *W. H. & Barbara T. Hodge 1857*, from between Laudat and Freshwater Lake (GH).

This species is very closely related to *T. oligocarpa*, as shown especially by the nature of the hairs on the underside of the blade. It differs from that variable species, however, by its larger, much more chaffy rhizome-scales; by its medial or slightly supramedial (instead of nearly marginal) sori; and by its persistent, long-ciliate indusia. Comparison with various South American relatives of *T. oligocarpa* has failed to disclose any material that could be considered conspecific.

T. antillana averages about twice the size of *T. hydrophila*, and further differs from the latter in its puberulent and minutely capitate-glandular stipes, by lacking aerophores along the rachis at base of pinnae, by having more numerous veins per segment (usually 7 - 10 pairs instead of 5 - 6), and by the larger indusium on which none of the hairs are glandular.

Thelypteris invisa (Swartz) Proctor, corrected citation (based on *Aspidium invisum* Swartz, Jour. Bot. Schrad. **1800**^{2}:34. 1801. Syn. *Nephrodium invisum* (Swartz) Desv., Mém. Soc. Linn. Paris **6**:257. 1827); incorrectly given as "(Desv.) Proctor" in Rhodora **61**:306. 1959 (1960). I am indebted to Mr. C. V. Morton for pointing out this necessary correction.

Ctenitis protensa (Afz.) Copel., var. **funesta** (Kunze) Proctor, comb. nov., based on *Aspidium funestum* Kunze, Linnaea **9**:96. 1834. Alston (Kew Bull. **1932**:309) raised this entity to specific rank (as *Thelypteris*), but the present writer prefers to follow Christensen in associating it at the varietal level with the typically African *C. protensa*.

Ctenitis excelsa (Desv.) Proctor, comb. nov., based on *Polypodium excelsum* Desv., Mém. Soc. Linn. Paris **6**:243. 1827.

Syn. *Dryopteris excelsa* (Desv.)C.Chr., Ind. Fil. 264. 1905 (excl. syn.).

Dicranoglossum desvauxii (Klotzsch)Proctor, comb. nov., based on *Taenitis desvauxii* Klotzsch, Linnaea **20**:431. 1847. Syn. *Eschatogramme desvauxii* (Klotzsch) C.Chr., Dansk Bot. Ark. **6**(3) :37. 1929. The generic name *Eschatogramme* was published as a *nomen nudum* and must be rejected in favor of *Dicranoglossum* J.Sm., Bot. Voy. Herald 232. 1854. This has been pointed out previously by Pichi-Sermolli, Webbia **9**:365. 1953.

Grammitis serricula (Fée)Proctor, comb. nov., based on *Polypodium serricula* Fée, Gen. Fil. 238. 1852.

Grammitis knowltoniorum (Hodge)Proctor, comb. nov., based on *Polypodium knowltoniorum* Hodge, Amer. Fern Jour. **31**(3) :105, *pl.1, figs. 4-6*. 1941.

Grammitis anfractuosa (Kunze ex Klotzsch)Proctor, comb. nov., based on *Polypodium anfractuosum* Kunze ex Klotzsch, Linnaea **20**:375. 1847. Syn. *Polypodium induens* Maxon, Bull. Torr. Bot. Club **32**:75. 1905.

Grammitis jubaeformis (Kaulf.)Proctor, comb. nov., based on *Polypodium jubaeforme* Kaulf., Flora **6**:364. 1823.

Grammitis tenuicula (Fée)Proctor, comb. nov., based on *Polypodium tenuiculum* Fée, Gen. Fil. 239. 1852.

Grammitis taxifolia (L.)Proctor, comb. nov., based on *Polypodium taxifolium* L., Sp. Pl. 1086. 1753.

Grammitis pendula (Swartz)Proctor, comb. nov., based on *Polypodium pendulum* Swartz, Prodr. Veg. Ind. Occ. 131. 1788.

Grammitis sericeolanata (Hooker)Proctor, comb. nov., based on *Polypodium sericeolanatum* Hooker, Sp. Fil. **4**:221. 1862.

Grammitis cultrata (Willd.)Proctor, comb. nov., based on *Polypodium cultratum* Willd., Sp. Pl. **5**:187. 1810.

Grammitis mollissima (Fée) Proctor, comb. nov., based on *Polypodium mollissimum* Fée, Mém. Foug. **11**:47, *pl.12, fig.2*. 1866. — INSTITUTE OF JAMAICA, KINGSTON, JAMAICA, WEST INDIES.

A NEW NAME FOR THE PUBERULENT SESSILE-LEAVED UVULARIA

ROBERT L. WILBUR[1]

For more than three-quarters of a century the puberulent sessile-leaved bellwort, which has a range extending from New Jersey and Pennsylvania south to Georgia and as far west as West Virginia and Tennessee, was known scientifically as *Uvularia puberula*, the name given to it by Michaux in 1803. Asa Gray in 1839, as reported by Fernald (Rhodora 41:537. 1939) identified the specimen in Walter's herbarium, upon which "Anonymos pudica" was based, as *Uvularia puberula*. He made no new combination since the convention generally followed by Gray adopted the first epithet given to a species in the accepted genus as its proper binary name.

In segregating the sessile-leaved species as the genus *Oakesia*, Sereno Watson in 1879 provided the new combination *O. puberula*. A new complexity was introduced in 1889 by N. L. Britton who described what has proven to be the glabrous variant of this species as "*Oakesia sessilifolia* var. (?) *nitida*." In 1893 Morong provided the combination "*Uvularia sessilifolia nitida*" and by 1908 Mackenzie had concluded that the plant from the New Jersey pine-barrens was more closely related to *U. puberula*. However, thinking its differences to be of specific rank, he made the combination *U. nitida*. Prior to Mackenzie's publication, however, Small, agreeing that the sessile-leaved bellworts were generically distinct from *Uvularia*, published the name *Oakesiella*. This was necessary since Watson's *Oakesia* (1879) was a later homonym of *Oakesia* Tuckerm. (1842), a later synonym of *Corema* D. Don (c.1826), a genus in the Empetraceae. *Oakesia*, it might be noted in passing, was a perfectly permissible generic name in the Liliaceae under the International Code until about 1935 but such names were always taboo

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[1] Grateful acknowledgment is made to the National Science Foundation for a grant of research funds to Duke University (NSF-Grant 5636) which make the present study possible.

under the provisions of the Code under which Small published (see Canon 16 b, Bull. Torrey Club 31:257. 1904). Small's new generic name in his Flora of 1903 required among others the accompanying new combination of *Oakesiella puberula.* In 1933 Small maintained the genus *Oakesiella* and, overlooking the combination *O. nitida* made by Heller in 1910, in the appendix of the Manual again made the combination *O. nitida* although attributing it to Mackenzie.

Fernald (Rhodora 37:407-409. 1935) discussed the thinner-leaved, glabrous variant and provided the combination *U. puberula* var. *nitida.* Four years later Fernald (Rhodora 41:536-538. 1939), investigating the "*Anonymos pudic.*" of Walter, concluded that there was no reason to doubt Asa Gray's determination. He therefore made two new combinations, *U. pudica* and *U. pudica* var. *nitida,* even though such names based upon *Anonymos* of Walter "were subject to ridicule by some of the younger English botanists."

In the nomenclatural sessions of the 1950 Stockholm Congress however these "younger English botanists" including and led by the then septuagenarian Dr. T. A. Sprague prevailed upon the majority of the delegates to declare definitely illegitimate "binary combinations of a specific epithet with the word Anonymos." (Article 23). The price of this insistence upon consistency will be at least nineteen changes in citation which have been largely ignored by most American taxonomists. Unfortunately a new combination is required for the above discussed bellwort.

Almost all of these necessary changes in citation will result merely in the appearance of the relatively unfamiliar J. F. Gmelin, the author of the 13th edition of Linnaeus' Systema Naturae, in place of the long-familiar Thomas Walter. Gmelin's Systema appeared in 1791, only three years after Walter's Flora, and for the most part Walter's species were included there. Most of the "Anonymos" genera were either assigned new generic names or their species included in previously established genera. Gmelin however sometimes made no reference whatever to Walter's species and once provided an entirely new epithet.

Turning then to Gmelin (Syst. Nat. ed. 13. 2:546. 1791), we find the following:

> 414. ERYTHRONIUM. *Cor.* 6 petala, campanulata. *Nectario* tuberculis 2 petalorum alternorum basi adnatis.
>
> Dens canis. 1. E. foliis oppositis. *Jacq. fl. austr.* 5. *app. t.* 9.
> carolinianum. 2. E. foliis alternis. *Walt. flor. carol.* p. 122.

Index Kewensis wrongly attributed *Erythronium carolinianum* to Walter's Flora (p. 122), (an obvious error since the genus *Erythronium* is not included as such) and equated the name to the synonymy of *Erythronium americanum* over which, if true, it would have priority. For "*Anonymos pudica*", however, which of course is the same plant, Index Kewensis equates it to *Uvularia perfoliata.* This determination is in accord with the disposition of this name by Michaux (Fl. Bor.-Am. 199. 1803). Dietz (Ann. Mo. Bot. Gard. 39:225. 1952) argues that "the name *Uvularia pudica* should be discarded and Michaux's *U. puberula* restored." His stated reason was that Walter described the plant as having "foliis amplexicaulibus" which Dietz felt not to be true. The term "amplexicaule" is not too far from the mark for the sessile leaves, even in fruiting specimens, are often so broadly rounded at base that they do "clasp the stem." Even Michaux, whose name Dietz accepts, described the leaves of this species as "subamplexicaulibus".

Fernald has quoted notes, (Rhodora 41:537. 1939) made in 1839, in which Gray, while examining the contents of Walter's herbarium, wrote that "*Anonymos* (Erythronio aff.) *pudica!* = *Uvularia puberula.*" Certainly Asa Gray would never have mistaken *U. puberula* for one of the perfoliate species; as Fernald wrote "there is no reason to doubt Gray's identification; there is every reason to accept it."

Apparently the first author to recognize this species following Walter was J. F. Gmelin in 1791. This work in regard to Walter's species at least, was merely a compilation. The new species described under *Anonymos* by Walter were either provided with new generic names, utilizing no more information than provided by Walter and in most cases providing far less, or assigned to an established genus. Following Walter's hint ("Erythronio affinis?") as to the affinities of this species, Gmelin made it the second species of *Erythronium* but substituted the epithet *carolinianum*. Such a substitution by Gmelin is legitimate by our present Code since Walter's epithets with "Anonymos" are no longer "taken into consideration for purposes of priority". Hence the puberulent sessile-leaved bellwort again must submit to a change in name. In the formal listing of synonymy below I include those names intended to apply to the glabrous or nearly glabrous representative which I do not believe merits formal recognition.

Uvularia caroliniana (J. F. Gmelin) Wilbur, comb. nov.

Anonymos pudic. Walt., Fl. Car. 123. 1788. *nom. illeg.* Art 23. *Erythronium carolinianum* J. F. Gmel., Syst. Nat. ed. 13. **2**: 546. 1791. *Uvularia puberula* Michx., Fl. Bor.-Am.**1**: 199. 1803. *Oakesia puberula* (Michx.) S. Wats., Proc. Am. Acad. **14**: 269. 1879. *Oakesia sessilifolia* var. (?) *nitida* Britt., N. Y. Acad. Sci. **9**: 13. 1889. *Uvularia sessilifolia nitida* (Britt.) Morong, Mem. Torrey Club **5**: 111. 1893. *Oakesiella puberula* (Michx.) Small, Fl. SE. U. S. 271. 1903. *Uvularia nitida* (Britt.) Mackenzie, Torreya **8**: 14. 1908. *Oakesiella nitida* (Britt.) Heller, Muhlenbergia **6**: 83. 1910. *Uvularia puberula* var. *nitida* (Britt.) Fern., Rhodora **37**: 407. 1935. *Uvularia pudica* (Walt.) Fern., Rhodora **41**: 536. 1939. *Uvularia pudica* var. *nitida* (Britt.) Fern., Rhodora **41**: 536. 1939. — DEPARTMENT OF BOTANY, DUKE UNIVERSITY, DURHAM, N. C.

NEW RECORDS FOR NORTH DAKOTA[1]

O. A. STEVENS

Since the publication of my Handbook (Stevens, 1950), some 60 species have been added to the State list. Some are recently introduced weeds, some have been found for the first time, while others had been incorrectly identified. A few records for species previously reported are included in the following list where they are of special interest in extending the known range. Moore (1951) noted some additions and changes in status. Some of these are included here

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[1] Contribution from the North Dakota Institute for Regional Studies. Journal Paper No. 12.

and some are still problematical. The nomenclature follows Gray's Manual, 8th ed., for the most part. Specimens of most species have been deposited in the U. S. National Herbarium, in herbaria of the University of California, University of Minnesota, Canadian National Museum and Science Service of Canada.

Equisetum variegatum Schleich. Some poor material, *Stevens 1218*, collected at Valley City in 1950 was determined by C. V. Morton as var. **nelsonii** A. A. Eaton.

Equisetum sylvaticum L. Tongue River, close to Pembina-Cavalier County line in 1958, *Stevens and Moir 1767*.

Botrychium lunaria (L.) Sw. Low, sandy prairie, McHenry County, *Stevens 1530*.

Cystopteris dickieana Sim. West of Grassy Butte, McKenzie County, *Stevens and Moir 2243*. Determined by C. V. Morton who notes that its status as a species is uncertain.

Woodsia oregana D. C. Eaton. Material formerly reported as **W. obtusa** has been identified by R. T. Clausen as *W. oregana*, var *cathcartiana* (Robins.) Morton.

Pteretis pensylvanica (Willd.) D. C. Eaton. This was found in the Turtle Mts., Bottineau County, by Duane Green in 1956 and later collected by D. R. Moir. It occurs also in one ravine near Huff, Morton County.

Onoclea sensibilis L. A second record is from Pembina County, Stevens in 1954.

Juniperus virginiana L. Near Fargo in 1959, J. R. Nelson. I had wondered why this had not become established from seeds scattered by birds. It is not native within probably 200 miles.

Typha angustifolia L. This was recognized as frequent in the Fargo area in 1958. It apparently has been spreading rather rapidly.

Sparganium chlorocarpum Rydb. Lower Souris Wildlife Refuge, Hotchkiss and Hammond in 1955.

Sparganium multipedunculatum (Morong) Rydb. N. E. Hotchkiss writes that there is a specimen in the U. S. National Herbarium collected at Riverside Marsh, south of Mandan, *Metcalf 337*.

Ruppia occidentalis S. Wats. Iverson Lake, Burke County, *Hotchkiss and Knowlton 4656*.

Potamogeton richardsonii (A. Benn.) Rydb. should replace *P. perfoliatus*.

Potamogeton friesii Rupr. Hotchkiss writes that he collected this in Burke County.

Elodea nuttallii (Planch.) St. John. McHenry and Burke Counties, Hotchkiss.

Bromus marginatus Nees. Black (H. T.) Butte, Slope County, *Stevens and Moir 2297*, det. Swallen.

Bromus brizaeformis Fisch. and Mey. Sent by Bert Miller from Tuttle, Stutsman County, in 1956. In a grass field, probably not permanently established.

Puccinellia cusickii Weatherby. Sheridan County, *Stevens 2095*, identified by J. R. Swallen. This was from a small area without glacial till that had also *Artemisia cana, Opuntia polyacantha* and *Oenothera caespitosa*, our easternmost records of the last two. Specimens collected in 1960 from Ward, Burleigh and Slope Counties are also referred to it.

Poa fendleriana (Steud.) Vasey. Bottineau County, *Stevens 2209.*

Eragrostis diffusa Buck. A specimen from Minot by Bolley in 1891 has been determined by J. R. Swallen.

Eragrostis perplexa L. H. Harvey. Reported (Harvey, 1954), from Mandan.

Hordeum montanense Scribn. Late season material from Minot, Curtis Benton in 1953, seems to be this form.

Hordeum pusillum Nutt. Medora in 1953, *Stevens 1445*, and Rhame in 1954, V. Facey.

Danthonia spicata (L.) Beauv. Killdeer Mountains in 1960, *Stevens and Moir 2254.* Quite common along a woodland trail.

Sporobolus airoides Torr. A flowering stalk was grown in the greenhouse from a piece of sod collected in Bowman County by Clayton Quinnild in 1957.

Eleocharis parvula (R. & S.) Link. Burleigh County, Hotchkiss in 1940, and Grand Forks County, F. C. Seymour in 1951.

Eriophorum viridicarinatum (Engelm.) Fern. One specimen from Walhalla, Pembina County, Stevens in 1938, seems this species, all others *E. angustifolium* Honck.

Carex foenea Willd. (C. siccata Dew.) Turtle Mts., Bottineau County, *Stevens 1610*, det. Hermann.

Carex prairea Dewey. Larimore, *Stevens 1722;* Turtle Mts., *Stevens & Moir 1776;* McHenry County, *Stevens and Moir 1779.*

Carex aenea Fern. Towner County, Stevens 1531; Tongue River, Cavalier County, *Stevens and Moir 1759*, det Hermann; Williams County, Stevens in 1956.

Carex molesta Mack. Richland County, *Stevens 1347*, det. Hermann.

Carex peckii Howe. Richland, Pembina, Grand Forks, Bottineau, Dunn and Ward Counties.

Carex richardsonii R. Br. McHenry and Cass Counties, *Stevens 1534* and *1715.*

Carex garberi Fern. Burke County, *Hotchkiss 6714.*

Carex haleana Olney. Richland County, *Stevens 1257*, det Hermann; Benson County by Lunell as *C. shriveri.*

Carex parryana Dewey. Burke County, *Hotchkiss 6715.*

Carex hallii Olney. Eddy County, *Stevens 1209*; reported by Mackenzie for Benson County and an old specimen, *Bell 61*, is from Richland County.

Carex substricta (Küken.) Mack. McLean County, *Stevens 1070*, det. Hermann.

Carex torreyi Tuckerm. Additional records are, Killdeer Mts. and Grassy Butte in 1960 and Moorhead, Minn. in 1959.

Calla palustris L. Pembina County, *Stevens 1338*; Rolette County, *Stevens and Moir 1926*. Abundant in Tongue River west of Cavalier, Pembina County.

Juncus gerardi Loisel. Fargo, *Stevens 1497*; Richland County, Bell 674; both determined by Hermann.

Calochortus pudica (Pursh) Spreng. A specimen overlooked was collected at Medora, Billings County, by E. C. Moran who wrote that he saw it also in Bowman County.

Uvularia sessilifolia L. Tongue River, Cavalier County, *Stevens and Moir 1754*.

Populus acuminata Rydb. One tree was shown me near Medora, Billings County (south side of Dedication Butte, *Stevens 1286*), by Virgil Weiser; Dr. L. D. Potter found a small grove near Vim in Slope County in 1958.

X Betula sandbergii Britton. One tree in poor condition at Carpenter Lake, Rolette County, *Stevens and Moir 1775*.

Betula pumila L., var. **glandulifera** Regel. Near Larimore, Grand Forks County, *Stevens 1431*; Carpenter Lake, Rolette County, *Stevens and Moir 1772*; noted by Hotchkiss in McHenry County.

Pilea fontana (Lunell) Rydb. Three of our specimens, all from the Richland County area, are this species.

Ulmus pumila L. Cass, Burleigh, Stark and Mountrail Counties. Volunteer seedlings are frequent.

Rumex stenophyllus Ledeb. First collected in this area by J. F. Brenckle in 1951 (No. 5106) in Spink County, South Dakota, and determined by Paul Aellen. In 1954 it was observed in quantity at Fargo *(Stevens 1492)* and later collected in McLean, Burleigh, Morton, Oliver and McKenzie Counties. Löve and Bernard (1950) have given other records and a description of the plant.

Rumex domesticus Hartm. This had been noted as a puzzling form and is well established; 21 counties, all parts of the State. Some old specimens are this species: Richland County, Bell in 1908; Pembina County, Bergman in 1912; Cass County, Stevens in 1920.

Polygonum douglasii Greene. McKenzie and Slope Counties in 1960, *Stevens and Moir 2240*. Frequent in small water channels on north-facing slopes.

Atriplex glabriuscula Edmonst. A considerable colony at Fargo in 1954, *Stevens 1507*.

Salsola collina Pall. In 1949, one of my former students, Lars Reitan, called attention to some "different" Russian thistles in Barnes County and a specimen was identified by Paul Aellen as *S. collina*. We noted it with increasing frequency and in recent years it has seemed the more common form. The bracts are appressed, the calyx wings very short and erect.

Mirabilis albida (Walt.) Heimerl. One specimen from Oliver County, Stevens in 1938, and one from Valley City, Stevens in 1949, are perhaps this species. Both approach *M. hirsuta.*

Mirabilis linearis (Pursh) Heimerl. Most specimens previously referred to *M. albida* belong here.

Cerastium scopulorum Greene? Black (H. T.) Butte, Slope County, *Stevens and Moir 2292,* seems to be this species rather than *C. arvense.* It was in a shady glade at the foot of a north-facing slope, July 14, 1960. Only one duplicate (US).

Cerastium vulgatum L. Numerous complaints of this in lawns in Fargo began about 1950. Apparently it was generally established but gradually subsided. In an area on our campus, seeded in 1949, it was vigorous in 1955, weak in 1956 and not found the following year.

Delphinium ajacis L. Rocket Larkspur. Streets at Belfield, Stark Co., *Stevens and Moir 2238.* Apparently well established.

Myosurus aristatus Benth. Kenmare, Ward Co., *Hotchkiss 6701.*

Chorispora tenella (Pallas) DC. Williston in 1960 by D. G. Hotchkiss, county extension agent.

Polanisia trachysperma T. & G. Previously reported as *P. graveolens* Raf.

Ribes hirtellum Michx. Rolette County, *Bergman 1503,* was overlooked. To this have been added: Richland County, *Stevens 1341*; Cavalier, Stevens in 1956; Pembina, *Stevens 1327*; Griggs, Stevens in 1952 and 1953; Bottineau, Stevens in 1957.

Potentilla palustris L. N. E. Hotchkiss writes that he saw it in McHenry County but no specimens are available.

Geum rivale L. Tongue River west of Cavalier, Pembina County, *Stevens 1232.*

Agrimonia gryposepala Wallr. Killdeer Mts., Dunn County, Stevens & Kluender in 1935; Richland County, *Stevens 1752.*

Caragana arborescens Lam. One bush at Valley City, Barnes County, seemed an escape but might have been planted. It is strange that volunteer plants are not found. The seeds germinate freely in bare soil by planted material. One at Cavalier, Pembina County in 1959 was a few rods from plantings.

Althaea officinalis L. This volunteer indefinitely from plantings.

Viola nephrophylla Greene. Many of our specimens formerly labeled *V. papilionacea* have been changed to this. It is often abundant in boggy meadows.

×**Viola bernardi** Greene. Four old specimens are referred to this: Fargo, Bolley and M. Field in 1891 and 1892; Ransom County, *Bell 653;* Hankinson, A. D. Stoesz in 1934.

Viola sarmentosa Nutt. A sterile specimen from Killdeer Mts., Dunn County, Stevens and Kluender in 1935, has been determined as this by

Norman H. Russell. Further collections are needed to verify this report.

Viola incognita Brainerd. Tongue River west of Cavalier, Pembina County, *Stevens 1332, 1395*, det. Russell.

Elaeagnus angustifolia L. I had wondered why we found no volunteer plants of this but since 1950 I find them in many places, especially in low areas, in fence rows and under telephone wires.

Oenothera rhombifolia Nutt. The specimen so reported seems to be *O. strigosa* (Rydb.) Mack. & Bush.

Myriophyllum verticillatum Michx. One sheet from Grant County, *Bell 729*.

Sanicula gregaria Bickn. Richland County, *Stevens 1344*, det. Constance.

Menyanthes trifoliata L. N. E. Hotchkiss reports seeing this 5 miles north of Towner, McHenry County, in 1932.

Apocynum medium Greene. Some material from Fargo, *Stevens 1251*, seems to be this species. It was in an area where both *A. androsaemifolium* and *A. sibericum* grew (now destroyed).

Asclepias sullivantii Engelm. Specimens previously referred to *A. purpurascens* L.

Asclepias lanuginosa Nutt. Dickinson, Stark County in 1960, J. R. Nelson, is a second record. I had been looking for it for 40 years and the Dickinson area has received more than usual attention.

Cuscuta glomerata Choisy. This was found near Lisbon, Ransom County in 1950 by Snorri Thorfinnson; *Stevens 1374*.

Navarretia propinqua Suksd. is our species according to Mason's treatment.

Hackelia virginiana (L.) I. M. Johnston. At Fargo, *Stevens 1495*, a quantity of this was noted in woods along the Red River. It seemed unaffected by a leaf spot which was abundant on *H. americana*. An older specimen, Stevens in 1934, is *H. virginiana* and one from Valley City in 1957.

Lappula redowskii, var. **cupulata** (A. Gray) M. E. Jones. At Medora in 1954 occasional plants, *Stevens 1441*, with cupulate nutlets, among abundant normal var. **occidentalis**, seemed pathological. These had not been seen since the previous report.

Cryptantha macounii (Eastw.) Payson. A specimen from White Earth, Mountrail County, T. A. Haigh in 1898, was referred to this by A. J. Breitung.

Amsinckia retrorsa Suks. The Fargo specimen, *Stevens 629*, should be called this according to Constance.

Lycopsis arvensis L. Dickinson, Stark County in 1955, *Stevens 1205*. One plant in a field. Determined by F. Chisaki.

Solanum interius Rydb. McClusky, Sheridan County, *Stevens 1645*, determined by Constance. We have been getting an occasional specimen, none in quantity.

Solanum dulcamara L. Mrs. P. F. Debertin, Parshall, Mountail County, sent a specimen in 1952 that she found growing by her house. A plant at Fargo I am told has been so growing for several years.

Linaria dalmatica (L.) Mill. Roadside, Steele, Kidder County, *Stevens 1194*, and Dickinson, Stark County, Stevens in 1955.

Linaria canadensis (L.) Dumort. One small plant on a sheet of *Veronica peregrina* from Grant County, *Bell 359*, was recognized by F. W. Pennell.

Mimulus guttatus DC. In a stream from a flowing spring near Inkster, Grand Forks County. This was first brought to our attention in 1956 by Dr. Vera Facey of the University of North Dakota, which has the area as a study preserve.

Utricularia intermedia Hayne. McHenry County, *Hotchkiss 4502* (US).

Linnaea borealis L. Killdeer Mountains in 1960, Stevens and Moir. Previously from Turtle Mountains, E. E. Hotchkiss.

Sherardia orientalis Boiss. & Hohen. Waste ground by railroad, Fargo in 1945, L. R. Waldron. Determined by Bernice G. Schubert.

Galium labradoricum Wieg. McHenry County, *Hotchkiss 4502* (US).

Sambucus canadensis L. This is not native but seems more or less established. A colony on the Agricultural College grounds at Fargo (now destroyed) was said not to have been planted though many years before it had been planted in at least two other places (long since destroyed). It was received from Park River, Walsh County, where it was said to have been present for some years and was found at Sheyenne, Eddy County *(Stevens and Moir 1661)* in a native grove; these last two both in 1956.

Galinsoga parviflora Cav. Fargo in 1958, *Stevens 2029*. These plants are becoming frequent about yards.

Bellis perennis L. A few plants in bloom in a lawn at Fargo in 1955.

Arctium lappa L. Kulm, LaMoure County, Brenckle in 1912; Arvilla, Grand Forks County, D. G. Walp in 1936.

Arctium tomentosum Mill. Fargo in 1956, *Stevens 1634*.

Petasites palmatus (Ait.) Gray. Turtle Mts., Bottineau County, *Stevens and Moir 1790*.

Centaurea maculosa Lam. Two or three plants by railroad at Fargo, *Stevens 1633*; destroyed the next year.

Stephanomeria tenuifolia (Torr.) Hall. Little Bad Lands, Stark County, V. Facey in 1952, Stevens in 1955.

Tragopogon pratensis L. Fargo, Lee in 1891, and Lisbon, Bell 686, are this species but we have been unable to find it in recent years.

Taraxacum kok-saghyz Rodin. Fargo, *Stevens 1703*. This was grown in a field plot in 1941 and 1942 but has not been observed in the area since. Some seed was cleaned at our building where a few plants continue to thrive near the west wall but are not aggressive. — NORTH DAKOTA STATE UNIVERSITY, FARGO.

LITERATURE CITED

HARVEY, L. H. 1954. New entities in North and Middle American *Eragrostis*. Bull. Torrey Club **81**: 405-410.

LÖVE, DORIS AND FRÈRE JÉAN-PAUL BERNARD (1958). Rumex stenophyllus in North America. Rhodora **60**: 54-57.

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A FERN NEW TO RHODE ISLAND. — *Asplenium montanum*, not previously recorded as growing in Rhode Island, has been found in a well-established colony on sandstone cliffs at West Glocester, Providence County. The fern grows with *Polypodium virginianum* on a west-facing ledge (about 150 feet long) where it receives mixed sun and shade. On August 18, 1960 when John Hudson and I collected specimens, there appeared to be no surplus moisture on the cliffs, yet the plants were luxuriant in crevices or hung from the seams of stony recesses.

Records, mostly from the early 1900's place *Asplenium montanum* in these nearby Connecticut towns: North Stonington, Franklin, Scotland, Salisbury, etc. Whether it has only recently invaded Rhode Island, or has simply eluded detection for many years is a moot question. John Hudson who led me to its location was in turn shown it by Lewis Carpenter of Hope, R. I. in 1957. Not until Hudson and I visited it, however, were any specimens collected. These have been deposited with the University of Rhode Island Herbarium and The New England Botanical Club. — RICHARD L. CHAMPLIN, JAMESTOWN, R. I.

FOURTEENTH REPORT OF THE COMMITTEE ON PLANT DISTRIBUTION

The thirteenth report included the Dicotyledoneae from Portulacaceae through Lauraceae. The present report deals with the families from Papaveraceae through Platanaceae, taken in the order of the eighth edition of Gray's Manual.

The data for these reports have been compiled from the material found in the herbarium of the New England Botanical Club and in the Gray Herbarium.

PRELIMINARY LISTS OF NEW ENGLAND PLANTS — XXXIX

The sign + indicates that an herbarium specimen has been seen, the sign — that a reliable printed record has been found and the sign * is used for those plants which are not native in the New England area.

	Me.	N.H.	Vt.	Mass.	R.I.	Conn.
PAPAVERACEAE						
Adlumia fungosa (Ait.) Greene	+	+	+	+	+	+
*Argemone alba Lestib. f.						+
*Argemone mexicana L.			—	+		+
*Chelidonium majus L.	+	+	+	+	+	+
Corydalis aurea Willd.			+			
Corydalis flavula (Raf.) DC.						+
Corydalis sempervirens (L.) Pers.	+	+	+	+	+	+
Dicentra canadensis (Goldie) Walp.	—	+	+	+	—	+
Dicentra Cucullaria (L.) Bernh.	+	+	+	+	—	+
*Dicentra eximia (Ker) Torr.			+	+		
*Dicentra formosa (Andr.) Walp.				+		
*Dicentra spectabilis (L.) Lem.						+
*Eschscholtzia californica Cham.						+
*Fumaria officinalis L.	+	+	+	+		+
*Glaucium flavum Crantz				+	+	
*Macleaya cordata (Willd.) R. Br.	+		—	+		
*Papaver dubium L.				+	+	—
*Papaver Rhoeas L.	+	+	+	+		+
*Papaver somniferum L.	+	+	+	+	+	+
Sanguinaria canadensis L.	+	+	+	+	+	+
CAPPARIDACEAE						
*Cleome serrulata Pursh				+		
*Cleome spinosa Jacq.				+	+	+
Polanisia graveolens Raf.			+			
CRUCIFERAE						
*Alliaria officinalis Andrz.			—	+		+
*Alyssum Alyssoides L.	+			+	+	+
*Alyssum saxatile L.		+		+		
Arabis canadensis L.	+	+	+	+	+	+
Arabis divaricarpa Nels.			+			
Arabis Drummondii Gray	+	+	+	+	+	+

	Me.	N.H.	Vt.	Mass.	R.I.	Conn.
Arabis glabra (L.) Bernh.	+	+	+	+	—	+
Arabis hirsuta (L.) Scop. var. pycnocarpa (M. Hopkins) Rollins	+	+	+	+		+
Arabis laevigata (Muhl.) Poir.	+	+	+	+	—	+
Arabis lyrata L.			+	+		+
Arabis missouriensis Greene	+	+	+	+	+	+
*Arabis procurrens Waldst. & Kit.				+		
*Arabidopsis Thaliana (L.) Heynh.	+	+	—	+	+	+
Armoracia aquatica (Eat.) Wieg.	+		+			
*Armoracia lapathifolia Gilib.	+	+	+	+	+	+
Barbarea orthoceras Ledeb.	+	+				
*Barbarea verna (Mill.) Aschers.	+			+		+
*Barbarea vulgaris R. Br.	+	+	+	+	+	+
*Barbarea vulgaris var. arcuata (Opiz) Fries	+	+	+	+	+	+
*Barbarea vulgaris var. brachycarpa Rouy & Foucaud	+	+		+		+
*Berteroa incana (L.) DC.	+	+	+	+	+	+
*Berteroa mutabilis (Vent.) DC.				+		
*Brassica hirta Moench	+	+	—	+	—	+
*Brassica juncea (L.) Coss.	+	+	+	+	+	+
*Brassica juncea var. crispifolia Bailey	+		+	+		+
*Brassica Kaber (DC.) L. C. Wheeler var. pinnatifida (Stokes) L. C. Wheeler	+	+	+	+	+	+
*Brassica Kaber var. Schkuhriana (Reichenb.) L. C. Wheeler	—		+	+	+	—
*Brassica Napus L.	+	+	—	+	+	+
*Brassica nigra (L.) Koch	+	+	+	+	+	+
*Brassica oleracea L.			—	+	+	
*Brassica Rapa L.	+	+	+	+	+	+
Braya humilis (C. A. Mey.) Robins. var. leiocarpa (Trautv.) Fern.			+			
Cakile edentula (Bigel.) Hook.	+	+		+	+	+
*Camelina microcarpa Andrz.	+	+	—	+	+	+
*Camelina sativa (L.) Crantz	+	+	+	+	+	+
*Capsella Bursa-pastoris (L.) Medic.	+	+	+	+	+	+
*Capsella Bursa-pastoris var. bifida Crépin				+		
*Capsella rubella Reut.	+			+		
Cardamine bellidifolia L.	+	+				
Cardamine bulbosa (Schreb.) BSP.			+	+	—	+
Cardamine Douglassii (Torr.) Britt.				+		+
Cardamine flexuosa With.			—			
*Cardamine hirsuta L.				+		+
*Cardamine impatiens L.		+				
Cardamine Longii Fern.	+					
Cardamine parviflora L. var. arenicola (Britt.) O. E. Schulz	+	+	+	+	+	+
Cardamine pensylvanica Muhl.	+	+	+	+	+	+
Cardamine pensylvanica var. Brittoniana Farw.	+			+		+
*Cardamine pratensis L.	+	+	+	+	+	+
*Cardamine pratensis f. plena G. Beck				+		
Cardamine pratensis var. palustris Wimm. & Grab.			+	+		+
*Cardaria Draba (L.) Desv.				+	—	+
*Chorispora tenella (Willd.) DC.				+		
*Coronopus didymus (L.) Sm.	+			+	—	+
*Coronopus procumbens Gilib.				+	+	
*Conringia orientalis (L.) Dumort.	+	+	+	+		+

	Me.	N.H.	Vt.	Mass.	R.I.	Conn.
Dentaria anomala Eames						+
Dentaria diphylla Michx.	+	+	+	+		+
Dentaria incisifolia Eames						+
Dentaria laciniata Muhl.		+	+	+		+
Dentaria maxima Nutt.	+		+	+		+
Descurainia pinnata (Walt.) Britt. var. brachycarpa (Richards.) Fern.		+	+			
Descurainia Richardsonii (Sweet) O. E. Schulz	+			+		+
*Descurainia Sophia (L.) Webb	+	+	—	+	+	+
*Diplotaxis muralis (L.) DC.				+		+
*Diplotaxis tenuifolia (L.) DC.				+		+
Draba Allenii Fern.						
Draba arabisans Michx.	+		+			
Draba glabella Pursh			+			
Draba lanceolata Royle	+	+	+			
Draba reptans (Lam.) Fern.				+	+	+
*Draba verna L.			—	+	+	+
*Draba verna var. Boerhaavii Van Hall				+	+	+
*Eruca sativa Mill.			—	+		—
*Erucastrum gallicum (Willd.) O. E. Schulz	+	+	—	+		
*Erysimum cheiranthoides L.	+	+	+	+	+	+
Erysimum inconspicuum (S. Wats.) MacM.	+	+				
*Erysimum pannonicum Crantz				+		
*Erysimum repandum L.				+		
*Hesperis matronalis L.	+	+	+	+	+	+
*Iberis amara L.	+			+		—
*Iberis umbellata L.		+				
*Lepidium campestre (L.) R. Br.	+	+	+	+	+	+
*Lepidium densiflorum Schrad.	+	+	+	+	+	+
*Lepidium latifolium L.				+		+
*Lepidium perfoliatum L.	+			+		+
*Lepidium ruderale L.	+	+	—	+	+	—
*Lepidium sativum L.	+	+	—	+	+	+
Lepidium virginicum L.	+	+	+	+	+	+
*Lobularia maritima (L.) Desv.	+		+	+	+	+
*Lunaria annua L.	—		+	+		—
*Malcolmia maritima R. Br.		+				
*Nasturtium officinale R. Br.	+	+	+	+	+	+
*Nasturtium officinale var. microphyllum (Boenn.) Thell.	+	+	+	+	+	+
*Nasturtium officinale var. siifolium (Reichenb.) Koch				+		+
*Neslia paniculata (L.) Desv.	+	+	—	+		+
*Raphanus Raphanistrum L.	+	+	+	+	+	+
*Raphanus sativus L.	+	+	+	+	+	+
*Rapistrum rugosum (L.) All.				+		
*Rorippa amphibia (L.) Bess.	+			+		+
Rorippa islandica (Oeder) Borbás		+		+	+	+
Rorippa islandica var. Fernaldiana Butt. & Abbe	+	+	+	+	+	+
Rorippa islandica var. hispida (Desv.) Butt. & Abbe	+	+	+	+	+	+
*Rorippa sessiliflora (Nutt.) Hitchc.				+		
*Rorippa sylvestris (L.) Bess.	+	+	+	+	+	+
*Sisymbrium altissimum L.	+	+	+	+	+	+
*Sisymbrium Loeselii L.		+		+		+
*Sisymbrium officinale (L.) Scop.	+	+	+	+	+	+

	Me.	N.H.	Vt.	Mass.	R.I.	Conn.
*Sisymbrium officinale var. leiocarpum DC.	+	+	+	+	+	+
*Sisymbrium orientale L.				+		
Subularia aquatica L.	+	+	+			
*Teesdalia nudicaulis (L.) R. Br.				+		
*Thlaspi arvense L.	+	+	+	+	+	+
RESEDACEAE						
*Reseda alba L.	+	+	+	+		+
*Reseda lutea L.	+		+	+	+	+
*Reseda Luteola L.				+		+
*Reseda odorata L.			+	+		—
SARRACENIACEAE						
Sarracenia purpurea L.	+	+	+	+	+	+
DROSERACEAE						
Drosera filiformis Raf.				+		
Drosera intermedia Hayne	+	+	+	+	+	+
Drosera linearis Goldie	+					
Drosera rotundifolia L.	+	+	+	+	+	+
Drosera rotundifolia var. comosa Fern.	+	+				
PODOSTEMACEAE						
Podostemum ceratophyllum Michx.	+	+	+	+	+	+
CRASSULACEAE						
*Sedum acre L.	+	+	+	+	+	+
*Sedum alboroseum Baker	+			+		
*Sedum anopetalum DC.	+					
*Sedum purpureum (L.) Link	+	+	+	+	+	+
Sedum Rosea (L.) Scop.	+		+			
*Sedum rupestre L.				+		
*Sedum sarmentosum Bunge				+		
*Sedum spurium Bieb.	+					
*Sedum Telephium L.			+	+	—	
Sedum ternatum Michx.	—		+	+	—	+
*Sempervivum tectorum L.	+	+	—	+		—
Tillaea aquatica L.	+			+		+
SAXIFRAGACEAE						
*Astilbe japonica (Morren & Dcne.) Gray					+	
Chrysosplenium americanum Schwein.	+	+	+	+	+	+
*Deutzia scabra Thunb.						+
*Heuchera americana L.						+
*Hydrangea paniculata Sieb.				+		+
*Hydrangea quercifolia Bartr.						+
*Hydrangea radiata Walt.						+
Mitella diphylla L.		+	+	+		+
Mitella prostrata Michx.						+
Mitella nuda L.	+	+	+	+		+
Parnassia glauca Raf.	+	+	+	+	+	+
Penthorum sedoides L.	+	+	+	+	+	+
*Philadelphus coronarius L.	+		+	+		+
*Philadelphus inodorus L.				+	+	—
*Philadelphus pubescens Loisel.						+
Ribes americanum Mill.	+	+	+	+	+	+
Ribes cynosbati L.	+	+	+	+		+
Ribes glandulosum Grauer	+	+	+	+		+
*Ribes Grossularia L.	+	+	+	+		+
Ribes hirtellum Michx.	+	+	+	+	+	+
Ribes hirtellum var. calcicola Fern.	+			+	+	
Ribes hirtellum var. saxosum (Hook.) Fern.	+					

	Me.	N.H.	Vt.	Mass.	R.I.	Conn.
Ribes lacustre (Pers.) Poir.	+	+	+	+		+
Ribes missouriense Nutt.						+
*Ribes nigrum L.	+	+	+	+		+
*Ribes odoratum Wendland f.	+		+	+		+
Ribes rotundifolium Michx.		+				+
*Ribes sativum Syme	+	+	+	+	+	+
Ribes triste Pall.	+	+	+	+		+
Saxifraga aizoides L.			+			
Saxifraga Aizoön Jacq. var. neogaea Butters	+		+			
Saxifraga oppositifolia L.			+			
Saxifraga pensylvanica L.	+	+	+	+	+	+
Saxifraga rivularis L.		+				
Saxifraga stellaris L. var. comosa Poir.	+					
Saxifraga virginiensis Michx.	+	+	+	+	+	+
Tiarella cordifolia L.	+	+	+	+		+
HAMAMELIDACEAE						
Hamamelis virginiana L.	+	+	+	+	+	+
Hamamelis virginiana var. parvifolia Nutt.	—			+		
Liquidamber Styraciflua L.						+
PLATANACEAE						
Platanus occidentalis L.	—	+	+	+	+	+

The Saxifragaceae, Hamamelidaceae and Platanaceae were treated by C. H. Knowlton in 1916 (Rhodora XVIII-245-248). The Capparidaceae, Resedaceae, Sarraceniaceae, Droseraceae, Podostemaceae and Crassulaceae were also treated by C. H. Knowlton in 1917 (Rhodora XIX-217-219). These groups are also included in the present report.

As noted in previous reports the introduced plants have in general tended to spread in the intervening years. The native species show the same distribution as in these earlier reports with very few exceptions. *Podostemum ceratophyllum* has now been collected in both New Hampshire and Vermont. *Parnassia glauca* and *Ribes rotundifolium* are now represented by specimens from New Hampshire. *Saxifraga Aizoön* before known from northern Vermont only has now been collected on Mt. Katahdin in Maine.

The geographical areas are in general the same as used previously. Again a large number of the plants included are not native to New England and the percentage of such plants is greater than in the two previous reports, fifty-six percent. If the Cruciferae alone were considered, the percentage of introduced plants would be sixty-six.

I. GENERALLY DISTRIBUTED. — *Cardamine pensylvanica, Lepidium virginicum, Rorippa islandica* var. *Fernaldiana, Sarracenia purpurea,* *Drosera intermedia*, *D. rotundifolia*, *Chrysosplenium americanum*, *Ribes hirtellum*. The number of species and varieties considered as generally distributed, eight, is small for the large number of the plants treated.

Ia. GENERAL, EXCEPT CAPE COD. — *Corydalis sempervirens*, *Rorippa islandica* var. *hispida*, *Ribes americanum*, *Tiarella cordifolia*. *Tiarella cordifolia* also is absent from Rhode Island and from Bristol and Plymouth Counties in Massachusetts.

Ib. GENERAL, EXCEPT CAPE COD AND THE MAINE COAST EAST OF THE KENNEBEC RIVER. — *Sanguinaria canadensis*, *Arabis glabra*, *Dentaria diphylla*.

Ic. GENERAL, EXCEPT CAPE COD AND WASHINGTON COUNTY, MAINE. — *Arabis Drummondii*.

IIa. NORTHERN-NOT OR NOT MUCH SOUTH OF 43°. — *Barbarea orthoceras*, *Subularia aquatica*. *Barbarea orthoceras* is distinctly northern and is represented in New England by only three stations, Fort Kent and St. Francis, Maine and Mt. Washington, New Hampshire. *Subularia aquatica* is also northern in its general distribution but in New England it has not been reported from Northern Maine; in fact there are only five collections in all from Maine.

IIb. NORTHERN-NUMEROUS STATIONS SOUTH OF 43°.— *Mitella nuda*, *Ribes glandulosum*, *R. lacustre*, *R. triste*.

III. ALPINE-ARCTIC. — *Cardamine bellidifolia*, *Sedum Rosea*, *Saxifraga aizoides*, *S. Aizoön*, *S. oppositifolia*, *S. rivularis*, *S. stellaris* var. *comosa*. *Sedum Rosea* in New England follows along the rocky coast of eastern Maine and has two stations in Vermont. *Saxifraga aizoides*, *S. Aizoön*, and *S. oppositifolia* are alpine but they are also calcicolous, as their occurrence only in northern Vermont indicates. *S. Aizoön*, although it prefers a calcareous soil, is not restricted to it and is found on Mt. Katahdin.

IVa. SOUTHERN-GENERAL SOUTH OF 45°. — *Cardamine parviflora* var. *arenicola*, *C. pensylvanica* var. *Brittoniana*, *Hamamelis virginiana*. Although *Cardamine pensylvanica* var. *Brittoniana* is represented by very few stations, it seems to belong to this category.

IVb. SOUTHERN-GENERAL SOUTH OF 45° BUT NOT ON MAINE COAST EAST OF THE KENNEBEC RIVER. — *Saxifraga pensylvanica*.

IVc. SOUTHERN-GENERAL SOUTH OF 45° BUT NEITHER CAPE COD NOR WASHINGTON COUNTY. — *Adlumia fungosa*, *Dicentra Cucullaria*, *Arabis hirsuta* var. *pycnocarpa*, *Penthorum sedoides*, *Saxifraga virginiensis*.

Va. CHIEFLY THE THREE SOUTHERN STATES. — *Platanus occidentalis*.

Vb. CHIEFLY THE THREE SOUTHERN STATES BUT NOT ON CAPE COD. — *Arabis canadensis*.

Vc. CHIEFLY THE THREE SOUTHERN STATES BUT NEITHER CAPE COD NOR WESTERN MASSACHUSETTS. — *Arabis missouriensis, Draba reptans.*

VI. SOUTHWESTERN NEW ENGLAND CHIEFLY. — *Cardamine Douglassii, Heuchera americana, Liquidambar Styraciflua. Cardamine Douglassii* is also a calciphile.

VIII. WESTERN NEW ENGLAND CHIEFLY. — *Dicentra canadensis, Arabis lyrata, Dentaria incisifolia, D. laciniata, D. maxima, Sedum ternatum, Mitella diphylla, Arabis lyrata* occurs in southwest Connecticut and Massachusetts and has two stations in southwest Vermont. *Dentaria incisifolia* occurs only in Sharon, Connecticut.

VIII. COASTAL PLAIN. — *Drosera filiformis, Ribes hirtellum* var. *calcicola.*

Ribes hirtellum var. *calcicola* is placed in this category with some hesitation. Outside of New England it is in general a calciphile. Within our area it simulates a coastal plain type of distribution as it occurs in Rhode Island, on Cape Cod, Martha's Vineyard and Nantucket and has several stations between the Kennebec River and Mount Desert. This variety is not found on the coastal plain south of New England.

IXa. CALCICOLOUS-CHIEFLY WEST OF THE CONNECTICUT RIVER IN THE SOUTH, IF IN THE EAST MOSTLY NORTH OF 45°. — *Corydalis aurea, Arabis divaricarpa, Braya humilis* var. *leiocarpa, Cardamine flexuosa, Draba arabisans, D. glabella, D. lanceolata. Corydalis aurea* is confined to western Vermont with the exception of Norwich in the eastern part of the state where it is represented by a collection made in 1877. *Cardamine flexuosa* has been collected at Wallingford and Smuggler's Notch in Vermont. *Braya humilis* var. *leiocarpa* is confined to the Willoughby region of Vermont. *Draba arabisans* has been collected in Maine and Vermont only. *Draba glabella* has one station at Willoughby, Vermont.

IXb. CALCICOLOUS-ALSO ON BASIC AND NEUTRAL SOILS IN EASTERN MASSACHUSETTS. — *Arabis laevigata, Cardamine pratensis* var. *palustris, C. bulbosa, Parnassia glauca.*

X. MARITIME-IN VICINITY OF COAST, NO INLAND STATIONS. — *Cakile edentula, Tillaea aquatica.*

XI. ESTUARINE. — *Cardamine Longii,* found only at Bowdoinham, Maine. A collection made at Newton Upper Falls, Massachusetts represents an authenticated introduction.

XII. MISCELLANEOUS. — *Corydalis flavula, Polanisia graveolens, Armoracia aquatica, Dentaria anomala, Descurainia pinnata* var. *brachycarpa, D. Richardsonii, Erysimum inconspicuum, Rorippa islandica, Drosera linearis, D. rotundifolia* var. *comosa, Podostemum ceratophyllum, Mitella prostrata, Ribes Cynosbati, R. hirtellum* var. *saxosum, R. rotundifolium. Corydalis flavula* is known only from Meriden and Middletown, Connecticut. *Polanisia graveolens* is confined to the Lake Champlain area of Vermont. *Armoracia aquatica* has two stations in the Lake Champlain region at Ferrisburg and Shelburne, Vermont and a questionable one at East Boothbay, Maine. *Dentaria anomala* occurs at Plainville and Orange, Connecticut. *Descurainia pinnata* var. *brachycarpa* is occasional in the White Mountains of New Hampshire and the Lake Champlain area of Vermont. *Descurainia Richardsonii* is apparently native at Moscow, Maine. Specimens from South Berwick, Maine, Acton, Massachusetts and Waterbury, Connecticut are presumably adventive. *Erysimum inconspicuum* is a western species adventive along railroad tracks at Canton and Falmouth, Maine and Gorham and Berlin, New Hampshire. *Rorippa islandica* has a very spotty distribution: two stations in New Hampshire, six in Massachusetts, one at Block Island, and two in Connecticut. *Drosera linearis* has been collected only in the marly bog at Crystal, Maine. *Drosera rotundifolia* var. *comosa* has been found at Mt. Desert, Maine and Waterville, New Hampshire. *Podostemum ceratophyllum* is occasional in some swift streams and rivers south of 45°. *Mitella prostrata* is known only at Gaylordsville, Connecticut. *Ribes Cynosbati* does not conform to any of the categories that have been used. It seems to occur chiefly in western New England but has four stations in Western Maine and appears on both Martha's Vineyard and Nantucket. *Ribes hirtellum* var. *saxosum* is represented by one collection from Mt. Desert, Maine. *Ribes rotundifolium* has been found at Crawford Notch, New Hampshire and at Danbury and Meriden, Connecticut.

XIII. INTRODUCED SPECIES-GENERAL. — *Armoracia lapathifolia, Barbarea vulgaris, Brassica juncea, B. nigra, B. Rapa, Camelina sativa, Capsella Bursa-pastoris, Erysimum cheiranthoides, Lepidium densiflorum, Sisymbrium altissimum, S. officinale* var. *leiocarpum, Thlaspi arvense, Ribes sativum.*

XIIIa. INTRODUCED SPECIES-NEITHER CAPE COD NOR NORTHERN MAINE. — *Hesperis matronalis, Rorippa sylvestris, Sisymbrium officinale.*

XIIIb. INTRODUCED SPECIES WITH SOUTHERN TENDENCIES-CHIEFLY SOUTH OF 43°. — *Chelidonium majus, Fumaria officinalis, Alyssum alyssoides, Arabidopsis Thaliana, Barbarea vulgaris* var. *arcuata, Berteroa incana, Brassica hirta, B. Kaber* var. *pinnatifida, B. Kaber* var. *Schkuhriana, Camelina microcarpa, Cardamine pratensis, Conringia orientalis, Descurainia Sophia, Draba verna, D. verna* var. *Boerhaavii, Lepidium campestre, L. ruderale, L. sativum, Lobularia maritima, Nasturtium officinale, N. officinale* var. *microphyllum, Neslia paniculata, Raphanus Raphanistrum, R. sativum, Sedum acre, S. purpureum, Sempervivum tectorum, Deutzia scabra, Philadelphus inodorus, Ribes Grossularia, R. odoratum.*

XIIIc. INTRODUCED SPECIES-SPORADIC. — *Papaver Rhoeas, P. somniferum, Barbarea verna, Brassica Napus, B. oleracea, Sisymbrium Loeselii, Reseda alba, R. lutea, Hydrangea paniculata* (apparently well established at Lincoln, Massachusetts), *Ribes nigrum.*

XIIId. INTRODUCED SPECIES-LOCAL. — *Argemone alba, A. mexicana, Dicentra eximia, Eschscholtzia californica, Glaucium flavum, Macleaya cordata, Papaver dubium, Cleome spinosa, Alliaria officinalis, Alyssum saxatile, Barbarca vulgaris* var. *brachycarpa, Berteroa mutabilis, Brassica juncea* var. *crispifolia, Capsella Bursa-pastoris* var. *bifida, C. rubella, Cardamine hirsuta, Cardaria Draba, Chorispora tenella, Coronopus didymus, C. procumbens, Diplotaxis muralis, D. tenuifolia, Eruca sativa, Erucastrum gallicum, Erysimum repandum, Iberis amara, Lepidium latifolium, L. perfoliatum, Lunaria annua, Nasturtium officinale* var. *siifolium, Rapistrum rugosum, Rorippa amphibia, Teesdalia nudicaulis, Reseda Luteola, R. odorata, Sedum alboroseum, S. anopetalum, S. rupestre, S. sarmentosum, S. spurium, S. Telephium, Philadelphus coronarius, P. pubescens.*

The following local introduced plants are represented by only one station in New England and it is doubtful if they should be considered as a real part of our flora: *Dicentra formosa* (Danvers, Massachusetts); *D. spectabilis* (Westport, Connecticut); *Cleome serrulata* (Lawrence, Massachusetts); *Arabis procurrens* (Wakefield, Massachusetts); *Cardamine impatiens* (Peterborough, New Hampshire); *Erysimum pannonicum* (Westfield, Massachusetts); *Iberis umbellata* (Randolph, New Hampshire); *Malcolmia maritima* (Shelburne, New Hampshire); *Rorippa sessilifolia* (Salem, Massachusetts); *Sisymbrium orientale* (Milton, Massachusetts); *Astilbe japonica* (Providence, Rhode Island); *Hydrangea quercifolia* (Norwalk, Connecticut); *H. radiata* (Fairfield, Connecticut). — R. C. BEAN, A. F. HILL, AND R. J. EATON.

A NEW MANUAL FOR OHIO VASCULAR PLANTS.[1] — The appearance of a new manual for the identification of Ohio vascular plants is worthy of special notice. For many years students have had to rely on J. H. Schaffner's manual[2] which has long since become out-dated and out-of-print. Dr. Weishaupt, who is curator of the Ohio State Herbarium, has prepared a book that meets this pressing need for an up-to-date accounting of Ohio plants.

Essentially, her manual is a series of dichotomous keys. Vascular plants are categorized as "Pteridophyta" or "Spermatophyta". Within these groups artificial keys to families

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[1] Vascular Plants of Ohio — a manual for use in field and laboratory, by Clara G. Weishaupt. 309 pp. 8½ x 11, 1960. Harold L. Hedrick, Columbus, Ohio, publisher. $5.50.

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[2] Field manual of the flora of Ohio and adjacent territory. Columbus, Ohio. 1928.

are given with page references to generic keys following the family name. A brief, general characterization of the family is presented followed by the key to genera. A further reference to a genus name and number leads one to the key for species. This key is headed by a brief genus description. Other than those that appear in the key, there are no descriptions or notes for the species, although common names are given. In the back of the manual two special keys are included, a key to woody plants in leaf and one to woody plants in winter condition. A glossary and index are at the end of the book.

The various diagnostic keys are the most praiseworthy feature of the manual; for the most part they are clear, concise, and highly usable. Obviously, much careful work went into their construction. There is a minimum of technical language which should facilitate their use by students. The keys to grasses and to sedges are excellent. The key to crucifers, depending on both flowering and fruiting material being available, is less successful. Some keys are prefaced with a "suggestion" to aid in their use.

The general approach of the author to species is conservative rather than modern. Seldom are varieties or forms described. Very little attention is given to natural hybrids. One is included for *Populus*, but none for *Viola* or *Quercus*. No distinction is made between native and introduced plants. Thus, *Ginkgo* and *Rheum* are included without reference to their origin or distribution. On the other hand, *Picea* has been left out. Perhaps the most serious fault in the treatment of species has been the omission of any ecological, geographical, or economic comments. An additional reference work will always be necessary for one who wishes to know as much about a species as he would ordinarily want to know. Species descriptions and comments would have added immeasurably to the value of the manual for students.

It would be unfair to criticize this manual, which has been designed primarily as a diagnostic key, entirely on grounds of what it could have been. Specialists may well be disappointed in the treatment of species, and others may wish for more information, such as maps, geologic history, drawings, and chromosome numbers, but as a clear and refined set of keys this book has few equals. One can hope that a revised edition will include not only these keys but also the usual supplementary information. — ROBERT W. LONG, OHIO WESLEYAN UNIVERSITY.

AN INDISPENSABLE MANUAL OF TROPICAL MARINE BOTANY. — Biologists interested in the marine algal flora of the tropical and subtropical coasts of the United States and the Caribbean area have long awaited the appearance of a comprehensive taxonomic manual to facilitate the determination of their collections. Taking into consideration the spectacular and highly diversified nature of the marine algal flora of this region, one is struck by the relative paucity of systematic treatments relating to it; descriptions of tropical American species have been widely scattered through general taxonomic works, such as Agardh's *Species Algarum* (1820-28), and the first important attempt to deal with them critically on a regional basis was that of W. H. Harvey in his *Nereis Boreali-Americana* (1852-58). For practical purposes of recent years, those wishing to identify marine algae of Florida and the Caribbean area have had recourse mainly to two manuals, namely Børgesen's *Marine Algae of the Danish West Indies* (1913-20) and W. R. Taylor's *Marine Algae of Florida, with special reference to the Dry Tortugas* (1928). Both of these, although critical and valuable treatments, cover the marine algae flora of restricted areas only and make no claims to exhaustive coverage.

The appearance of a marine algal flora for the whole of the Eastern American tropical and subtropical seaboard,[1] from Bermuda and North Carolina to Southern Brazil, therefore satisfies an acute and very long-felt need.

Dr. Taylor's book of 870 pages, with numerous plates of illustrations, contains descriptions of, and keys to, all the

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[1] WILLIAM RANDOLPH TAYLOR: *Marine Algae of the Eastern Tropical and Subtropical Coasts of the Americas.* UNIVERSITY OF MICHIGAN PRESS, Ann Arbor, Mich., 1960. 8°, vii-ix +, 870 pp., 14 text-figs., 80 plates. $19.50.

genera and species of marine algae known from this area, the total number being 272 genera, 760 species, and 140 infraspecific taxa. The treatment follows the same lines as the same author's well known *Marine Algae of the Northeastern Coast of North America* (1937, 1957), in which, from Virginia to the Eastern Arctic, 401 species were recorded; the approximate doubling of this number in the present manual emphasizes in a very striking way the richness and diversity of the tropical and subtropical element along the Eastern American coasts. Like the earlier work mentioned above, Dr. Taylor's new manual makes no claim to present a critically monographic treatment of all groups, which is of course a task yet to be accomplished, piecemeal, by generations of future workers. Nevertheless, it embodies the results of well over thirty years of practical acquaintance with the flora in shore and herbarium studies, and the species descriptions for the most part incorporate original and independent observations on the part of the author. Those species known only from the descriptions have been evaluated insofar as possible and, unless completely dubious, inserted in the keys. Original references, except when unique, are not given for all species, but at the end of each description there follows a bibliographic selection including all the more important geographic, and most of the morphological, data published on the species in the past. The distribution of each species is given in terms of the various islands and coastal segments comprising the area, together with information on the special ecology and mode of occurrence.

The descriptions of genera and species, with the accompanying keys, form the greater part of the book, the "Descriptive Catalogue", from page 44 onwards. The preceding pages contain a general introduction divided into the following sections: "Historical survey", "Geographical distribution", "Algal habitats", and "Collection and preservation". For the non-specialist, the section on "Algal habitats" contains much of considerable general interest, illustrated by 14 full page reproductions of photographs taken by the author in Bermuda and Jamaica of various littoral and sublittoral associations.

Latin descriptions of the new taxa (1 new family, *Wurdemanniaceae* in the Florideae, 8 new species and 4 new varieties) are assembled together as an appendix at the end of the descriptive section.

The extensive bibliography contains references to all works in which the geographical distribution and essential morphology of the marine algae of the region has been dealt with.

As with Dr. Taylor's treatment of the Northeastern Coast flora, considerable care has been taken to present a series of illustrations showing the general appearance and *habitus* of many of the commoner species, as well as of the details of their microscopic organization. In the present book the amount of illustration may be termed lavish, to the extent of 74 plates of line drawings and 6 of photographs. The drawings, apart from those executed by the author himself, were prepared by a team of several artists, and a certain disparity in treatment and technique is obvious, but all are extremely good and naturalistic representations, with the exception of a very few in which the artist, like his predecessors in ancient Egypt, seems to have had some difficulty in producing on a flat surface the illusion of a third dimension.

The index is arranged by names of species and higher taxa; varieties are indented under the species to which they belong. One small error in alphabetical placing was noted on page 866, the duplication of entries for *TITANOPHORA* (J. Ag.) Feldm.

For those working on aspects of tropical and subtropical marine biology in which an understanding of the marine plant life is essential, this book is indispensable for the routine identification of collections; while for the student with less specialized approach but with a lively interest in the remarkable world of offshore plant life in tropical and subtropical waters, its fascinatingly written introduction will stimulate, instruct, and probably lure not a few, whose interest has previously been held in check by lack of readily accessible information, to delve into the taxonomic profundities of the descriptive section.

Dr. Taylor is to be congratulated on the production in such eminently adequate format of this fundamental and extensively documented marine flora. — I. MACKENZIE LAMB.

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AN ECOLOGICAL INTERPRETATION OF RHODODENDRON COLONIES IN MAINE AND NEW HAMPSHIRE

A. R. HODGDON AND RADCLIFFE PIKE

Over a large part of its natural range *Rhododendron maximum* is a local or rare species occupying certain unique habitats. Thus its disjunct distribution in the peripheral part of its range can be explained in part by the discontinuity of possible habitats. But after making extended observations of rhododendrons in central and northern New England we have seen that there are many more apparently suitable places for the species to grow than there are colonies. One explanation of this interesting fact might be that wind dispersal results in the establishment of new colonies only here and there as the minute seeds are fortuitously blown into new areas. Yet wind dispersal for great distances does not seem to warrant much consideration due first to the very protected and nearly windless sites in which the Maine and New Hampshire colonies are found and our failure to find seedling reproduction beyond one to two hundred feet away from mature plants. We might more reasonably account for the more disjunct colonies on the basis of their being relics of an earlier more continuous distribution of the species, the assumption here being that various disturbances have occurred to destroy them in many of the swampy areas that now seem to be entirely suitable for them. The recent fluctuations in size of a number of rhododendron col-

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onies in Maine and New Hampshire as reported by us recently[1] give some support to the contention that a great decline in both number and size of colonies could indeed have resulted from the climatic changes that are known to have occurred many times in the post glacial period. A recent review[2] points up the nature of some of these climatic oscillations. The data presented in this paper make it seem likely that the limits of tolerance of rhododendron for certain climatic factors have been exceeded locally during some of the more severe climatic minima. At two periods in post glacial times climatic conditions were apparently such as to make possible the northward migration of warmer floras. These moderate periods were followed by decidedly colder more rigorous climatic conditions. For rhododendron to have persisted as a relic, one must postulate not only a once wider and more general distribution which could conceivably have occurred during these two warmer periods but also a continuity of suitable habitats from the time when the species was more or less continuously distributed.

There have been several papers on *Rhododendron maximum* emphasizing its distributional peculiarities and something of its ecology. Recently Iltis[3] has discussed interestingly and in some detail an outlying colony in the Coastal Plain of Virginia below Fredericksburg. He found that the majority of common species of associated trees and shrubs there were also among the dominant species listed by Spencer[4] in his study of 36 New Jersey Colonies and by Griggs[5] for the Sugar Grove Region of Ohio. The Virginian

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[1] Hodgdon, A. R. and Pike, R. "Recent Changes in Some Rhododendron Colonies in Maine and New Hampshire". Rhodora **62**: 87-93, April 1960.

[2] Dorf, Erlig. Climatic Changes of the Past and Present. American Scientist **48**: 341-364, September 1960.

[3] Iltis, Hugh H. Studies in Virginia Plants II. *Rhododendron maximum* in the Virginia Coastal Plain and its Distribution in North America. Castanea **21**: 114-24, September 1956.

[4] Spencer, Ernest L. "Natural distribution of *Rhododendron maximum* in New Jersey". Bull. Torr. Bot. Club **59**: 401-14, 1932.

[5] Griggs, R. F. A Botanical survey of the Sugar Grove Region. Ohio State University Bull. **18** (25): 273-75, 328, 1914.

TABLE I. Colonies of *Rhododendron maximum* in Maine and New Hampshire. (The first 7 stations listed are in Maine, the others are in New Hampshire).

Location "Township"	Characteristics of site	Size (estimated)
1. Lexington	Swamp and south facing slope mostly swamp (seedlings)	½ acre
2. Standish (1)	Swamp and south facing slope mostly swamp (seedlings)	3½ acres
3. Standish (2)	Swampy woods (seedlings)	½ acre
4. Standish (3)	Well drained ridge adjacent to swamp	1/12 acre
5. Standish (4)	Swampy woods	1/20 acre
6. Acton	Gently south facing and well drained slope	10 x 6 ft.
7. Sanford	North facing slope of about 20% in steepest part (seedlings)	5 acres
8. Albany	Steep north facing mossy and wet ledges (seedlings)	1/3 acre (concentrated); few plants scattered over acre.
9. Pittsfield-Barnstead	Swampy wooded pond north-facing shore (seedlings)	1/3 acre
10. Grantham	Swampy woods (seedlings)	¾ acre
11. Manchester (1)	Slope at eastern edge of swamp and in swamp: reported to have covered formerly scores of acres in swamp (seedlings)	2 acres on slope, acreage in swamp uncertain but plants decidedly scattered there.
12. Manchester (2)	Slope facing northeast	¼ acre
13. Manchester (3)	Swampy woods and bed of stream	½ acre
14. Hopkinton	Moist but scarcely swampy woods	1/16 acre
15. Mason	Swamp and adjacent west facing slope mostly swamp (seedlings)	7 acres
16. Wilton	Northerly slope and bank of stream (seedlings ?)	1/3 acre
17. Fitzwilliam	Mostly swampy woods but also adjoining slopes and ridges (seedlings)	15 acres
18. Richmond	Swampy woods said to have covered 7-8 acres formerly (seedlings)	1½ acres
19. Harrisville	Swampy woods (seedlings)	½ acre

Colony resembled the New Jersey stands also in having a strongly acid soil, pronounced shade and abundant water. Iltis agreed with Spencer's conclusion for New Jersey that the distribution of *R. maximum* in Virginia is governed by topography and not by climate. It should further be noted that the Virginia colony, all of those in New Jersey reported by Spencer and those in Ohio mentioned by Griggs (see references) are on north-facing slopes or, in the case of a few in New Jersey, in swamps.

During recent field work we have recorded for each of our 19 Maine and New Hampshire colonies, such facts as the associated woody species, the absence or presence of seedling rhododendrons, the nature of the habitat — whether swamp or slope and, if so, the direction of slope as well as some other features. We are now in a position therefore to evaluate the ecological requirements of *R. maximum* by comparing our colonies with those discussed by Iltis, Spencer and Griggs. Since we had no reason to doubt that the soils in all colonies were definitely acid and moreover because of the mass of scientific evidence that shows the oxylophytic character of the species, we decided at the outset not to include pH determinations as part of the record. We did attempt to determine the area of each stand, however, to provide a basis for evaluating the changes that may occur in the future.

TABLE I.

Table I shows 11 of our colonies to be chiefly in swamps, one other (Manchester (1)) divided between a swamp and an adjoining east-facing slope, 4 colonies on north-facing slopes, 2 very small colonies in non-swampy woodland and 1 small stand on a south-facing slope. But it should be remarked that of the 11 swamp-colonies, 2 have excellent rhododendrons on their adjacent south-facing slopes and another has prolific plants on the west-facing adjacent slope. In contrast to the situation in New Jersey, the Coastal Plain of Virginia and in Ohio, swamps generally provide better habitats for rhododendrons in Maine and New Hampshire than do slopes. Also with us the direction of slope does not seem to be critical. We have pointed out elsewhere[6] that juxtaposition of swamps and adjacent slopes as alternative habitats for rhododendrons in many of the finest Maine and New Hampshire colonies may provide the species with a means of surviving environmental changes.

Seedlings were noted in all of the larger colonies in Maine and New Hampshire and in some of the smaller stands as

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[6] Hodgdon, A. R. and Pike, R. "Recent Changes in Some Rhododendron Colonies in Maine and New Hampshire". Rhodora 62: 87-93, April 1960.

well. Thirteen colonies (more than 68%) had seedlings in contrast to the situation in New Jersey where Spencer reported seedlings in only 5 of his 36 stations (less than 14%). Since Spencer's observations were made about 30 years ago we are led to speculate on the present condition of the New Jersey stands as a result of the tendency for temperatures in Northeastern United States to rise appreciably between

TABLE II. List of tree-species associated with *R. maximum* in Maine and New Hampshire Stations: X indicates presence*

	Lexington	Standish (1)	Standish (2)	Standish (3)	Standish (4)	Acton	Sanford	Albany	Pittsfield-Barnstead	Grantham	Manchester (1)	Manchester (2)	Manchester (3)	Hopkinton	Mason	Wilton	Fitzwilliam	Richmond	Harrisville
Acer rubrum	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tsuga canadensis	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
Betula lutea	X	X	X		X		X	X		X	X	X	X	X	X		X	X	X
Betula papyrifera		X	X	X			X	X	X		X		X		X	X	X		X
Fagus grandifolia		X	X	X		X	X	X	X		X			X	X			X	
Pinus strobus			X	X		X					X	X	X	X	X	X	X	X	X
Quercus rubra		X		X		X	X		X		X	X		X		X			X
Picea rubens			X	X	X			X		X	X						X	X	X
Nyssa sylvatica		X	X	X			X				X				X		X		X
Betula lenta									X		X		X		X		X		
Fraxinus nigra	X	X								X							X		X
Fraxinus americana			X	X									X		X				
Abies balsamea		X			X					X							X		
Quercus alba						X						X	X						
Acer saccharum									X*							X			
Castanea dentata										X		X							
Betula populifolia								X					X						
Populus grandidentata							X										X		
Pinus resinosa										X									
Thuja occidentalis	X											X							
Chamaecyparis thyoides				X															
Quercus velutina													X						
Q. coccinea																X			
Q. prinus														X					
Carpinus caroliniana						X													
Ostrya virginiana														X					
Ulmus americana																	X		
Populus tremuloides																	X		
Prunus pennsylvanica																	X		
Prunus serotina																			
Tilia glabra									X										

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* The nomenclature in this paper follows that of Gray's Manual of Botany, 8th edition, 1950.

the years 1930 and 1955.[7] Such temperature rise might easily further reduce areas suitable for seedling reproduction as our observations indicate that *R. maximum* seedling reproduction takes place only on mossy generally moist sites.

Tables IV and V, which compare the associated species of woody plants growing along with *Rhododendron maximum* in the 4 areas under consideration, point up certain similarities, notably the almost universal presence of *Acer rubrum* and the rather high frequency of *Tsuga canadensis*. *Kalmia latifolia*, *Cornus florida* and *Quercus alba* are the three other species that are present in more than half of the New Jersey

TABLE III. List of shrub-species associated with *R. maximum* in Maine and New Hampshire Stations.

	Lexington	Standish (1)	Standish (2)	Standish (3)	Standish (4)	Acton	Sanford	Albany	Pittsfield-Barnstead	Grantham	Manchester (1)	Manchester (2)	Manchester (3)	Hopkinton	Mason	Wilton	Fitzwilliam	Richmond	Harrisville
Hamamelis virginiana	x	x	x						x		x	x		x	x			x	
Viburnum cassinoides			x	x	x		x		x				x				x	x	x
Viburnum alnifolium	x		x		x		x		x		x								
Nemopanthus mucronata		x			x		x										x	x	x
Acer pensylvanicum		x	x		x			x			x								
Vaccinium corymbosum							x		x		x			x				x	
Ilex verticillata							x			x	x	x							x
Kalmia latifolia											x				x		x	x	
Acer spicatum	x							x		x									
Kalmia angustifolia							x		x					x					
Epigaea repens var. glabrifolia		x									x			x					
Linnaea borealis var. americana		x							x								x		
Alnus rugosa										x		x							
Lyonia ligustrina											x							x	
Vaccinium angustifolium											x			x					
Salix Bebbiana										x									
Lindera Benzoin													x						
Sassafras albidum											x								
Pyrus floribunda																			x
Amelanchier laevis							x												
Rhus radicans													x						
Vaccinium myrtilloides									x										
Lonicera canadensis			x																
Viburnum recognitum												x							
Sambucus pubens								x											

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[7] Braun, E. L. Deciduous Forests of Eastern North America, Blakiston, 1950.

stands and might therefore be regarded as being characteristic associates of rhododendron in that area. However *C. florida* is absent from all Maine and New Hampshire colonies, occupying instead only certain well drained and warm exposures often with *Quercus velutina* — very different sites indeed from those of rhododendron. Mountain Laurel is similarly a disjunct species over most of its Maine and New Hampshire range; again it is adapted there to better drained habitats though occupying the same general range. *Quercus alba* on the other hand is a common forest tree in much of southern New Hampshire and southwestern Maine; yet it is met with in only 3 of the nineteen colonies; it too grows more commonly in drier places.

TABLE IV. Presence of Common New Jersey woody species in four Rhododendron areas: the figure given is the percent of stands (to the nearest full number) in which a species was observed; ×=present

Species	New Jersey Spencer 1932	Maine and New Hampshire	Ohio Griggs 1914	Virginia Iltis 1956
Acer rubrum	94	100	×	×
Tsuga canadensis	72	95	×	—
Kalmia latifolia	69	21	×	×
Cornus florida	61	—	×	×
Quercus alba	58	16	×	×
Quercus velutina	42	5	×	—
Q. Prinus	42	5	×	—
Betula lenta	39	26	×	—
B. lutea	39	79	—	—
Fagus grandifolia	28	58	×	×
Liriodendron tulipifera	25	—	×	×
Chamaecyparis thyoides	5.5	5	—	—

Of the remaining so-called "Common Species" *Betula lutea* is associated with rhododendron in 15 of our 19 stands though it is present in only 14 of the 36 New Jersey colonies and it is not mentioned by Griggs in Ohio nor is it present in the Virginian Colony studied by Iltis. *Fagus grandifolia* seems to do a bit better being present in all 4 areas but occupying only 10 stands out of 36 in New Jersey and 11 of our 19. Of the other prevalent species in the Ohio, New Jersey and Virginia stands, *Liriodendron tulipifera* does not extend north of southern New England while *Quercus Prinus* barely gets into southern New Hampshire and Maine.

Turning to the commonest Maine and New Hampshire associates, aside from those already mentioned, we find several species that would be found very rarely if at all in the other 3 areas. Such include *Betula papyrifera, Pinus strobus, Viburnum alnifolium, Picea rubens* and *Viburnum cassinoides.*

TABLE V. Presence of Common New Hampshire Woody species in four Rhododendron areas

Species	Maine and New Hampshire	New Jersey	Ohio	Virginia
Acer rubrum	100	94	×	×
Tsuga canadensis	95	72	×	—
Betula lutea	79	39	—	—
Betula papyrifera	63	—	—	—
Fagus grandifolia	58	28	×	×
Pinus strobus	63	—	—	—
Quercus rubra	53	—	—	×
Hamamelis virginiana	47	sometimes present	×	×
Picea rubens	47	—	—	—
Viburnum cassinoides	47	—	—	—
Nyssa sylvatica	42	—	×	—
Viburnum alnifolium	32	—	—	—
Betula lenta	26	39	×	—
Fraxinus nigra	32	—	—	—
Nemopanthus mucronata	32	—	—	—
Acer pensylvanicum	26	—	—	—
Vaccinium corymbosum	26	—	—	—

In Braun's "Deciduous Forests of Eastern America" frequent mention is made of the types of forest communities in which *Rhododendron maximum* occurs, *Tsuga canadensis* being usually a dominant tree where rhododendron is found and *Acer rubrum* occurring commonly. The presence of other species of trees depends on the peculiarities of the habitat and the geographical area in which the rhododendrons are found. These also are the only two species that appear repeatedly in a majority of colonies under consideration in this paper. Of the 15 other commonest associated species of trees in Maine and New Hampshire 11 are absent in New Jersey, 11 in Ohio and 13 in the Virginian Coastal Plain, the remaining species having no high order of coincidence in these places either.

For local parts of the range of *Rhododendron maximum* there seems to be some usefulness in recognizing a characteristic rhododendron association, because the same group of associated species of plants is met with over and over again. But over the whole range the associates may change markedly; the nearly ubiquitous Tsuga may give way to *Picea rubens* at one extreme of climatic tolerance of rhododendron or to *Chamaecyparis thyoides* at another.

Good[8] has stated that each species has its particular range of tolerance. As a corollary it may be assumed that no two species, unless they are mutually dependent, have precisely the same range of tolerance of environmental conditions. A consideration of the associated woody species growing with *Rhododendron maximum* in various parts of its range lends support to this contention. Obviously none of the associated species has precisely the same tolerance of environmental factors as *R. maximum.* Those that are most frequently associated with it over its entire range are those that presumably most closely approach it in tolerance. But many of the common associated species in any one part of the range have very different amplitudes of environmental tolerance from that of rhododendron and therefore will be absent from climatically different parts of the range. It seems preferable to interpret the facts of the *Rhododendron maximum* "association" in this way rather than to try to contrive a definite rhododendron association to embrace any considerable portion of the area that it occupies. On the other hand, it is to be expected that whenever environmental conditions are somewhat similar there will be essentially the same associates unless indeed these associates have had a different history and followed different migrational paths. It can be seen then that *Tsuga canadensis* and *Acer rubrum* have ranges of tolerance somewhat similar to that of *R. maximum.* But *Betula lutea* and other northern associated

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[8] Good, R. A Theory of Plant Geography. New Phytologist 30: 155, 1931.

species have ranges of tolerance overlapping that of *R. maximum* only in the northern States.

We must conclude from this comparison of *Rhododendron maximum* colonies in 4 outlying parts of its range that 1. There is no single physiographic situation to which the species is confined so long as an abundance of moisture is available. 2. There is no such thing as a predictable association of species with which *Rhododendron maximum* is constantly to be found. 3. Within any particular climatic zone the rhododendron association is usually composed of essentially the same dominant species and often occupies similar physiographic situations. 4. The suggestion is made that Good's concept of tolerance suggests a reasonable explanation of the observed diverse character of the rhododendron association. — DEPARTMENT OF BOTANY AND DEPARTMENT OF HORTICULTURE, UNIVERSITY OF NEW HAMPSHIRE, DURHAM, NEW HAMPSHIRE.

TAXONOMIC FERN NOTES. I

ROLLA TRYON

1. **Adiantum humile** Kze.

The name *Adiantum humile* Kze., based on a Poeppig collection from Peru, has seldom appeared in the literature since it was first published and to my knowledge has never been treated in a definitive manner. Mettenius identified *Lechler 2319* and *2319a* (B!) from Peru as *A. humile* but he did not publish these identifications in *Filices Lechlerianae;* the specimens are *Adiantum terminatum* or a variant of it.

An authentic specimen of *Adiantum humile* is at Vienna and a photograph of this specimen and fragments from it were obtained for the British Museum (Natural History) by the late A. H. G. Alston. This specimen has a valid claim to represent the name since the holotype was presumably destroyed with the Herbarium at Leipzig and since it is perhaps the only authentic material now extant (I saw no type material at B, BM, K, L, LE, P, S-PA, or U). I studied this authentic material and it unquestionably represents the species described by Maxon and Weatherby as *Adiantum Killipii.* Such specimens as *Guppy 6192, Tutin 366* and *Leprieur 145* (all BM) are substantially identical to the Poeppig collection.

The description of this species by Maxon and Weatherby (as *A. Killipii*) is an excellent one; it may be amplified by some comments about the variation of the indument. Narrow scales (these two or three cells broad at their base), as well as trichomes, often occur on the under surface of the segments. The scales or trichomes occur especially toward the base of the ultimate segments and as Kramer[1] has noted, they are more persistent on the fertile segments than on the sterile ones, which indeed, may be glabrate. In some specimens only trichomes are present on the under surface of the segments, in others there are trichomes and also a few scales and in yet others the scales are more abundant than the trichomes.

Adiantum humile occurs from British Honduras to Panama, east to French Guiana and Trinidad, south to the state of Amazonas, Brazil and to Peru. The only recent collection that I have seen from Peru is: Quimiri Bridge, La Merced, Dept. Junín, *Killip & Smith 24003* (NY, US).

Adiantum humile Kze. Linnaea **9**: 80. 1834. Holotype: "In sylvis fl. Huallagae superior. Peruv. ad Mission Tocache, Jun. 1830", *Poeppig,* Herb. Kunze, LZ, destroyed. Authentic specimen: "Maynas, alto fl. silvis primaeva, Toache [Tocache], Maj. 1830", *Poeppig,* W, photograph and fragments BM!

Adiantum Killipii Maxon & Weath. Amer. Journ. Bot. 19: 166. 1932. Holotype: Ancón Hill, Canal Zone, Panama, *Killip 2752,* US! (15 paratypes are also cited).

2. **Adiantum lobatum** Presl (Plate 1255, fig. 1).

Two recent collections by D. S. Correll and E. E. Smith from the Department of Lambayeque, Peru, apparently represent this species which has been little, if at all, understood since it was published. These collections are rather similar to *A. brasiliense* and *A. curvatum* in the leaf-architecture

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[1] Acta Bot. Neerland. **3**: 482. 1954.

and in the minute puberulence only on the upper surface of the rachis and lesser axes. However, in those two species the sori are oblong or oblong-lunate and the segments are strongly dimidiate. In the Peru material the sori are orbicular to suborbicular and although some segments are dimidiate (but not strongly so), others are subdimidiate or flabellate.

A photograph of the holotype of *A. lobatum,* a single rather small leaf, agrees closely with the Correll & Smith collections in characters of the ultimate segments, and also, allowing for the difference in the size of the leaves, with its characters of leaf-architecture. The lack of a rhizome in the holotype introduces an element of uncertainty in its identity. Also Presl described the leaves as glabrous while in the Peru material they are minutely puberulent on the upper side of the rachis and other axes of the lamina. Presl, however, might well have overlooked this small character. While it is by no means certain, then, that the present specimens represent Presl's species, they do not seem to belong to any other, and I think it is better to use Presl's name for them, albeit tentatively, rather than to describe them as new.

Adiantum lobatum Presl, Rel. Haenk. **1**: 62, t. 10, f. 4. 1825. Holotype: Guayaquil, 1790, *Haenke,* PR, photograph GH! (Presl's illustration is a very accurate copy of the specimen; Presl gave the locality as Mexico but the label accompanying the photograph gives Guayaquil). *Adiantum lobatum* "(Poir.)" Steud. Nomencl. Bot. 2: 275. 1824, in synonymy of *Lindsaea lobata* Poir. is invalid.

Dept. Lambayeque, Peru: 27 km. from Olmos on road to Jaen, 1250 m., March 23, 1960, *D. S. Correll & E. E. Smith P801* (GH,LL,US); 31 km. from Olmos on road to Jaen, 1400 m., March 23, 1960, *D. S. Correll & E. E. Smith P808* (GH, LL).

The following description will serve to orient this species, as I interpret it, within the genus.

Rhizome rather slender, creeping, the petioles spaced but not distant, scales ca. 1-2 mm. long, long-triangular, acuminate to lanceolate-acuminate, wholly sclerotic, brown to atropurpureous; leaves to 60 cm. long, lamina deltoid to long-triangular, bipinnate to tripinnate at

Plate 1255. Fig. 1. *Adiantum lobatum*, × 1/3, *Correll & Smith P801* (GH). Fig. 2. *Cheilanthes Orbignyana*, × 1/4, *Sagástegui 2937* (GH).

the base, bipinnate below the large conform terminal pinna, rachis subflexuous, it and the other axes faintly glaucous, minutely puberulent on the upper, darker colored surface, glabrous and lighter colored beneath; ultimate segments toward the apex of the pinna oblong to trapeziform, subsessile to short-stalked, those toward the base of the pinna subflabellate or flabellate, with longer stalks, the terminal ones flabellate-cuneate, all entire to usually sparingly and moderately incised (sometimes strongly so), non-articulate, the dark color of the stalk entering the base of the segment; sterile vein tips end between the indistinct marginal crenulations; sori orbicular to suborbicular, borne on all margins of the fertile segment except the lower one.

3. **Cheilanthes fractifera** Tryon, Rhodora **62:** 7. January, 1960

Cheilanthes Saundersii Alston, Lilloa **30:** 110, t. 6. August, 1960. Holotype: Dept. Lima, prov. Huarochiri, dist. Surco, *S. G. E. Saunders 350*, BM; paratype: (from the same district) *Saunders 219*, BM! GH!

This recently recognized species has been independently described by myself and the late A. H. G. Alston. Although I did not see *Saunders 350* at the British Museum, Alston's photograph (t. 6), his description and the citation of *Saunders 219* (also a paratype of *C. fractifera*), all confirm the identity of his species with mine. Dr. Alston's paper was certainly prepared before I had seen any material of this species and it is unfortunate that its publication was delayed.

In addition to the collections cited by myself *(Correll & Smith P169, Saunders 219)* and by Alston, two specimens collected by *Rauh & Hirsch* in Peru were seen at Berlin: Rimac Valley, Dept. Lima, *P143* and Cerros de Caldera desert, Dept. Arequipa, *P570*.

4. **Cheilanthes Orbignyana** Mett. ex Kuhn
(Plate 1255, fig. 2)

Cheilanthes Orbignyana is evidently a valid species although a very rare one; there is no previous material of it at the Gray Herbarium or the United States National Herbarium. An isotype at Paris (La Laguna, Bolivia, *D'Orbigny 388*) is represented in the Gray Herbarium by descriptive notes by Mr. C. A. Weatherby and a photograph taken by Mrs. Weatherby.

The following specimen, the first from Peru, compares very closely with these materials and I believe that its identification with them is reasonably certain: La Pampa, Guzmango, prov. Contumazá, Dept. Cajamarca, Peru, 2730 m., May 30, 1959, *Sagástegui 2937* (GH,US). This may be distinguished from the other Peruvian species that lack hairs or scales on the lamina by the following key.

Pinnules, or most of them, sessile; rhizome scales with a dark sclerotic central portion and pale, thinner margins. *C. Poeppigiana.*
Pinnules petiolulate or, at least most of them, on short broad stalks; rhizome scales entirely, but not always heavily, sclerotic.
  Indusia extending along the segment stalks and pinna-rachises. *C. marginata.*
  Indusia confined to the segments.
    Rhizome short, erect, the petioles clustered; petiole, especially in the apical half, flat to convex between small lateral ridges. *C. Orbignyana.*
    Rhizome short, creeping, the petioles rather spaced; petiole, especially in the apical half, sulcate between the prominent lateral ridges. *C. rufopunctata.*

5. **Costaricia** Christ (Plate 1256, figs. 3, 4)

The genus *Costaricia*, described by Christ in 1909 on the basis of a sterile fern collected by Wercklé in Costa Rica, has never been understood and Christensen listed it in *Index Filicum Suppl.* 1 and again in *Suppl.* 3 as a *genus valde dubium.* The type material at Paris consists of *Wercklé no. 238* mounted on two sheets; a photograph of one of them is given in fig. 3. This material is wholly sterile but while studying it some of its characters reminded me of two fertile collections from Costa Rica I had examined while working on *Dennstaedtia.* A later comparison of these with my notes and photographs of the Wercklé collection indicated that they were portions of fertile leaves of *Costaricia Wercklena* and that the original material represented a juvenile plant. On the basis of the fertile material (Fig. 4) it is now possible to draw a more satisfactory description of the genus (or species).

Rhizome (of juvenile plant) long-creeping, slender, pubescent with more or less moniliform trichomes, their short cells with clear whitish side and brown end walls, the leaves borne singly at intervals; leaves probably to 1 m. or more tall, to tripinnate, acroscopic, herbaceous, bearing trichomes similar to those of the juvenile rhizome, especially on the upper surface in the grooves of the major axes and on each side of the costa of the penultimate segments; veins free, the sterile tips ending well back of the margin and not enlarged; pinnae and pinnules subarticulate; sorus terminal on a lobe, the receptacle, a continuation of the single vein, elongate within the rather cuneate, slightly bilabiate indusium which is formed of a more modified inner true indusium and a less modified outer opposed lobe of leaf tissue, these being almost wholly joined to the tissue of the lobe which extends well up on each side; sporangia developing in a basipetal sequence, paraphyses absent (although persistent stalks of previously maturing sporangia may simulate them), annulus vertical, or more or less displaced by crowding in the sorus, of 10-12 indurated cells, these extending from near the apex of the capsule down to the apex of the stalk.

The characters strongly suggest that *Costaricia Werckleana* is a species of *Dennstaedtia,* although if this is true, then it is not at all closely related to any other of the American ones. It was for this reason (as well as the absence of information about the rhizome) that I did not account for the fertile material in my paper on American Dennstaedtia. The most distinctive characters of *C. Werckleana* in comparison with American Dennstaedtias are the subarticulate pinnae and pinnules and the leaf tissue that extends well up on each side of the sorus. These characters, however out of place among the New World species, are known in some of those of southeast Asia. For example, *D. ampla* (Bak.) Bedd., *D. glabrata* (Ces.) C. Chr. and *D. Elmeri* Copel. have articulate segments and *D. scabra* (Wall. ex Hook.) Moore sometimes has a substantially identical sorus. It is possible then, or perhaps probable, that *C. Werckleana* is a species of *Dennstaedtia.*

However, the rhizome of the adult plant, and especially its indument, must be known before it can be placed in *Dennstaedtia* with certainty. The adult rhizome may have a dif-

Plate 1256. *Costaricia Werckleana.* Fig. 3. Holotype, ca. × 1/3, *Wercklé 238* (P). Fig. 4. Two pinnae, × 1/3, *Brade 336* (NY).

ferent type of indument than the juvenile one as in *Sphenomeris* in which the adult rhizome may bear scales while the juvenile one may bear only trichomes. Until more adequate material of *Costaricia Werckleana* is available, the possibility that it represents an endemic genus can not be eliminated.

For the present, then, I prefer to retain *Costaricia* as a dubious genus rather than to reduce it to *Dennstaedtia* and make a new combination that may be taxonomically incorrect.

Costaricia Werckleana Christ, Bull. Soc. Bot. Genève II, 1: 229, fig. on 230. 1909. Holotype: Costa Rica, 1903, *Wercklé 238*, P! Other specimens examined: (all from Costa Rica) La Palma, 1400 m., 1909, *Brade 336* (NY, US ex Rosenst., US ex C); La Hondura, 1200 m. 1933, *Valerio 1815* (US).

6. Synonyms in **Dennstaedtia**

The examination of certain type or authentic specimens has enabled me to place some of the dubious names listed[2] in my recent paper on American Dennstaedtia.

Dennstaedtia divaricata (Sod.) C. Chr. = **D. arborescens** (Willd.) Ekman ex Maxon. Authentic specimen: Niebly, Ecuador, 1883, *Sodiro*, P!

Dennstaedtia erosa (Kze.) Moore = **D. obtusifolia** (Willd.) Moore. A probable isotype: "Pampayaco, Peru, July, 1829, *Poeppig 169*" (det. Kunze), B! is taken to represent this name since the holotype was presumably destroyed with the Herbarium at Leipzig. The data on the Berlin specimen are the same as those given by Kunze except that he cited "*Diar. 1127*" rather than "*no. 169*". A fragment (one pinnule) at K! (ex Kunze, det. Kunze) is also *D. obtusifolia* as are probable isotypes at LE! and P!

Dennstaedtia grandifrons Christ = **D. distenta** (Kze.) Moore. The type was not seen at Paris but an authentic specimen is *D. distenta: Münch 154* (Herb. Christ, det. Christ), P!

Dennstaedtia Munchii Christ = **Hypolepis** sp. The holotype, *Münch 137*, was not seen at Paris; a specimen at US

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[2] Contrib. Gray Herb. 187: 52. 1960.

Plate 1257. Fig. 5. ***Notholaena angusta***, × 1/3, paratype, *Broun in 1937* (PH). Fig. 6. ***Notholaena cantangensis***, × 1/2, holotype, *López & Sagástegui 3366* (GH).

(ex Stanford) with this name but with number *76* is probably an isotype incorrectly numbered.

Dennstaedtia Orbignyana Mett. ex Kuhn = **D. obtusifolia** (Willd.) Moore. Holotype: *D'Orbigny 278,* (Herb. Mett.) B!; isotype, P!

Dennstaedtia vagans (Bak.) Diels = **D. arborescens** (Willd.) Ekman ex Maxon. The holotype, Andes of Quito, Ecuador, *Sodiro,* K! is evidently a juvenile leaf-form.

7. **Notholaena angusta,** spec. nov. (Plate 1257, fig. 5)

Rhizoma breve paleis rigidis obscuris scleroticis nitidis pectinato-ciliatis. Folia 5-20 cm. alta, petiolus quam lamina brevior teres rubelle brunneus vel nigrescens fasciculo vasculari uno ceraceo-glandulosus glande plerumque longe cauliculatis trichomatibus paucis magnis brunneis modice paleaceus paleis eis rhizomatis similibus nisi brevioribus ad 1 mm. longis. Lamina linearis modice pinnato-pinnatifida vel pinnato-pinnatisecta, rhachis modice paleacea teres vel subteres trichomatibus multis circa 0.5 mm. longis eis petiolorum similibus. Pinnae ad 30-jugae oblongae obtusae plus minusve aequilaterales segmentis obtusis 2-3-jugis coriaceae pagina superiore modice albo-ceracea pagina inferiore dense albo-ceracea costa trichomatibus paucis magnis brunneis. Venulae 1-2-furcatae sporangia 64-sporis in apicibus gerentes, margem immutatus leviter revolutus.

Specimens examined (all from Hidalgo, Mexico): Holotypus: ca. 1 km. south of Tasquillo Bridge, Jan. 23, 1941, *T. C. & E. M. Frye 3145* (US). Paratypi: Near Barranca de Veneado, 1800 m., Sept. 23, 1951, *E. Matuda & D. B. Gold* (Matuda Herb. no. 23571) (US); Near Tasquillo, 8000 ft., July 17, 1940, *C. L. Hitchcock & L. R. Stanford 7249* (US); Río Tula, Puente Tasquillo, arid rocky slopes, March 8, 1937, *M. Broun* (PH).

This new species will key out with *Notholaena Schaffneri* in my revision of the American species of Notholaena[3]. It may be separated by the following key which modifies and amplifies my published one.

29. Lower surface of the lamina and the rachis with large, brown trichomes; rhizome scales dark sclerotic, rigid, strongly pectinate-ciliate. 29a.
    29a. Lamina elliptic-lanceolate, bipinnate-pinnatifid; the larger scales of the petiole ca. 2-3 mm. long, the trichomes of the rachis ca. 1 mm. long. . . . 29. *N. Schaffneri.*

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[3] Contrib. Gray Herb. 179: 11. 1956.

29a. Lamina linear, pinnate-pinnatifid to pinnate-pinnatisect; the large scales of the petiole ca. 1 mm. long, the trichomes of the rachis ca. 0.5 mm. long. . . . 29A. *N. angusta.*

Notholaena angusta is related to *N. Schaffneri* in characters of the indument: the long-stalked ceraceous glands generally distributed on the petiole and rachis, the scales on the rachis, and the large brown trichomes on the lower surface of the pinnae. It is related to *N. Ekmanii, N. cubensis* and *N. affinis* in its linear, pinnate-pinnatifid lamina. These three species differ from *N. angusta* in lacking scales on the rachis and trichomes on the pinnae. They also either lack long-stalked glands on the primary axis, or, if these are sometimes present (in *N. Ekmanii* and *N. affinis*), they are confined to the upper surface. *N. Ekmanii* also differs from *N. angusta* in having a sulcate rather than terete or flattened petiole and rachis.

In my treatment of *Notholaena,* I placed the Broun collection cited above in *N. affinis,* and later identified the Hitchcock & Stanford collection as the same species. It is now evident that all of this material from Hidalgo is a distinct species and that *N. affinis,* which occurs principally in Guatemala and Honduras, is known to occur in Mexico only in Oaxaca.

8. **Notholaena cantangensis,** spec. nov.
(Plate 1257, fig. 6)

Rhizoma breve paleis medio nigrescentibus scleroticis marginibus fulvis pectinato-serrulatis. Folia 10-15 cm. alta caespitosa, petiolus quam lamina brevior teres brunneus vel rubelle brunneus fasciculo vasculari uno decidue paleaceus paleis magnis fulvis concoloribus pectinato-serrulatis nisi eis rhizomatis similibus ad basem. Lamina lanceolato-elliptica bipinnato-pinnatifida, rhachis teres vel subteres, paleacea paleis eis petiolorum similibus. Pinnae ad 15-jugae oblongae vel leviter latiores ad basem obtusae aequilaterales pinnulis 5-8-jugis obtusis coriaceae pagina superiore parce pubescens trichomatibus brevibus subcrassis cellulis brevibus pagina inferiore paleis imbricatis anguste ovato-lanceolatis acuminatis vel ligulato-acuminatis. Venulae 2-3-furcatae sporangia 64-sporis in apicibus gerentes, margem leviter mutatus planus vel leviter revolutus, sporae rugosae.

Holotypus: Entre piedras, Cantange, ruta Celendín-Río Marañon, prov. Celendín, Dept. Cajamarca, Peru, 1450 m., 4 Junio 1960, *A. López & A. Sagástegui 3366* (GH).

This new species, and the following one, belong to a small group (previously of two species) that have the lamina with both hairs and scales but lacking wax. *N. cantangensis* is closely related to *N. Hassleri* of Paraguay which also has similar rather sparse hairs only on the upper surface of the lamina. Following the description of the next species, a modification of the appropriate portion of my key to the American species is presented in which both new ones are incorporated. This will serve to compare the four species of this group and to bring out their most distinctive characters.

9. **Notholaena solitaria,** spec. nov. (Plate 1258, fig. 7)

Rhizoma ignotum. Folia circa 18-32 cm. alta, petiolus quam lamina brevior vel longior teres obscurus rubelle brunneus vel nigrescens fasciculo vasculari uno pubescens paleaceusve paleis angustis fulvis concoloribus nisi medio nigrescentibus scleroticis marginibus fulvis ad basem. Lamina anguste lanceolata vel anguste elliptica modice bipinnato-pinnatifida vel bipinnato-pinnatisecta, rhachis teres decidue paleacea paleis eis pinnarum similibus. Pinnae circa 10-15-jugae obtusae aequilaterales pinnulis anguste oblongis 6-9-jugis subcoriaceae pagina superiore tomentosa trichomatibus longis subcrassis cellulis longis pagina inferiore dense tomentosa sub paleis imbricatis anguste auriculatis vel cordatis marginibus vel tantum base longe ciliatis. Venulae 1-2 furcatae sporangia 64-sporis in apicibus gerentes, margem modice mutatus revolutus, sporae rugosae.

Holotypus: Surinam, *Hostmann 199* (Herb. Hook.-K)

Mr. C. A. Weatherby annotated this specimen in 1938 as probably a new species. It is closely related to *N. brachypus* (Mexico to Costa Rica) but is amply distinct in the characters of the scales at the base of the petiole, the complexity of the lamina and the scales on the under surface of the lamina.

N. solitaria is geographically isolated from other species of the genus. There are six species in Colombia and of these only two widely distributed ones, *N. aurea* and *N. sinuata,* extend eastward to (north-central) Venezuela. One would have expected that a *Notholaena* from Surinam would be one of these two species rather than an endemic with its affinities in Central America. This species and the previous one form with *N. brachypus* and *N. Hassleri,* a small group that lacks ceraceous indument but has both hairs and scales on the lamina. These are distinguished in the following key which modifies and expands the one in my Revision of the American species of Notholaena[4].

3. Indument of the lamina of both hairs and scales; spores rugose. 8.
  8. Under surface of the pinnae densely tomentose beneath the imbricate scales, the upper surface tomentose with long hairs these with long cells. 8a.
    8a. Rhizome scales and those of the petiole base concolorous or nearly so, or sometimes with a brownish sclerotic center; lamina pinnate-pinnatifid, hairs of the upper surface of the pinnae very slender, scales of the lower surface with smooth or irregularly dentate margins, the larger ones strongly auriculate; sporangium with 32 spores. Mexico to Costa Rica. . . . 6. *N. brachypus.*
    8a. Rhizome scales not known, those of the petiole base with a blackish sclerotic central area and pale margins; lamina bipinnate-pinnatifid to bipinnate-pinnatisect, hairs of the upper surface of the pinnae rather stout, scales of the lower surface with long-ciliate margins (or the cilia confined to the base), usually narrowly auriculate or cordate; sporangium with 64 spores. Surinam. . . . 6A. *N. solitaria.*
  8. Under surface of the pinnae paleate with imbricate scales, the upper surface sparsely pubescent with short thickish hairs, these with short cells, sporangium with 64 spores. 8b.
    8b. Rhizome creeping, the petioles approximate to moderately spaced; pinnae inequilateral although not strongly so; scales of the under surface of the pinnae (especially of the pinnarachis) predominantly ovate-acuminate to deltoid-acuminate; margins of the segments somewhat revolute, of broadly rounded lobes which have a hyaline border. Paraguay. . . . 7. *N. Hassleri.*
    8b. Rhizome short-creeping, the petioles clustered; pinnae equilateral; scales of the under surface of the pinnae predominantly narrowly ovate-lanceolate and acuminate to ligulate-acuminate; margins of the segments flat to slightly revolute, very slightly modified. Peru. . . . 7A. *N. cantangensis.*

10. **Notholaena Stuebeliana** (Hieron.) Tryon, comb. & stat. nov. (Plate 1258, fig. 8)

Pellaea dealbata var. *Stuebeliana* Hieron. Hedwigia 48: 225, t. 12, fig. 15, 1909. Holotype: Sunibamba, valle Río Utcubamba, [Dept. Amazonas], Peru, 1800 m., *Stübel 1048* (part), B!

Pellaea Stuebeliana Hieron. *l.c.*, in synonymy.

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[4] Op. Cit. 9.

Plate 1258. Fig. 7. *Notholaena solitaria*, ca. × 1/3, holotype, *Hostmann 199* (K). Fig. 8. *Notholaena Stuebeliana*, × 4/10, *Correll & Smith P841* (GH).

Hieronymus described *Pellaea dealbata* var. *Stuebeliana* on the basis of a single leaf presumably collected in Peru along with *Notholaena nivea* (*Stübel 1048* proper). In my Revision of American Notholaena[5] the name was cited as a synonym of *Notholaena dealbata* on the assumption that the specimen and the label had been erroneously associated with each other. Although Hieronymus did emphasize, in his description, the significant rounded ultimate segments, these were not brought out well in the illustration. Three recent collections from the same general region now verify the occurrence of this plant in Peru and the adequate material allows an assessment of it:

Cajamarca: Celendín, May 22, 1960, *López & Sagástegui 3104* (GH); about 40 km. from Cajamarca on road to Chilete, March 24, 1960, *D. S. Correll & E. E. Smith P841* (GH,LL, US). La Libertad: Camino de las Quishuas, Bolivar, May 31, 1960, *López & Sagástegui 3288* (GH).

Notholaena Stuebeliana grows in rocky places in northern Peru at elevations of 2250 to 3000 m. It is most closely related to *N. limitanea* of Mexico and the adjacent southwestern United States; it is also closely related to *N. dealbata* of the central United States. The following key will serve to bring out the important characters of these three species, and to distinguish them; it amplifies the key to species in my Revision of American Notholaena[6].

57. Petiole moderately stout (rarely slender), it and the rachis dark reddish-brown; ultimate segments coriaceous, the veins not visible; sporangium with 32 spores. 57a.
    57a. Rhizome scales somewhat thickened, their cells evident, rather straight or occasionally somewhat sinuous, dry in appearance; terminal segments of the pinnae and pinnules oval to usually oblong. Southwestern United States and Mexico. . . . 51. *N. limitanea.*
    57a. Rhizome scales thickened, their cells obscure, mostly strongly sinuous, oily in appearance (but not evidently viscid) (they may appear dry with age); terminal segments of the pinnae and pinnules (or their terminal lobe) orbicular, suborbicular, orbicular-deltoid or infrequently oval. Northern Peru. . . . 51A. *N. Stuebeliana.*

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[5] Op. Cit. 87.

[6] Op. Cit. 14.

57. Petiole slender, it and the rachis bright chestnut-brown; ultimate segments subherbaceous, the veins usually visible; sporangium with 64 spores. Central to south-central United States. . . . 52. *N. dealbata.*

11. **Pteris Lechleri** Mett.

The species currently called *Pteris Killipii* Maxon has two earlier names. Mettenius described *Pteris Lechleri (Lechler 2533)* in 1859, a name that was seldom, if ever, used after its publication. In 1867 Baker described *Pteris vestita (Spruce 4063)* but the specimen was not annotated by him and later Maxon cited it as a paratype of *P. Killipii.* An examination of the holotypes of these three names shows that they all represent the same species and accordingly Mettenius' name must be reinstated for it. *Pteris Lechleri* grows on the moist eastern slopes of the Andes in Peru and Bolivia.

Pteris Lechleri Mett. Fil. Lechler. 2: 13, 1859. Holotype: Tatanara, [Valle Río San Gaban, prov. Carabaya, Dept. Puno], Peru, *Lechler 2533,* Herb. Mett.-B!, photo GH!

Pteris vestita Baker, Syn. Fil. 169. 1867. Holotype: (not annotated by Baker), near Tarapoto, Peru, *Spruce 4063,* K!, fragment ex K, US!, photo US.

Pteris Killipii Maxon, Amer. Fern Journ. 23: 107. 1933. Holotype: San Ramón, Dept. Junín, Peru, *Killip & Smith 24697,* US!; paratypes: *Killip & Smith 23919,* US!, *Killip & Smith 23962,* US!, *Spruce 4063,* K!

12. Recent fern collections from Peru

In the past few years several collectors have obtained material from Peru that is of unusual interest and it seems worthwhile to comment on some of the principal features of these collections. This will serve to emphasize the regions in which new discoveries of special importance are being made and at the same time will acknowledge the efforts of these collectors who have added to our knowledge. The ferns mentioned at this time, with one exception, are all members of the *Gymnogrammeae* and all are from the Andean region of Peru. The collections are those of P. Coronado in 1953 and 1955; D. S. Correll and E. E. Smith in 1958 and 1960; P. Hutchison in 1957; W. Rauh and G. Hirsch in 1954, W. Rauh in 1956[7]; A. Sagástegui (sometimes with A. López) in 1953-1960; and S. G. E. Saunders in 1954. Five of the new or rare species from these collections have been discussed in the previous portions of this paper and these are omitted from the following list.

Adiantum alarconianum Gaud. — The first collections in Peru were made by Coronado *(218, 228)* in Tumbes in 1955.

Adiantum concinnum Willd. — The first collections in Peru were made by Coronado *(222, 229)* in Tumbes in 1955; it was collected again in Lambayeque, somewhat to the south, by Correll & Smith *(P791, P794)* in 1960.

Adiantum Henslovianum Hook. f. — The second collection in Peru is that of Correll & Smith *(P807)* from Lambayeque in 1960; the original collection by Matthews was probably made in northern Peru about 1835.

Adiantum Poiretii var. **hirsutum** (Hook.) Tryon — First collected in Peru on lomas in Arequipa by Coronado *(33, 42)* in 1953.

Cheilanthes notholaenoides (Desv.) Weath. — Known from Huánuco and Junín by two earlier collections, it was collected by Rauh & Hirsch *(P1935)* in Piura in 1954 and by Correll & Smith *(P838)* in Cajamarca in 1960.

Notholaena obducta (Mett. ex Kuhn) Baker — First collected in Peru by P. Hutchison *(1425)* in Cajamarca in 1957. The principal range of the species is from Paraguay to Bolivia; it is also known from several Colombian collections. The Peru locality is about half-way between these two areas.

Notholaena peruviana Desv. — This species has been known to occur in the Rimac Valley (Lima) and southward on coastal lomas. Three recent collections extend its range considerably northward: Sagástegui *(2220)* in Cajamarca in 1953, Sagástegui *(2665)* in La Libertad in 1958, and Correll & Smith *(P822)* in Lambayeque in 1960.

Saffordia induta Maxon — This monotypic genus has been the rarest of American fern genera being known only from the original collection made by Safford in 1892. However, it

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[7] These collections were reported on by D. E. Meyer, Willdenowia 1: 642-653. 1956; 1: 704-708. 1957; 2: 23-26. 1958. I studied some of them at Berlin in 1960.

has now perhaps lost this distinction since four collections of it have been made in 1954-1959, and its range has been considerably extended beyond the type locality in the Rimac Valley. In 1954 it was collected by Rauh & Hirsch *(P186)* at Matucana (Lima) which is probably the type locality (Safford gave only "along the Arroya [La Oroya] Railway in the mountains back of Lima"). In the same year Saunders *(218)* collected it near Surco, also in the Rimac Valley, somewhat below Matucana. This collection was sent to the British Museum (Natural History) and spores from it were germinated at Kew where a number of mature plants are now growing. In 1958 Sagástegui *(205)* collected it in La Libertad (prov. Otuzco) and in 1959 *(2936)* in Cajamarca (prov. Contumazá) somewhat to the northwest. All of the collections are from the rather dry western slopes of the Andes at elevations between 1900 and 2900 m.; and they were all made in the months of February to May which corresponds to the "rainy" season in that zone.

Stylites andicola Amstutz emend. Rauh and **S. gemmifera** Rauh — This new genus of *Isoëtaceae*, from the borders of high lakes in central Peru, was first collected by Rauh & Hirsch *(P271b)* in 1954. It was collected again by Rauh *(P186/56, P384/56)* in 1956, by Amstutz *(2000)* in 1956 and by von Appen in 1958. The careful studies of W. Rauh and H. Falk[8] and D. E. Meyer[9] have presented an exceptionally detailed and complete account of this unusual plant.

Trachypteris pinnata (Hook. f.) C. Chr. — This rare fern was collected by Rauh & Hirsch *(P2160)* in Cajamarca (prov. Jaen) in 1954 and in the same province by Hutchison *(1424)* in 1957. — GRAY HERBARIUM, HARVARD UNIVERSITY.

A VARIEGATED FOLIAGE FORM OF COMMELINA. — During the summer of 1958, Mr. Joseph Monachino of our staff collected a specimen of *Commelina communis* L. var. *ludens* (Miquel) C. B. Clarke, which he found growing along the shore walk of the Palisades near the George Washington Bridge in New Jersey.

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[8] Sitz. Heidelberg. Akad. Wissen. Math-naturwissen. Klasse 1959: 1-160.

[9] Willdenowia 2: 32-40. 1958.

The interesting feature of the plant was its variegated foliage, the leaves being a light lemon color with narrow lines of light green running the entire length of the leaf. The greater portion of some of the leaves was either entirely a light lemon color, or slightly diffused with very thin, broken lines of a very light green. They resemble greatly the leaves of *Tradescantia fluminensis* Vell., the Wandering Jew.

Having been careful to keep the roots moist, Mr. Monachino presented the plant to me, to grow in my wildflower garden. There it thrived until killed by the frost.

Early in the Spring of 1959, while cleaning my garden I discovered that the crown was alive and that it was showing a few curled-up leaves of light cream color.

I was rather dumbfounded as I had always considered the Dayflower to be an annual in this area; especially as our temperature had dropped, occasionally, to five degrees below zero.

Later on in the Spring, it was discovered that because of someone's faulty cultivation the plant had been destroyed. However, it was noted that the area was covered with a fine stand of young seedlings possessing the variegated foliage of the parent plant. These seedlings were permitted to fend for themselves and, by the end of the Summer, had established a fine colony of beautiful and interesting plants. These variegated plants were taller and more robust than the usual type of the plant, two patches of which were permitted to grow on either side of the variegated form. However, the flowers seemed somewhat smaller and lighter blue in color.

A few of the variegated plants have been pulled and are being prepared for mounting and for exchange with other institutions. The balance will be left to reseed themselves, for my friends and I shall look forward to a renewed acquaintance with this pretty plant next year.

Therefore, I should like this variegated form to bear the name of — **Commelina communis** L. var. **ludens** (Miquel) C. B. Clarke forma **aureostriata** MacKeever, f. nov. A varietate differt foliis luteo-striatis.

This form is similar to the variety except for its leaves, which are striped with yellow.

The type specimen was collected by Frank C. MacKeever in Mount Vernon, N. Y., on October 1, 1959, and is deposited in the New York Botanical Garden.

Isotypes are deposited at Chicago Natural History Museum, Chicago, Ill.; Gray Herbarium, Cambridge, Mass.; Missouri Botanical Garden, St. Louis, Mo.; Smithsonian Institution, Washington, D. C.; L. H. Bailey Hortorium, Ithaca, N. Y. — FRANK C. MACKEEVER, NEW YORK BOTANICAL GARDEN.

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SOME NEW ASPECTS OF THE FERN PLATYZOMA MICROPHYLLUM

Alice F. Tryon

Since this north Australian fern was described by Robert Brown in 1810 and placed in the *Gleicheniaceae*, it has been the subject of several papers. Because of its unusual stelar structure and absence of leaf gaps it was considered particularly in theories relating to the origin of the stele. In the most recent of these morphological studies by J. M. Thompson (1919) the literature is reviewed. F. O. Bower (1926) in his survey of the primitive ferns cites Thompson's work and figures the reconstruction of the stele and the irregularities of the sporangium. In connection with his studies on the *Gleicheniaceae*, R. E. Holttum (1956) has discussed the relationships of *Platyzoma*. He excludes it from that family on the basis of the filiform leaves, the occurrence of waxy indument and the terminal position and characters of the sporangium. He tentatively refers it to a place among the gymnogrammoid ferns on evidence drawn from a comparison with *Jamesonia*. While there are good reasons for excluding *Platyzoma* from the *Gleicheniaceae*, there are some objections to its close alliance with *Jamesonia*. A study of *Platyzoma* was undertaken in search of new evidence which might help to establish its relations more certainly. Observations have been made on the following specimens in the Gray Herbarium and the United States National Herbarium[1].

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[1] I am most grateful for the loan of specimens from the United States National Herbarium, and for the opportunity to study the collections and the use of facilities at the Gray Herbarium.

AUSTRALIA. QUEENSLAND: near Hughenden, *Brass & White 64* (fragment GH ex K); northern Queensland, *Hann* (US); Thursday Island, *N. J. Hey*, in 1917 (US); Dimbulah, Cook District, *Hubbard & Winders 6856* (US); Hughenden, Burke District, *Hubbard & Winders 7592* (US); Rockingham Bay, *F. Müller* (GH); between Inglewood and Millmerran, Darling Downs, *C. T. White 9705* (GH); between Cecil Plains and Millmerran, Darling Downs, *White & Webb 1177* (GH). NORTHERN TERRITORY: east of Borroloola, *R. A. Perry 1851* (US); east of Carlton Station, *R. A. Perry 3005* (US); in Gulf of Carpentaria, Groote Eylandt, *R. L. Specht 197* (US); Port Bradshaw, Arnhem Land, *R. L. Specht 716* (US); Oenpelli, Arnhem Land, *R. L. Specht 1252* (US). WESTERN AUSTRALIA: Cambridge Gulf, *F. Müller*, (GH); east of Kimberly Research Station, *R. A. Perry 2566* (US).

OBSERVATIONS ON PLATYZOMA MICROPHYLLUM

Roots. — The roots are long, coarse and of a diameter nearly equal to that of the petioles. They arise from the lower surface of the rhizome. The outer tissue of the roots appears spongy and consists of large, lustrous, light brown, parenchyma cells. Long persistent root hairs arise from the surface of these cells forming dense mats in which particles of white sand may be enmeshed.

Rhizome. — The rhizome is dorsiventral, ca. 0.4 cm. in diameter with a tomentum of rigid, concolorous, lustrous, rust colored, multicellular trichomes. The trichomes are relatively long and consist of about 30 - 60 cells (Fig. 1). These cells are as long as or up to four times longer than broad, and are not arranged in any regular sequence of size. The base of the trichome may be catenate (Fig. 2); the cells being flattened and twisted. The terminal cell is short and bulbous. The leaves are close but irregularly placed on the rhizome or fasciculate. Many arise from the upper and lateral surfaces but some of the pinnate leaves and most of the filiform ones arise from the lower surface of the rhizome. The longest rhizome (with attached leaves) was 4 cm. long and there were 4 circinate leaves at the apex, 34 pinnate leaves and about 50 filiform leaves. The filiform leaves in some specimens are fascicled while in others they are quite uniformly distributed along the entire rhizome. Details of the structure of the rhizome are given by Thompson (1916). It is described as a medullated protostele with a discontinuous inner endodermis and lacking leaf gaps.

Pinnate leaves. — Fully developed leaves have an expanded apex with a terminal pinna although many leaves are not entirely developed. In the smallest complete leaf the petiole was 2.5 cm. long, the lamina 11.0 cm. long and 0.3 cm. wide. The lamina of the longest leaf, with a broken apex, was 32.0 cm. long, 0.4 cm. wide and the petiole was 8.0 cm. long. Most leaves are about 24.0 cm. long.

PETIOLE: The petiole is terete or oval near the rhizome, atropurpureous and with sparse, multicellular, capitate trichomes similar to those of the rhizome. At the apex of the petiole the adaxial half is flattened in three planes and the abaxial half is convex. There are no stomata on the petiole but small mounds of sclerotic tissue rarely occur.

RACHIS: The adaxial surface of the rachis is flat, slightly lighter in color than the petiole or sometimes greenish. The lateral surfaces, on which the pinnae are borne, are flat or slightly grooved. There are abundant, glandular, multicellular trichomes on the lateral and adaxial surfaces of the rachis (Fig. 3). The apical portion of the rachis is attenuate and heavily indumented.

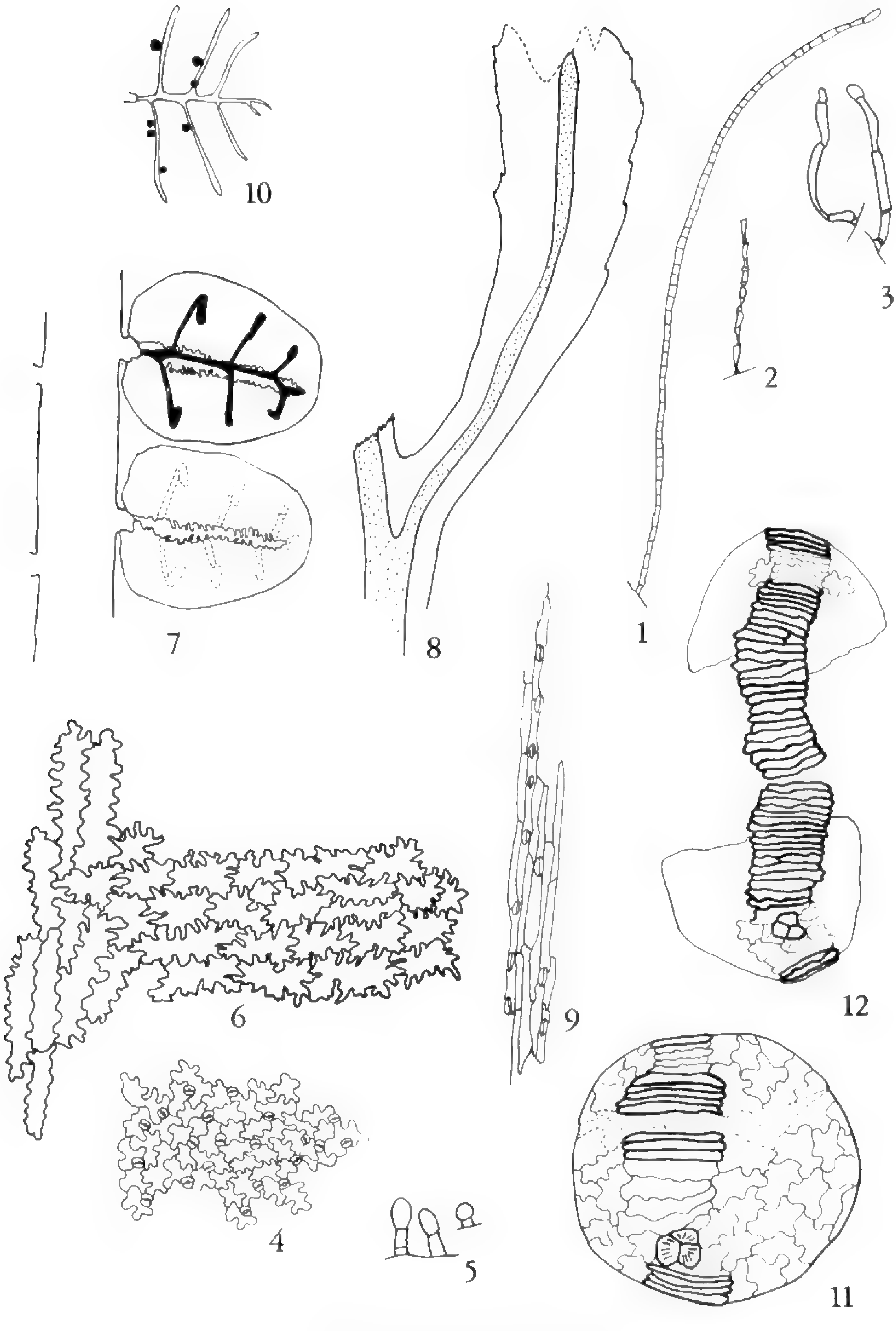
PINNAE: The lamina is once pinnate with about 500 small, simple pinnae which are easily detached from the rachis in dried specimens. Articulation occurs in the stalk without specialized tissue. Most leaves are wholly sterile. Fertile pinnae occur in zones usually in the terminal half or quarter of the lamina and on one or both sides of the rachis. One leaf consisted of 433 pinnae of which 11, borne on one side of the rachis, were fertile. The pinnae are somewhat bladder-shaped with a central slit. The margins are more or less enrolled and nearly meet at the center of the pinna. The pinna *stalk* is usually brown, 0.1 - 0.25 mm. long, 0.2 mm. broad with a cushion of parenchyma cells at the apex which is attached to the lower epidermis and is very glandular. The cells of the *lower epidermis* are thin walled and about 4 to 6 times longer than broad (Fig. 4). In surface view the cell walls are undulate with rounded lobes. Stomata occur only on this surface and are abundant adjacent to the costa and more diffuse towards the margins. Two- or three-celled, capitate glands (Fig. 5) which secrete copious quantities of yellow wax-like substance, are especially abundant along the veins. The mesophyll is thick and with many large lacunae. The cells of the *upper epidermis* are thick walled and have a shape and a pattern distinct from those of the lower epidermis (Fig. 6). The pattern, which can be observed in dried specimens under 15 × magnifications, consists of a band of elongate cells about 6 to 12 times longer than broad with undulating walls. This band extends through the center of the pinna from the stalk to the apex where it becomes flabellate. Adjacent to it and along the curved sides of the pinna the cells are broader and deeply dissected. The *vascular system* of the pinna is a short sympodium with 6 - 12 lateral branches (Fig. 7). The central vein is slightly flexuous and terminates in an unequal dichotomy. The lateral veins are unbranched and become broader toward their distal end. They terminate well back of the pinna margin and the ends are acute or slightly enlarged. The veins are situated in the spongy mesophyll somewhat closer to the upper than the lower epidermis. They consist of a cord of short, thick-walled tracheids so tightly joined that the entire sympodium can be withdrawn from a pinna softened in sodium hydroxide.

STERILE PINNAE: These are rigid herbaceous, 0.5 - 4.0 mm. long, 0.5 - 2.0 mm. wide, ovate or somewhat orbicular with enrolled margins (Fig. 7). A central slit extends from the stalk to short of the apex and the pinna margins adjoining this are strongly papillate. There are some *unusual pinnae* on the leaves of one collection (*Hubbard & Winders 6856*). The lower pinnae on these are 2 or 3 times as long as the normal ones and clavate or boat-shaped (Fig. 8). The base is narrowed and decurrent on the broad and greenish adaxial surface or on the light brown colored lateral surface of the rachis. If a pinna stalk can be distinguished from the decurrent tissue, it is longer and broader than those of the normal pinnae and only partially brown. The margin is irregular with protruding, elongate cells. The pinna is thickened on its abaxial surface by a ridge of tissue extending from the stalk to the apex. Such a ridge also occurs in otherwise normal pinnae of the lamina and there seem to be transitional forms between these elongate ones and the normal pinnae.

FERTILE PINNAE: These are slightly larger than the sterile pinnae, orbicular and the margins are not or only slightly enrolled. The papillae from opposite margins may be somewhat enmeshed and close the bladder-shaped pinnae. The fertile pinnae are often a darker brown color and more wrinkled than the sterile pinnae.

Filiform leaves. — These are simple, linear structures with attenuate apices. The apical portion is straw colored or light brown, the basal portion is atropurpureous. They are 3.0 - 8.0 cm. long, 0.05 cm. wide. There are two prominent grooves, presumably on the adaxial side, and two or more shallow ones on the other side extending nearly the length of the leaves. Stomata may be more or less in rows in the shallow grooves (Fig. 9).

Sporangia. — Sporangia are attached along the lateral veins usually nearer to the costa than to the distal end of the vein (Fig. 10). They have been observed on the distal portion of the vein but not in a terminal position. There is considerable variation in the size of the sporangia for among mature ones within the same pinna some may be twice the size of others. There is also variation in the shape, spore content and the position and structure of the annulus. Such irregularities are discussed and illustrated by Thompson (1917, p. 160) and Bower (1926, p. 209). There is however a rather uniform sporangial type which will be described here. Sporangia in several stages of development are found along a single vein and up to 13 have been observed on a single pinna. The sporangium stalk is short, usually of two or three tiers of cells. Three basal cells have been observed in immature sporangia. At the capsular end of the stalk there are either 3 or 4 cells which differ from other stalk cells in having striated thickenings. The capsule of the sporangium is spherical, the annulus is broad, slightly raised



Platyzoma microphyllum

and usually more or less oblique with the capsule faces correspondingly unequal in size (Fig. 11). The annulus (Fig. 12) is composed of a single row of cells which may vary in size and shape, but its width is roughly one third the diameter of the capsule. There are about 40 indurated cells which extend from the base of the capsule around and below its apex. There are about 4 cells with thin and undulating walls which interrupt this annular series. These are followed by 7 - 14 indurated cells similar to those of the annulus. The sporangium opens between these indurated cells at a point usually above their center. There are a few, usually 2 or 4, cells with thin and undulating walls between these indurated ones and the sporangium stalk. The annulus is interrupted by the stalk and the rupture of the sporangium occurs between several indurated cells which resemble those of the longer annular series. A unique characteristic of the sporangium is the cells of the capsule faces (Fig. 11). In surface view these are strongly undulating and somewhat resemble the cells of the lower epidermis.

Spores. — The number of spores in a sporangium and their size seem to correlate with the size of the sporangium. The larger sporangia usually contain 16 large spores and small sporangia contain 32 small spores. There are also sporangia intermediate in size and in one of these, which was open, I found a single large spore nearly filling the capsule and 4 small spores. In six collections examined both 16- and 32-spored sporangia were found on the same pinna. Most

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Tracings from cleared material of *Platyzoma microphyllum* — Fig. 1. Rhizome trichome, × 10, *Perry 2566.* Fig. 2. Catenate base from rhizome trichome, × 15, *Perry 2566.* Fig. 3. Glandular trichomes from rachis, × 35, *White 9705.* Fig. 4. Portion of lower epidermis of pinna, × 45, *Specht 1252.* Fig. 5. Glands from abaxial surface of pinna, × 60, *Specht 197.* Fig. 6. Portion of the upper epidermis of the pinna. Elongated cells at the left are from the central band, × 45, *Specht 1252.* Fig. 7. Sterile pinnae on a portion of the rachis. The venation darkened in the upper; the lower showing the outline of the margins, the veins in broken lines, × 15, *White 9705.* Fig. 8. An elongate pinna, decurrent on a portion of the rachis, the apex torn by flattening, the vascular tissue shaded, × 15, *Hubbard & Winders 8656.* Fig. 9. Portion of the epidermis of a filiform leaf with stomata, × 45, *Specht 1252.* Fig. 10. Vascular system of a pinna with attached immature sporangia, × 15, *Brass & White 64.* Fig. 11. A sporangium with the aperture shaded. With indurated cells above and below the gap, the three celled stalk in the lower part, × 70, *Brass & White 64.* Fig. 12. An opened annulus of a sporangium, with a three celled stalk in the lower part, × 70, *Brass & White 64.*

spores are tetrahedral with a trilete proximal face. In a few sporangia there were also bilateral spores some of which were trilete with ridges of unequal length and others were monolete. The spores are prominently sculptured. The proximal face has long, broad ridges which are somewhat parallel to the commissural ridges and are connected by shorter ones to form a reticulum. The distal face is also prominently sculptured but the rugae are mostly short and form circular or irregular loops. In the equatorial region there may be one or a few parallel ridges nearly continuous around the spore. The spores are often retained in open sporangia. They are also found free within the pinna, sometimes covered with the yellow indument from the glands.

DISCUSSION

Some of these observations are at variance with those previously reported by Thompson and Holttum. The first is the position of the sporangia which Thompson (1916) reports as terminal on the vein ends. Although sporangia may occur on the distal portion of the veins, I have not observed them to be exactly terminal in cleared pinnae. They occur on the lateral veins adjacent to the costa and along the veins to near the distal end. The position is best observed when the sporangia are immature. I interpret them as lateral rather than terminal on the veins. The apical growth of the leaves has been described as indefinite. Some leaves have undeveloped apices which may expand slowly; however they do terminate in a completely developed apex before the lower pinnae have deteriorated. The leaves are determinate and the lamina is imparipinnate. The spores are mostly tetrahedral and trilete as reported but a few spores have been observed which are bilateral and monolete.

From this survey of *Platyzoma* it was noted that there are certain similarities with the *Schizaeaceae*. A medullated protostele with sclerosed pith and inner endodermis are reported by Bower (1926) in species of *Anemia* and *Schizaea*. The rhizome in these genera has multicellular trichomes. Reduced filiform leaves with a central vascular trace and stomata are found in several species of *Schizaea* — *S. fistu-*

losa Labill., *S. papuana* Brause, and they are especially abundant in the North American *S. pusilla* Pursh. In the filiform leaves of *Platyzoma* the guard cells may be larger relative to the adjacent cells than in *Schizaea,* but the form of the intra-stomatal cells is similar. In the elongate pinnae which were found in one collection of *Platyzoma* there is a resemblance to the form of the lobes of the lamina in *Schizaea.* Since these pinnae have been found in only one specimen of *Platyzoma* they might be considered as abnormal. In the company of other similarities with *Schizaea,* I am inclined to regard them as something more than an anomalous condition. On the leaves of many species of *Anemia* and *Schizaea* there are 2- or 3-celled capitate glands. These are similar to the glands on the pinnae of *Platyzoma* although the basal cell may be larger and there is no yellowish indument. The sporangium of *Platyzoma* is most remarkable in its spherical shape, short stalk, its broad, more or less oblique annulus which is scarcely raised from the surface of the capsule, and especially in the undulating cell walls of the capsule faces. In *Mohria* and some species of *Anemia* the sporangia are spherical and short stalked or sessile. The cell walls of the capsule in *Schizaea melanesica* Sell. and *S. confusa* Sell. (Selling 1944b, 1947) are undulating and similar to those of *Platyzoma.* There is also similarity in the reticulate sculpture of the spores between *S. confusa* and *Platyzoma.* In his studies on the spores of *Schizaea* O. H. Selling (1944a) reports variations in size and sculpturing. In *S. fistulosa* there seem to be two sizes which show some correlation with the geographic distribution. It would be of interest to determine whether such variation in spore size in *Schizaea* and *Platyzoma* might be related to the apogamous condition as it is in species of *Pellaea* (Tryon & Britton, 1958).

In addition to an evaluation of similarities between *Platyzoma* and *Schizaea,* the distinctive character of the *Schizaeaceae* — the apical annulus — must be considered, and also the possibility of parallel reduction in these two genera. Resemblances in the sporangia are remarkable and there is little possibility of parallel reduction in this structure. In *Platyzoma* the annulus is usually oblique — with unequal capsule faces, it is scarcely raised from the surface and is about one third the diameter of the capsule. There is a series of indurated cells in the stomial region and epidermal-like cells in the capsule faces. In these features the resemblance seems to be with *Schizaea* although there are similarities with species of *Anemia* and *Mohria* which have spherical sporangia, and in which there are several non-indurated cells in the apical portion of the sporangia. While the sporangia of *Platyzoma* are not identical to those of the *Schizaeaceae*, in this structure and in some aspects of the leaves there are resemblances closer to that group than to any other family.

There is also similarity to the *Polypodiaceae* particularly in the interruption of the annulus by the sporangium stalk. *Platyzoma* can be placed here in the subfamily *Gymnogrammoideae* and in the tribe *Gymnogrammeae* on the superficial sporangia following the course of the veins. In this tribe it would be allied to *Eriosorus* and *Jamesonia* by its monomorphic leaves and pubescent rhizome. It was tentatively placed here by Holttum (1956).

In the course of the preparation of a revision of *Jamesonia*, I have studied its species in some detail and wish to remark upon a number of characters of *Jamesonia* which differ from *Platyzoma*. The species of *Jamesonia* grow mainly on the South American páramos at altitudes from 2350 to 5000 meters. The species center in Colombia and Venezuela and occur northward into southern Mexico and southward to Bolivia and eastern Brazil. In the páramos *Jamesonia* is usually found growing in the shelter of rocks with grass or moss. The rhizomes are horizontal, creeping, dichotomously branched, with spirally arranged leaves, and are sparsely to densely covered with simple, multicellular trichomes. In some species the trichomes have more massive bases and become rather scale-like. The leaves in some but not all species are indeterminate and there are no reduced or filiform leaves such as in *Platyzoma*. Young leaves are produced behind the apex on older parts of the rhizome and it is possible that these or a cluster of old petioles may have been the basis of the report of reduced leaves. A dense pubescence or glutinous exudate is characteristic of the leaves of *Jamesonia* but ceraceous indument is rare. It is indeed of such rare occurrence on the abaxial surface of the pinnae that it has been observed there in only one collection — the type of *J. ceracea* Maxon. It is perhaps in the form of the pinnae that *Jamesonia* and *Platyzoma* differ most markedly. The pinnae in *Jamesonia* are generally flat with the margins more or less enrolled. The margin is usually membranous or ciliate. The pinnae are relatively long stalked, rarely subsessile and in two species adnate. The venation of the pinnae is dichotomous with the ramifications branching and terminating usually in numerous ultimate veins which extend to or near the pinna margin. The form of the annulus may be somewhat irregular but there are generally about 20 raised and indurated cells. There is a distinct stomial region with 2 - 4 indurated lip cells which are smaller than those of the annulus. The sporangial stalk may be short — one quarter or less than the length of the capsule or equal to it in length. The spores of *Jamesonia* are entirely different from those of *Platyzoma* in the type of sculpture. They are trilete with 3 broad smooth or verrucate planes on the proximal face; there is a prominent equatorial ridge or wing and 3 broad ridges forming a triangle on the distal face. *Jamesonia* is a specialized group, closely related and with species transitional to *Eriosorus*. Although there is some resemblance between *Jamesonia* and *Platyzoma* the relationship is not a close one.

Platyzoma is properly excluded from the *Gleicheniaceae* and can, in the present classification, be placed in the *Polypodiaceae*. This disposition however, adds to the problems of the definition of that family. There is general agreement that the *Polypodiaceae*, as treated by Christensen, is polyphyletic but there is no clear understanding of the natural groups.

It is my belief that the *Schizaeaceae* is a source from which some of those groups have been independently derived. *Sinopteris* and some species of *Cheilanthes* have similarities with *Mohria; Eriosorus, Jamesonia* and *Pterozonium* comprise a group having certain resemblances to *Anemia.* While in *Platyzoma* there are similarities with *Schizaea* in the shape of the pinnae and lobes of the lamina, the filiform leaves, the spores and particularly in the structure of the sporangium.

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THE GENUS LECHEA *(CISTACEAE)* IN THE SOUTHEASTERN UNITED STATES

ROBERT L. WILBUR[1] AND HAZIM S. DAOUD

The genus *Lechea* is a small group of about seventeen species found only in North and Central America and in the West Indies. Actually all of the species occur in the United States east of the Rocky Mountains except for one little known and seldom collected endemic from western Cuba. *L. tripetala,* which is found in Oklahoma, occurs in the United States only as one small population widely separated from the principal area of the species in Mexico and Guatemala. The genus is particularly well-represented in the southeastern United States (here defined as the area east of Texas and Oklahoma and south of Missouri, Kentucky and Virginia) where ten species occur and four of them are endemic. *L. Torreyi* cannot rank as an endemic due to its puzzling reappearance in the pine forests of British Honduras. The variety of *L. Leggettii* found in the Southeast barely ranges beyond its borders but does occur in southeastern Virginia. No other region possesses so many species of the genus nor can claim so rich and varied an endemic element.

Lechea is most strongly and clearly distinguished from all other genera within the family by its trimerous, persistent corolla; sessile, fimbriate stigmas and the presence of three incomplete partititions within the capsule. Hence for all practical purposes there has never been any real confusion over generic limits. *Lechea* has usually been considered a difficult genus due to the rather minute technical characters upon which the species distinctions rest. The admirable revision of Hodgdon (1938) has provided a firm foundation for an understanding of the genus by clarifying species limits and evaluating morphological variation. The key provided, however, relies to a considerable degree upon characters not present during the season when most specimens

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[1] Grateful acknowledgement is made to the National Science Foundation for a grant of research funds to Duke University (NSF-G5636) which were used in part for this study.

are collected, and therefore is not as usable as might be desired. Even plants collected with mature fruit and seeds often have not yet developed the basal shoots often called for in the key. These shoots are commonly not present until very late in the growing season. Although it does not now seem possible to prepare a key for sterile or even young flowering material, it is thought that the following key will aid in the determination of fruiting specimens of those species found in the southeastern United States.

Rafinesque (1836) in his monograph of the genus placed considerable emphasis upon the comparative lengths of the inner and outer sepals. The three subgenera recognized by him were actually largely characterized by the comparative lengths of the two whorls of the calyx. Since then most workers have placed considerable reliance upon this character. We too have found it a useful character and hence have employed it; but having seen considerable variation, especially in *L. racemulosa*, have felt it necessary to place this species under both leads of the key. Small's key (1933) is rendered almost unusable by too complete a reliance upon the constancy of this character. For example one would be in a quandary in attempting to determine a specimen of *L. villosa* with Small's key since in that species the outer sepals typically equal the inner and his key treats all species as having the outer lobes either longer or shorter than the inner sepals.

It was hoped when the present study was undertaken that it might result in some suggestions as to the relationships of the species and perhaps even a grouping of them into formal series or sections. Rafinesque recognized three subgenera based largely upon comparative lengths of the calycine whorls and also stamen and seed number. Spach in 1837 segregated the Texan species now known as *Lechea san-sabeana* as the monotypic genus *Lechidium* based largely upon the extreme development of the incomplete partitions found within the capsule. This taxon has since been treated as of subgeneric or sectional rank. Hodgdon accepted it as a section although admitting its close affinity to *L. tenuifolia* and *L. tripetala.* Small (1933) in his treatment of the genus, covering almost the same area as that in this paper, segregated the species into five named groups whose rank, as is customary in Small's Manual, is undesignated. Hodgdon declined to provide formal subgeneric categories except for the section *Lechidium.* Although the genus seems admirably suited for the construction of a phylogenetic tree based upon the rather obvious reduction series, our data are not sufficiently complete for us to present a phyletic scheme.

We are accepting the nomenclature of Hodgdon's revision and are ignoring the perplexing monograph presented by Rafinesque in 1836. It seems probable, however, that some of the twenty new species published by Rafinesque will eventually prove identifiable and will have priority over some of the names now current.

In the course of this study more than 4000 herbarium specimens were examined and annotated. For having made their collections available to us in whole or in part, we are indebted to the curators of the herbaria indicated below by the abbreviations: BUS, CU, F, FLAS, FSU, GA, IA, KY, MICH, MISSA, NCSC, NCU, NO, NY, OS, PUL, SMU, TENN, TEX, UARK, USF, VDB, U. of So. Carolina.

KEY TO THE SOUTHEASTERN SPECIES OF LECHEA

1. Pubescence of aerial stems for the most part strongly divergent and spreading.
    2. Internal sepals conspicuously V- or U-shaped in cross-section with thin scarious margins and a roughened, often sparsely pilose keel (the sepal otherwise glabrous); leaves, or at least many of them, over 1:5 cm long; capsule thin-walled, readily splitting into 3 valves at maturity, subglobose, about equaling the calyx in length; widespread throughout much of the eastern United States .... 1. *L. villosa.*
    2. Internal sepals but slightly bowed in cross-section with texture appearing uniform and pubescence scattered across surface; leaves all less than 1 cm long; capsule thick-walled, indehiscent; ellipsoid or somewhat rounded- barrel-shaped, exserted from the calyx for at least 1/3-1/2 its length; restricted to peninsular Florida .... 2. *L. divaricata.*
1. Pubescence of aerial stems mostly closely appressed or lacking.
    3. External sepals equaling or exceeding the internal sepals in length.
        4. Calyx of fruit and of older flowers strikingly differentiated into an obconic to somewhat cylindrical base about 0.4-0.6 mm

long, shiny and yellowish in color and scarious in texture contrasting considerably with the texture, color and appearance of the inner sepals; pedicels (at least after anthesis) averaging 2 mm or more in length..............7. *L. racemulosa.*

4. Calyx-base of fruit and of older flowers not conspicuously differentiated in texture, color or appearance from the inner sepals; pedicels averaging less than 2 mm long.
    5. Capsule completely enclosed by sepals, stigma not exposed after anthesis; fruit and inner sepals together subglobose; cauline and rameal leaves averaging 10 or more times as long as broad..................................3. *L. tenuifolia.*
    5. Capsule slightly to conspicuously exserted, the sepals not enclosing the top of the fruit; stigma exposed on developing and maturing fruit; fruit and inner sepals together cylindrical to pyriform (at least higher than broad); cauline and rameal leaves mostly less than 9 times as long as broad.
        6. External sepals at least one-fifth longer than the inner sepals and usually equaling or exceeding the capsule in length; capsule equaling or exceeding the inner sepals by not more than one-fifth its length; cauline leaves usually elliptic to elliptic-oblong, usually less than 5 times as long as wide, those below the inflorescence commonly appearing whorled and often more than 2 mm wide........................4. *L. minor.*
        6. External sepals about equaling the inner sepals and never equaling the capsule in length; capsule usually exceeding the inner sepals by about 1/3-1/2 its length; cauline leaves narrowly oblong to linear, usually 6 times (or more) as long as wide, those below the inflorescence alternate and less than 2 mm wide............ ....5. *L. patula*

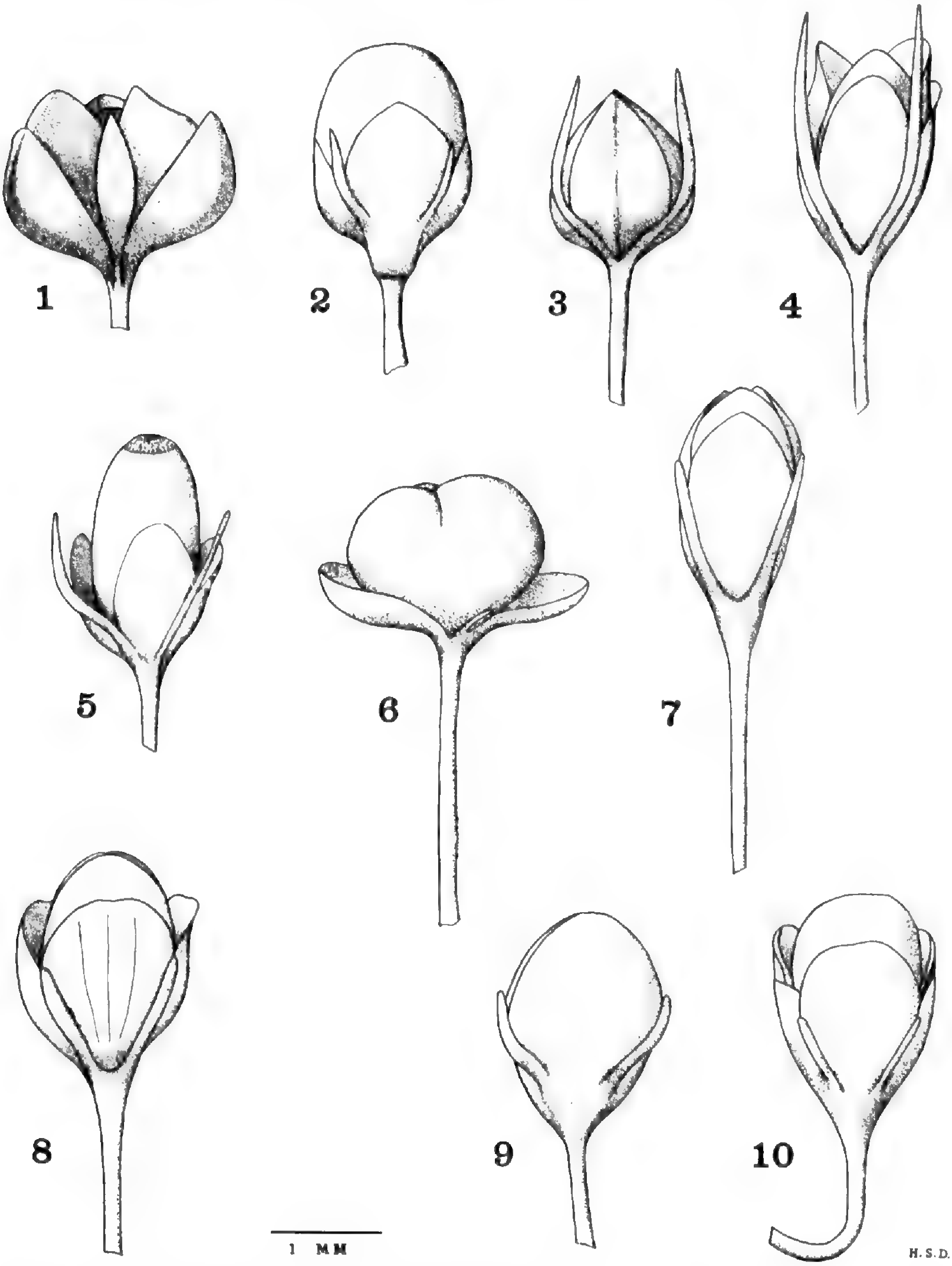
3. External sepals shorter than the internal sepals.
    7. Leaves pubescent on both upper and lower surfaces (at least those of the basal shoots conspicuously pilose above and below while the cauline and rameal leaves are usually inconspicuously pubescent over entire surface); flowers or fruits mostly clustered in 2's or 3's: capsule wall thickened and indurate; plants of peninsular Florida............10. *L. cernua.*
    7. Leaves variously pubescent below but glabrous on upper surface; flowers or fruits not appearing fascicled (attached separately); capsule wall thin or at least not conspicuously indurate.
        8. Aerial stems perennial, suffruticose, clearly woody at base, with wiry woody branches; capsule exserted from the often spreading calyx by 1/3-1/2 its length; calyx

sparingly short-pubescent to glabrous; known only from southern Georgia and Florida.......................6. *L. Deckertii.*

8. Aerial stems annual, herbaceous, dying to the base each year; capsule equaling the calyx or exserted not more than 1/5 its length from the closely enveloping sepals; calyx moderately to densely pilose.
    9. Capsule and calyx together narrowly obovoid, about twice as long as broad; capsule narrowly ellipsoid or ovoid, 1.5 times or more as long as broad; pedicel filiform, about 0.1 mm in diameter; basal leaves, when present, less than 5 times as long as wide; distribution primarily in the Piedmont and Mountains but also occurring in the Coastal Plain............7. *L. racemulosa.*
    9. Capsule and calyx together broadly pyriform to obovoid, usually less than 1.5 times as long as broad; capsule ovoid to subglobose to broadly ellipsoid, about 1-1.3 times as long as broad; pedicel stout, at least 0.2 mm in diameter; basal leaves, when present, 6 or more times as long as wide; distribution typically of the Coastal Plain and the outer Piedmont.
        10. Leaves abruptly tapering at apex into a hardened, shiny, conical callosity about 0.25 mm long; inner sepal clearly 3-nerved (often best demonstrated by moistening); pedicels averaging over 1.5 mm long; capsule exceeding the sepals by about 1/5 its length; seeds mostly 2................8. *L. Leggettii.*
        10. Leaves pointed but not differentiated into a callosity; inner sepal 1-nerved; pedicels averaging less than 1.5 mm long; capsule almost completely enveloped by the sepals; seeds mostly 3-6...9. *L. Torreyi.*

1. **L. villosa** Ell. Hodgdon recognized three varieties of this species. The one found throughout much of eastern North America is var. *villosa* (=var. *typica* Hodgd.). Apparently overlapping the range of this eastern variety along the extreme western fringe of the species distribution is a relatively little collected plant of problematic distinctness called var. *macrotheca* Hodgd. Another variant of which there is too little material available for adequate appraisal is var. *Schaffneri* Hodgd. This is known only from a few stations in northeastern Mexico (Tamaulipas and San Luis Potosí). The conspicuously carinate inner sepals of *L. villosa* are diagnostic and together with several other distinc-

tive features make this species easy to recognize and perhaps indicate a relatively isolated position within the genus. As is to be expected in so widespread a species, considerable



FIGURES 1-10. Sepals and capsules of *Lechea* (pubescence not shown.) Fig. 1. *Lechea villosa;* fig. 2. *L. divaricata;* fig. 3. *L. tenuifolia;* fig. 4. *L. minor;* fig. 5. *L. patula;* fig. 6. *L. Deckertii;* fig. 7. *L. racemulosa;* fig. 8. *L. Leggettii;* fig. 9. *L. Torreyi:* fig. 10. *L. cernua.*

variation is encountered which is striking even within the range of var. *villosa.*

In the course of our studies two collections were examined that seemed definitely to be hybrids between *L. villosa* and *L. racemulosa.* As both of these species are extremely wide-ranging and in part share broadly overlapping areas, it is no doubt indicative of the effectiveness of whatever isolating mechanisms that they possess that so little evidence of hybridization was encountered. The putative hybrids were both collected from the sandy inner margin of the Coastal Plain at the outer margin of the range of *L. racemulosa.* One (*Radford 26436* NCU) was from Edgefield Co., S. Carolina and the other (*Wiegand & Manning 2072* CU) was collected in Moore Co., N. Carolina. The spreading stem pubescence of these plants resembles that of *L. villosa* and the sepals are keeled, but not so strongly, as they are in *L. villosa.* The leaves are shaped more like those of *L. racemulosa* and the shape of the inflorescence also is more like that species.

RANGE: The typical variant occurs beyond our area as far north as southern New Hampshire and as far west as eastern Texas and into Illinois.

Specimens examined from the following counties: NORTH CAROLINA: Anson, Bladen, Brunswick, Carteret, Cherokee, Cleveland, Craven, Cumberland, Currituck, Dare, Duplin, Greene, Halifax, Harnett, Hyde, Iredell, Johnston, Jones, Lenoir, Montgomery, Moore, New Hanover, Northampton, Onslow, Pender, Richmond, Robeson, Scotland, Wake, Wayne, Wilson. SOUTH CAROLINA: Aiken, Allendale, Barnwell, Beaufort, Calhoun, Charleston, Chesterfield, Clarendon, Colleton, Darlington, Dillon, Dorchester, Edgefield, Fairfield, Florence, Georgetown, Hampton, Horry, Lancaster, Lee, Lexington, Marion, Marlboro, McCormick, Newberry, Orangeburg, Richland, Saluda, Sumter, Williamsburg. GEORGIA: Atkinson, Baker, Brantley, Charlton, Clay, Decatur, Dougherty, Echols, Glynn, Jones, McDuffie, McIntosh, Pierce, Richmond. FLORIDA: Alachua, Citrus, Clay, Columbia, Dixie, Duval, Escambia, Franklin, Gilchrist, Hamilton, Hernando, Lake, Liberty, Leon, Levy, Madison, Manatee, Nassau, Okaloosa, Putnam. TENNESSEE: Bledsoe, Chester, Coffee, Dickson, Fayette, Franklin, Gibson, Henderson, Hickman, Lawrence, Lewis, McNairy, Montgomery, Rutherford, Sumner. ALABAMA: Jefferson, Lee, Mobile, Montgomery, Sumter, Tallapoosa. MISSISSIPPI: Clarke, Hancock, Harrison, Hinds, Jackson, Jefferson, Lafayette, Lincoln, Monroe, Oktibbeha, Pike. LOUISIANA: Allen, Caddo, Claiborne, Grant, Jackson, Lincoln, Rapides, Sabine, Tangipahoa, Union, Vernon, West Feliciana. ARKANSAS: Baxter, Benton, Calhoun, Clark, Cleveland, Columbia, Conway, Dallas, Drew, Faulkner, Garland, Hempstead, Independence, Izard, Jefferson, Johnson, Logan, Marion, Miller, Phillips, Pike, Prairie, Pulaski, Saline, Sevier, Stone, Union, Washington.

2. **L. divaricata** Shuttlew. ex Britt. A most distinctive species restricted in range to southern peninsular Florida. In our key, *L. divaricata* keys out next to *L. villosa* with which it was long confused (or at best treated as a Floridian variant). Hodgdon comments upon their relationship as follows: "It would be difficult to find any *Lechea* differing more from *L. villosa* in everything except quality of pubescence and the general shape of the leaves, both of which are vegetative characters and not in themselves necessarily indicative of close relationship." Hodgdon placed more confidence in the characters of the fruit which he felt indicated the relationships of this species to be closest to *L. Deckertii* and *L. patula*. As is usual when facts are few, speculation is unfettered; obviously too little is known at present to be at all dogmatic about relationships. Although *L. divaricata* is an isolated species, its relationships would seem to us somewhat closer to *L. villosa* than to *L. Deckertii* or *L. patula.*

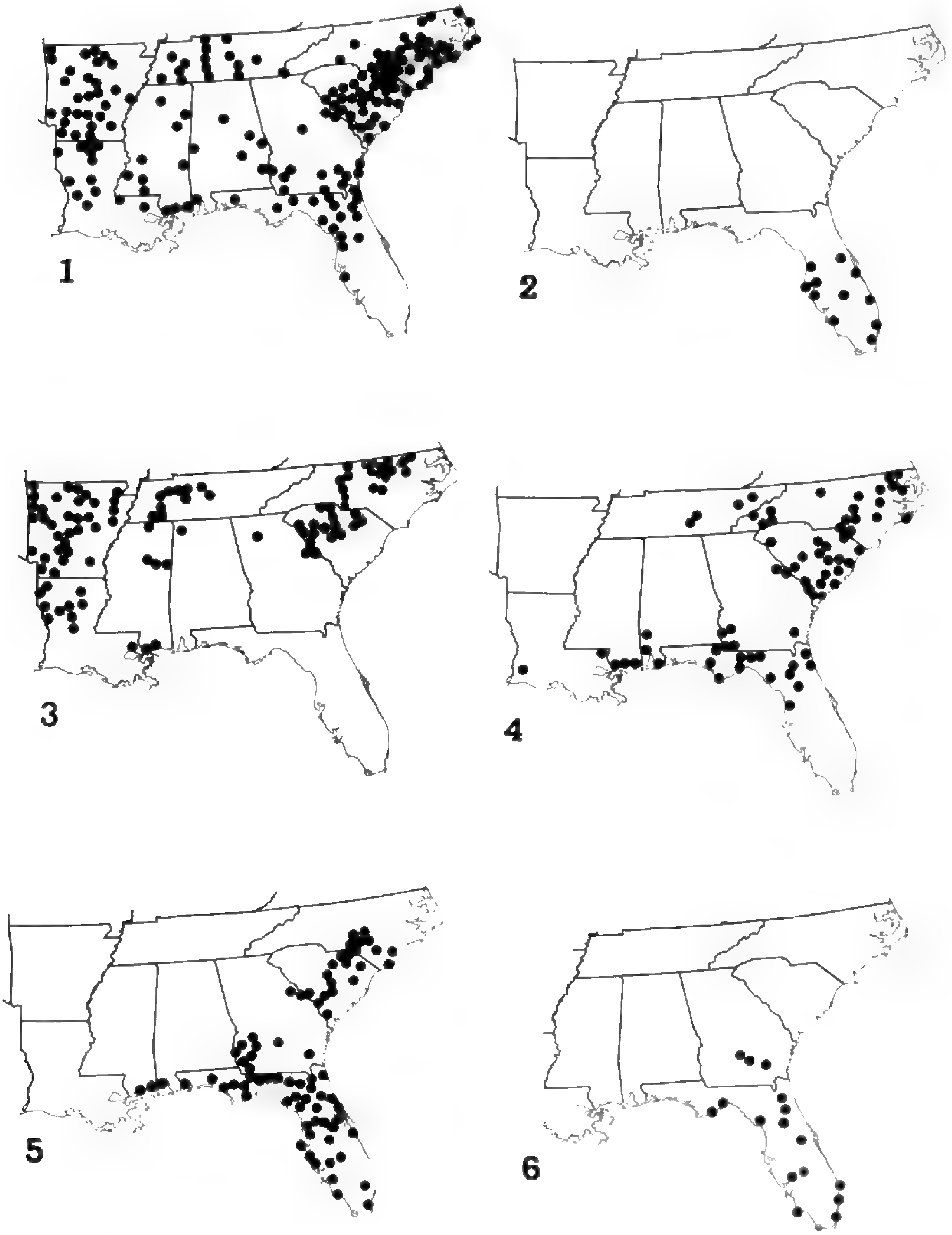
RANGE: Endemic to the southern half of peninsular Florida but apparently absent from the Keys.

Specimens examined from the following counties of Florida: Brevard, Broward, Dade, Hernando, Highlands, Hillsborough, Lee, Manatee, Martin, Pinellas, Seminole.

3. **L. tenuifolia** Michaux. A widespread species easily recognized by its very narrowly linear leaves (usually 1.5 mm or less wide), globose capsules and enveloping calyx, and its external sepals that are equal to or more commonly exceed the inner. According to Hodgdon's treatment our representatives of this species belong to var. *tenuifolia* which is distinguished by its smaller stature, fruit and seeds from var. *occidentalis* Hodgd. whose range it somewhat overlaps only in northwest Illinois. In our area it can be confused in the young flowering stages with *L. patula* and in such

cases the greater degree of pubescence and coarseness of the trichomes of *L. tenuifolia* are the best guide to its identity.

RANGE: Hodgdon's typical variety extends beyond our area as far north as southern Maine and as far west as Minnesota and eastern Texas.



MAPS 1-6. Distribution of *Lechea* in the Southeastern United States. Map 1. *Lechea villosa;* map 2. *L. divaricata;* map 3. *L. tenuifolia;* map 4. *L. minor;* map 5. *L. patula;* map 6. *L. Deckertii.*

Specimens examined from the following counties: NORTH CAROLINA: Cabarrus, Caswell, Davie, Edgecombe, Durham, Forsyth, Franklin, Granville, Halifax, Harnett, Lee, Northampton, Orange, Person, Rowan, Stokes, Union, Vance, Wake, Warren. SOUTH CAROLINA: Abbeville, Anderson, Cherokee, Chester, Chesterfield, Darlington, Fairfield, Greenwood, Laurens, Lee, Lexington, McCormick, Newberry, Richland, York. GEORGIA: Cherokee, McDuffie, Richmond. TENNESSEE: Benton, Carroll, Chester, Davidson, Dickson, Hardeman, Hickman, Humphreys, McNairy, Rutherford. ALABAMA: Colbert. MISSISSIPPI: Benton, Hancock, Harrison, Lowndes, Oktibbeha, Webster. LOUISIANA: Bossier, Caddo, Caldwell, DeSoto, Grant, Natchitoches, Ouachita, Rapides, Sabine, St. Tammany, Winn. ARKANSAS:Baxter, Benton, Clark, Columbia, Conway, Crawford, Craighead, Dallas, Drew, Faulkner, Franklin, Garland, Greene, Hempstead, Hot Springs, Independence, Izard, Logan, Marion, Miller, Newton, Ouachita, Poinsett, Prairie, Pulaski, St. Francis, Saline, Sebastian, Sevier, Stone, Washington, White, Yell.

4. **L. minor** L. The type-species of the genus. The only other named by Linnaeus, *L. major*, has been shown to be a synonym of *Helianthemum canadense* (L.) Michx. As was pointed out by Britton (1894), Linnaeus had compounded under *L. minor* at least two other species, *L. villosa* and *L. maritima*, but Britton's typification of the species, although at variance with previous interpretations, has been universally accepted. The species presents few problems in identification as it is easily distinguished by its long external sepals and the comparatively broad and often apparently whorled leaves beneath the inflorescence branches.

RANGE: This species extends north of our area to southern New Hampshire and from there west across southern Ontario to the area of Illinois about Chicago.

Specimens examined from the following counties: NORTH CAROLINA: Bertie, Buncombe, Carteret, Cumberland, Duplin, Edgecombe, Forsyth, Gates, Greene, Harnett, Henderson, Hertford, Hoke, Robeson, Scotland, Swain, Transylvania, Wake, Washington. SOUTH CAROLINA: Aiken, Allendale, Anderson, Beaufort, Berkeley, Charleston, Clarendon, Colleton, Dillon, Dorchester, Georgetown, Hampton, Horry, Jasper, Kershaw, Lee, Lexington, Sumter, Williamsburg. GEORGIA: Brantley, Calhoun, Decatur, Early, McDuffie, Seminole, Richmond. FLORIDA: Alachua, Bay, Bradford, Dixie, Duval, Gulf, Hernando, Jackson, Jefferson, Leon, Madison, Marion, St. Johns, Wakulla. TENNESSEE: Coffee, Hamblen, Knox, Warren. ALABAMA: Baldwin, Mobile, Washington. MISSISSIPPI: Hancock, Harrison, Jackson. LOUISIANA: Calcasieu, Washington.

5. **L. patula** Legg. A species of such variability that Small (1933) recognized three species. Hodgdon, after a careful appraisal of the suggested differences, could accept but one. The three species were placed by Small in two different informally named groups. The group "Longisepalae" contained *L. patula* and *L. prismatica* Small while his *L. exserta* was assigned to the group "Brevisepalae". Characteristic features of *L. patula* are its narrowly linear cauline leaves, its sepals that usually either nearly equal one another or the outer ones somewhat the longer, its conspicuously exserted capsule capped by the striking reddish-brown fimbriate stigmas and very loosely enveloped about its basal half (to two-thirds) by the calyx.

RANGE: Endemic to the southeastern Coastal Plain. *Specimens examined from the following counties:* NORTH CAROLINA: Bladen, Brunswick, Cumberland, Harnett, Hoke, Moore, Pender, Richmond, Scotland. SOUTH CAROLINA: Aiken, Allendale, Bamberg, Calhoun, Chesterfield, Darlington, Jasper, Kershaw, Marion, Marlboro, Orangeburg, Richland, Williamsburg. GEORGIA: Baker, Ben Hill, Brantley, Clay, Decatur, Dougherty, Lee, McDuffie, Miller, Randolph, Richmond, Sumter. FLORIDA: Alachua, Bay, Bradford, Brevard, Broward, Calhoun, Collier, Columbia, Dade, Dixie, DeSoto, Duval, Escambia, Flagler, Franklin, Gadsden, Gilchrist, Hernando, Highlands, Jefferson, Lake, Liberty, Lee, Leon, Levy, Madison, Manatee, Marion, Orange, Pasco, Pinellas, Polk, Putnam, Sarasota, Seminole, Suwannee, Sumter, Volusia, Walton. ALABAMA: Mobile. MISSISSIPPI: Harrison, Jackson.

6. **L. Deckertii** Small (including *L. myriophylla* Small). An unmistakable species distinguished by its suffruticose habit, more or less globose fruit with thin papery walls tardily dehiscent at maturity, and its exceedingly short external sepals and often strongly divergent inner sepals. Small (1933) distinguished two species by means of the following key to his group "Myriophyllae".

Leaf-blades subulate to elliptic-subulate: capsule depressed-globose. .... 13. *L. Deckertii.*

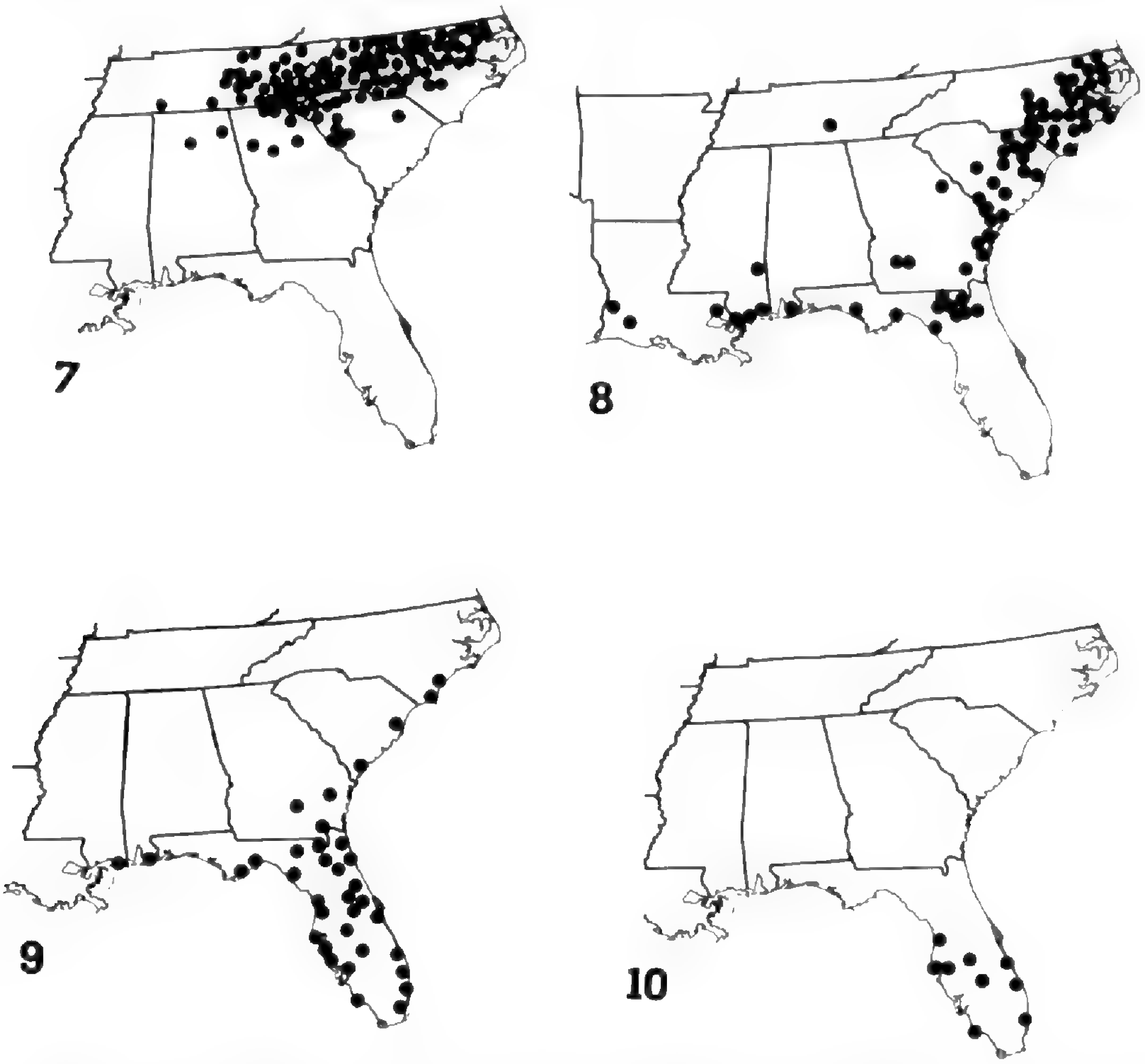
Leaf-blades elliptic, sometimes narrowly so: capsules globose........ .... 14. *L. myriophylla.*

Hodgdon concluded that these were merely growth-differences. He found that there did seem to be a difference in calyx pubescence between the two populations described as separate species by Small with *L. myriophylla* having a nearly glabrous calyx. He concluded however that these largely vegetative variants could be included within the bounds of one species. We have seen considerably more material than was available to Hodgdon and our conclusion is no different than his.

RANGE: Known only from the Coastal Plain of southern Georgia and throughout much of Florida.

Specimens examined from the following counties: GEORGIA: Ben Hill, Coffee, Pierce. FLORIDA: Broward, Clay, Collier, Dade, DeSoto, Franklin, Highlands, Levy, Marion, Orange, Palm Beach, Putnam, Wakulla.

7. **L. racemulosa** Michx. The Appalachian distribution pattern of this species has been modified by a migration onto the Coastal Plain from upper North Carolina to Long Island (but scarcely at all further south) and by its sporadic



MAPS 7-10. Distribution of *Lechea* in the southeastern United States. Map 7. *Lechea racemulosa;* map 8. *L. Leggettii;* map 9. *L. Torreyi;* map 10. *L. cernua.*

occurrence in parts of the glaciated Midwest. It is distinguished by its relatively long, slender pedicels and its conical, hardened shiny calyx-base. It apparently rarely hybridizes with *L. villosa* under which name the intermediates are discussed.

RANGE: Extending north of our area to Long Island and southern Ohio and Indiana. Reappearing in Indiana on the shore of Lake Michigan and also in eastern Missouri. *Specimens examined from the following counties:* NORTH CAROLINA: Alamance, Alexander, Alleghany, Anson, Bertie, Buncombe, Burke, Cabarrus, Caldwell, Caswell, Catawba, Chatham, Cherokee, Chowan, Clay, Cumberland, Davidson, Davie, Durham, Edgecombe, Forsyth, Franklin, Gates, Graham, Granville, Greene, Guilford, Halifax, Harnett, Haywood, Henderson, Hertford, Iredell, Jackson, Johnston, Lee, Lincoln, Macon, Martin, McDowell, Mecklenburg, Mitchell, Montgomery, Moore, Nash, Northampton, Orange, Person, Pitt, Polk, Randolph, Richmond, Rockingham, Rowan, Rutherford, Sampson, Stanly, Stokes, Surry, Swain, Transylvania, Union, Wake, Warren, Watauga, Wilson, Yadkin, Yancey. SOUTH CAROLINA: Anderson, Cherokee, Darlington, Edgefield, Greenville, Greenwood, Laurens, McCormick, Oconee, Pickens, Saluda, Spartanburg, York. GEORGIA: Clarke, DeKalb, Fanin, Habersham, Paulding, Rabun, Union. TENNESSEE: Bledsoe, Blount, Cocke, Cumberland, Fentress, Franklin, Grainger, Hamilton, Hawkins, Knox, Monroe, Polk, Rhea, Roane, Scott, Sevier, Van Buren, Wayne, White. ALABAMA: Cullman, De Kalb.

8. **L. Leggettii** Britt. & Holl. Hodgdon treats the variant occurring in the South as var. *ramosissima* Hodgd. His two other varieties are found in the Northeast and Midwest. For the most part *L. Leggettii* is restricted to the Coastal Plain but surprisingly one collection from central Tennessee seemed to belong here and adds to the list of Coastal Plain plants found as disjuncts in Tennessee or Kentucky. The most striking vegetative characteristic of this species is the hardened, conical apex of the leaf. The short external sepals, the 3-nerved inner sepals and the subglobose to pyriform fruiting calyx are a combination of characters which render this species rather easily identified.

RANGE: var. *ramossissima* Hodgd., which alone occurs in the Southeast ranges beyond that region only into southeastern Virginia.

Specimens examined from the following counties: NORTH CAROLINA: Bertie, Beaufort, Bladen, Brunswick, Carteret, Chatham, Chowan, Columbus, Craven, Cumberland, Duplin, Edgecombe, Gates, Greene, Harnett, Hoke, Jones, Lee, Martin, Nash, Northampton, Onslow, Pamlico, Pender, Pitt, Robeson, Sampson, Scotland, Washington, Wilson. SOUTH CAROLINA: Allendale, Beaufort, Chesterfield, Darlington, Dillon, Dorchester, Florence, Georgetown, Hampton, Jasper, Lee, Lexington, Orangeburg, Sumter, Williamsburg. GEORGIA: Brantley, Chatham, Dougherty, Liberty, McDuffie, McIntosh, Worth. FLORIDA: Baker, Bay, Bradford, Clay, Columbia, Dixie, Hamilton, Suwanee, Union, Wakulla. TENNESSEE: Coffee. ALABAMA: Baldwin. MISSISSIPPI: Hancock, Harrison, Jackson, Wayne. LOUISIANA: Beauregard, Jefferson Davis, St. Tammany.

9. **L. Torreyi** Legg. ex Britt. It seems probable that both Britton (1894) and Small (1903, 1933), in attributing to *L. maritima* Legg. ex Britt. a range as far south as Georgia, actually mistook some specimens of *L. Torreyi* for it. *L. maritima* is not known south of Virginia. Leggett (1878) pointed out that there are two distinguishable elements within the populations now covered by *L. Torreyi.* The differences were largely overlooked until Hodgdon (1938) treated the two as varieties distinguished by him more or less as follows:

Var. *Torreyi:* Seeds 4-6; calyx dark brown to slightly ferruginous and densely pilose with cinereous pubescence; fruit somewhat loosely arranged or scattered.

Var. *congesta:* Seeds 3; calyx usually markedly ferruginous and pubescence not conspicuously cinereous; fruit densely clustered.

The typical element was thought by Hodgdon to be restricted to Florida where var. *congesta* also was abundantly represented but which in addition ranged as far north as southeastern North Carolina and west into Mississippi. There is neither geographic segregation of the two types within peninsular Florida nor from the scanty information available is there any ecologic separation. The morphological differences are certainly not striking or clear-cut and, with the exception of the number of seeds in each capsule, are rather subjective in nature. Our study has not been exhaustive but we chose not to recognize the two varieties. More material and habitat information are required before a proper evaluation of them can be made. We would like to reemphasize that Hodgdon reports the reappearance of this species (the 3-seed variant) about 800 miles across the Gulf of Mexico in the pine forests of British Honduras.

A far more conspicuous variant has come to our attention and is represented by two sheets in the Buswell Herbarium from the "Sandy scrub above Fort Lauderdale." It is completely glabrous (leaves, stems and calyx) and of a dark reddish brown. There is but one vein in the inner sepal and that is strongly elevated — so much so as to form almost a keel. This vein extends to the very apex of the sepal. We have seen nothing remotely approaching these specimens but feel it best not to recognize them formally until more is known about the population to which they belong.

RANGE: The range of this species is shown by the accompanying map except for the reappearance of the species in British Honduras.

Specimens examined from the following counties: NORTH CAROLINA: Brunswick, Pender. SOUTH CAROLINA: Beaufort, Georgetown. GEORGIA: Charlton, Coffee, Long. FLORIDA: Alachua, Baker, Bradford, Brevard, Broward, Charlotte, Citrus, Collier, Dade, Dixie, Duval, Franklin, Hernando, Highlands, Lake, Lee, Manatee, Martin, Orange, Palm Beach, Pinellas, Polk, Putnam, St. Johns, Sarasota, Seminole, Suwannee, Volusia, Wakulla. ALABAMA: Baldwin. MISSISSIPPI: Jackson.

10. **L. cernua** Small. The species is so unlike any other within the genus that it is strange that it was overlooked until Small described it in 1924. The flowers and fruits are borne in clusters of 2-4 on stiff, often reflexed pedicels and the leaves are at least minutely pubescent upon both surfaces. The fruits are 1-2-seeded with thickened valves. The species is as distinctive as any within the genus including *L. san-sabeana* (Buckl.) Hodgd., which alone has been provided with a separate formal category by students of the genus.

RANGE: Endemic to peninsular Florida.

Specimens examined from the following counties in Florida: Broward, Collier, Hernando, Highlands, Hillsborough, Indian River, Martin, Pinellas, Polk. — DEPARTMENT OF BOTANY, DUKE UNIVERSITY.

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MENTZELIA ALBESCENS AND LONICERA XYLOSTEUM IN MISSOURI. — While botanizing near Joplin, Missouri, recently I came upon a plant, obviously belonging to the family *Loasaceae*, which I did not recognize; and I was unable to find it in either the eighth edition of Gray's Manual or in Britton and Brown's Illustrated Flora.

It proved to be *Mentzelia albescens* (Gill.) Griseb., previously known only from much farther west, ranging from New Mexico and Texas through Mexico and to Argentina and Chile. The plant was described by Gray as *Mentzelia Wrightii* in Plantae Fendlerianae Novi-Mexicanae, Mem. Amer. Acad. 4: 48. 1849; and there are several other synonyms. The determination was confirmed by Dr. Robert E. Woodson, curator of the herbarium, Missouri Botanical Garden.

Where first found, the plant was growing on mine dumps, perhaps at least fifty or sixty years old, on the north side of Turkey Creek about 2½ miles n. w. of Joplin, Missouri. The dumps consist of crumbling limestone and dolomite with fragments and boulders of chert and limestone; and practically no other vegetation was growing on them. The plants here were rather abundant, 3-5 dm. high, nearly simple or a little branched above. My collection data is No. *69221*, Aug. 27, 1960.

A few days later I again found the plant growing on chat piles of old mines about two miles up Turkey Creek and about a half mile n. w. of Joplin. The record here is No. *69227*, along Loan Elm Road, Aug. 30, 1960.

Then on Sept. 9th, 1960, while collecting near Carl Junction, Jasper County, Missouri, about ten miles n. w. of the Joplin localities, I again found the plant growing on chat piles of abandoned mines, about a mile and a half from the town. The plants here were more abundant and averaged larger in size than at the Joplin localities; some of them were up to 7-8 dm. high and more widely branched above the middle. The collection No. is *69263*.

The chat piles, on which *Mentzelia albescens* was growing, consist of crushed chert with a smaller admixture of limestone or dolomite or both from which the lead and zinc ore has been extracted. Because of its loose dry nature and the presence of alkalies and sulphides, the surface, if undisturbed, remains sterile for many years, and no plant life can find lodgment on it. However, it seems that this southwestern desert plant has found it to be a congenial habitat, for it is becoming abundant and is well established at all of the localities given above. Specimens of all the collections mentioned are deposited in the Ernest J. Palmer private herbarium, Webb City, Missouri. Duplicates of some of them will be sent to the Gray Herbarium, the herbarium of the Missouri Botanical Garden, and to other herbaria.

Lonicera Xylosteum L. is another recent collection that appears to be new to the Missouri flora, though not to that of the Manual Range. A large plant was found growing in open upland woods, along a bank of an old electric railway grade, about half a mile north of Joplin, Missouri. It was collected under my No. *69188*, Aug. 6, 1960. The range given for this introduced species in the eighth edition of Gray's Manual is N. E. to Mich., s to N. J., Penn. and O. — ERNEST J. PALMER, WEBB CITY, MISSOURI.

A NEW VARIETY OF RUDBECKIA FULGIDA. — *Rudbeckia fulgida* Ait. var. *auriculata* var. nov. Folia radicalia elliptica, lamina 15-25 cm. longa, 5-8 cm. lata, acuta, basi attenuata; folia caulina acuta, integra vel grosse serrata; folia caulina inferiora sessilia, pandurata vel spatulata, basi angustata, auriculata; folia caulina mediocria sessilia pandurata, basi lata, auriculata; folia caulina superiora sessilia ovata vel ovato-lanceolata, auriculata vel truncata.

Basal leaves elliptical, blade 15 to 25 cm. long, 5-8 cm. wide, acute, the base attenuate into a petiole that is ½ as long to as long as the blade; cauline leaves acute, coarsely and irregularly serrate; lower cauline leaves sessile, pandurate with a narrow base or spatulate, strongly auriculate, those nearest the base (nodes 1-3) occasionally elliptic-spatulate but sessile and auriculate; middle cauline leaves sessile, pandurate with a broad base, strongly auriculate; upper cauline leaves and bracts subtending the branches sessile, ovate to ovate-lanceolate, auriculate or truncate.

TYPE: Moist soil along Alabama Highway 55, 11 miles south of McKenzie (2 miles north of Red Level), Covington Co., Alabama, *R. E. Perdue, Jr. 2177*, July 24, 1958. Type in the Gray Herbarium, isotype in the U. S. National Herbarium.

This variety is very distinct from the others of *R. fulgida*. In my key to the varieties of this species[1], the plant described here keys out to either *R. fulgida* var. *fulgida* or *R. fulgida* var. *spathulata* (Michx.) Perdue. Variety *auriculata* is readily distinguished from each of these as well as from its other relatives by the typically auriculate leaves of the lower and middle parts of the stem.

I first collected the new variety in very immature condition during the summer of 1952. Not until 1958 was I able to return to the original locality and obtain additional specimens to provide a basis for the description of this new variety. My original collection was taken from a small colony extending about 25 feet along a ditchbank and consisting of about 25 or 30 individual plants. When I made the second collection, 6 years later, the colony had expanded to several hundred plants extending along the ditchbank for some 300 feet. On two separate occasions I looked extensively elsewhere in the vicinity of the type locality without finding other plants of this variety. — ROBERT E. PERDUE, JR., U. S. DEPARTMENT OF AGRICULTURE, AGRICULTURAL RESEARCH SERVICE, CROPS RESEARCH DIVISION, BELTSVILLE, MARYLAND.

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[1] Synopsis of *Rudbeckia* subgenus *Rudbeckia*. RHODORA 59 (708): 293-299 (1957).

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CHROMOSOME NUMBERS IN THE COMPOSITAE. V.

MEXICAN AND GUATEMALAN SPECIES[1]

B. L. TURNER, J. H. BEAMAN AND H. F. L. ROCK

The present study is based on bud material collected by Beaman and Rock during the summer of 1959 incidental to their separate studies on certain elements of the flora of Mexico and Guatemala.

Chromosome counts were made by Turner from pollen mother cell squashes as outlined by Turner and Ellison (1960). The voucher specimens collected by Beaman (Table 1) are deposited in the Michigan State University Herbarium; those collected by Rock are deposited in the University of Texas and Vanderbilt University Herbaria. The taxonomic identifications are those of the authors, except where otherwise noted. Table 1 should be consulted for a complete tabulation of the species studied, as some are not included in the discussion.

DISCUSSION

EUPATORIEAE — *Eupatorium glabratum* ($n=17$), *E. scorodonioides* ($n=17$). These counts are consistent with those previously reported for taxa of the section Eximbricata (Turner, Ellison and King, 1961).

Eupatorium pazcuarense ($n=25$). Both apomictic and sexual species are known for this genus; the present meiotic figures were normal with 25 bivalents. Chromosomally the species is related to those taxa on a base of $x=10$. *E. prunellaefolium* ($n=50$ univalents) is apparently apomictic, the meiotic chromosomes showing complete absence of pairing.

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[1] This study was supported by National Science Foundation Grants G-9025 and G-9045.

Ageratum corymbosum ($n=20$). This species was also reported as a tetraploid by Turner, Ellison & King (1961).

Stevia ($n=34$ univalents) . The count agrees with those obtained for several other Mexican species (Turner, unpublished), except that the latter have been completely regular at meiosis, showing 17 bivalents.

ASTEREAE — *Astranthium guatemalense* ($n=9$). The present count was also determined by Beaman and Stoutamire (unpublished) from the same bud collections. *A. guatemalense* is very restricted, occurring, so far as known, only in the Sierra de los Cuchumatanes.

Astranthium xanthocomoides ($n=8$). As indicated below, some species of *Astranthium* show a polyploid series on a base of $x=4$. This series apparently extends from the diploid to the hexaploid level. In this connection it is interesting to note that *A. guatemalense* (see above) is diploid with $n=9$; Stoutamire and Beaman (1960) and the present authors have reported $n=18$ for *A. mexicanum*. Further study, both morphological and cytological, is needed to determine if the apparent chromosomal base of $x=9$ for the latter two species has any phyletic significance. This information would seem particularly significant in view of the controversy concerning the probable ancestral basic number for the tribe Astereae (Turner, Ellison and King, 1961).

Astranthium sp. ($n=12$). This material probably represents an undescribed species. It is apparently hexaploid on a base of $x=4$, since the lowest diploid number reported for the genus is $n=4$ for *A. integrifolium* (Baldwin, 1941; Beaman, unpublished).

Erigeron ($x=9$). The chromosome numbers for the 4 species listed in Table 1 are consistent with the previous base numbers reported for other species in the genus. *E. pubescens* ($n=36$ univalents) is apparently apomictic. *E. scaposus* ($n=18$) is tetraploid showing 18 bivalents at meiosis I.

Figs. 1-25. Camera lucida drawings of meiotic chromosomes, all approximately × 1300. Fig. 1, *Eupatorium glabratum* ($n=17$). Fig. 2. *E. prunellaefolium* ($n=50$ univalents). Fig. 3. *Stevia* sp. ($n-34$ univalents). Fig. 4. *Astranthium xanthocomoides* ($n=8$). Fig 5. *Astranthium* sp. ($n=12$). Fig. 6. *Erigeron pubescens* ($n=36$ univalents). Fig. 7. *Erigeron* sp. ($n=36$). Fig. 8. *Grindelia oxylepis* ($n=6$). Fig. 9. *Machaeranthera tanacetifolia* ($n=4$). Fig. 10. *Bidens angustissima* ($n=10$).


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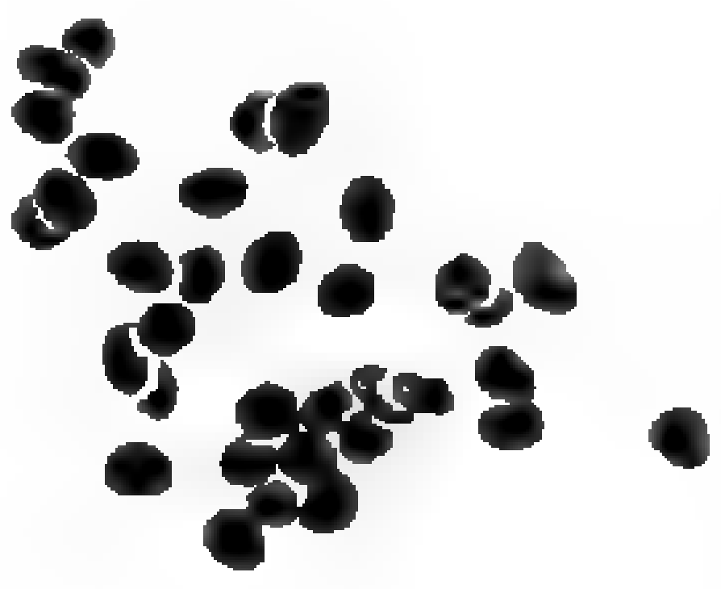
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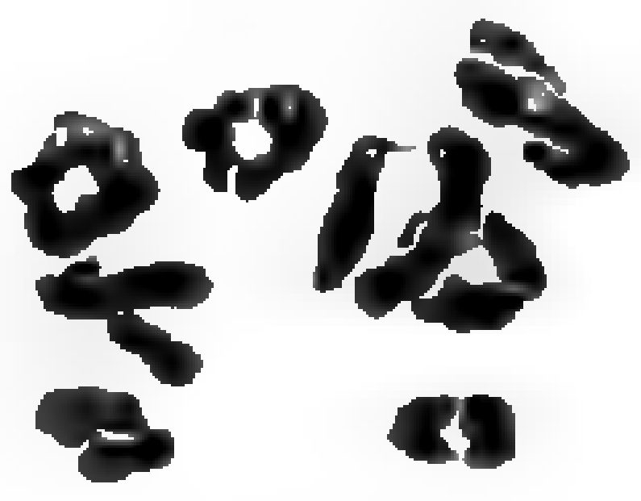
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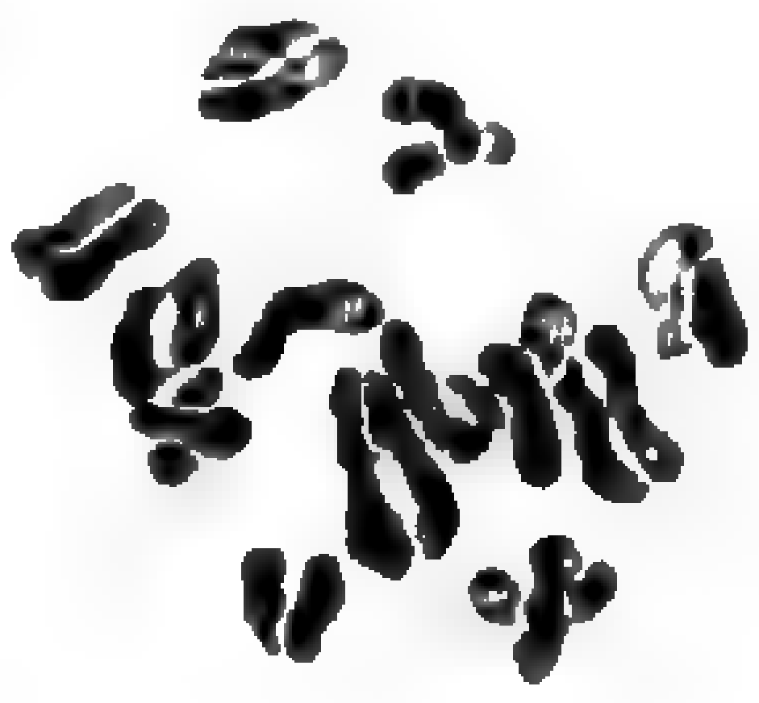
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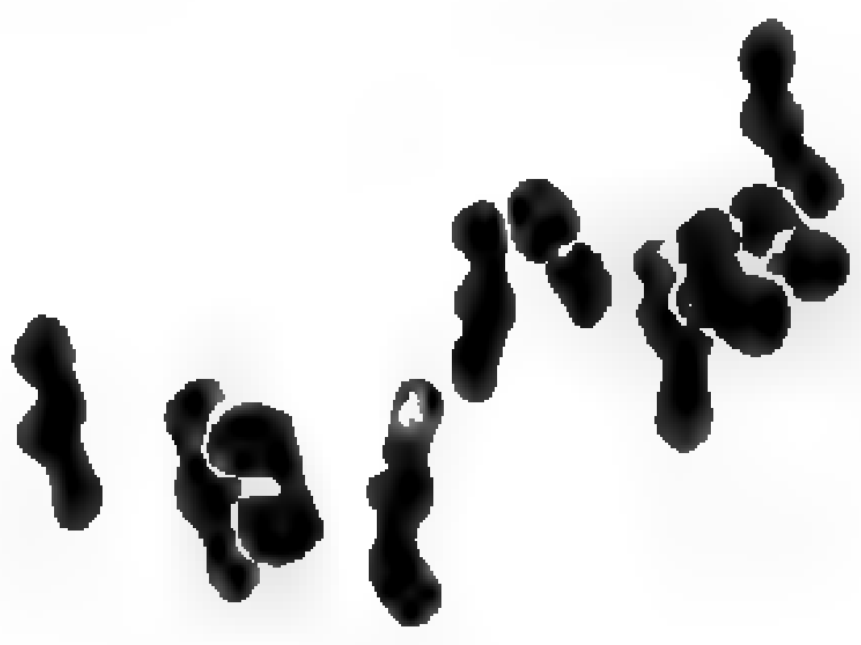
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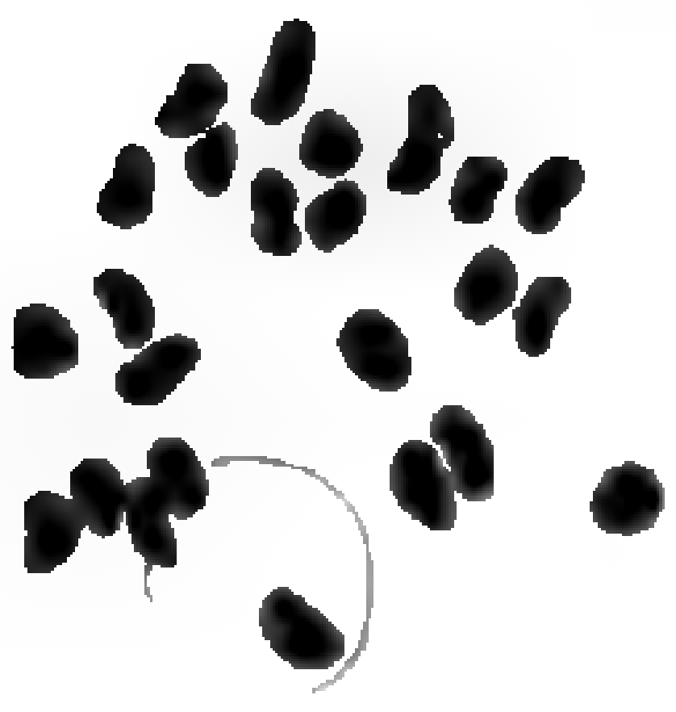
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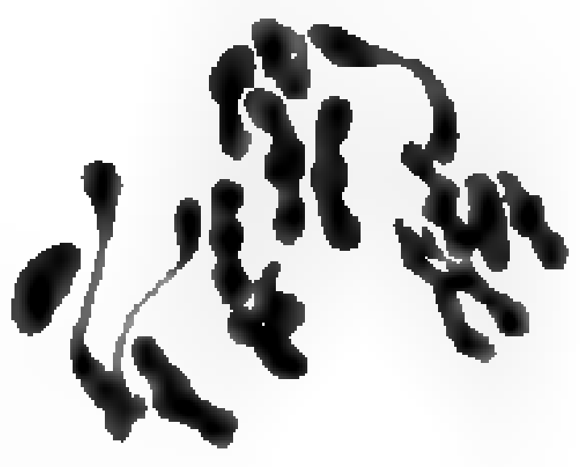
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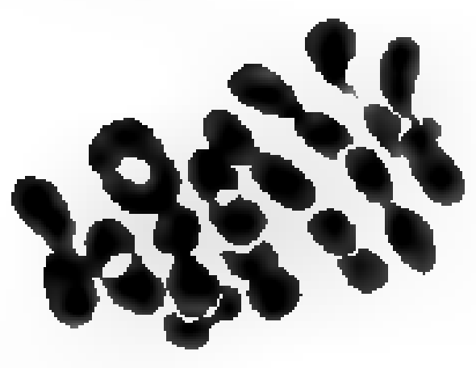
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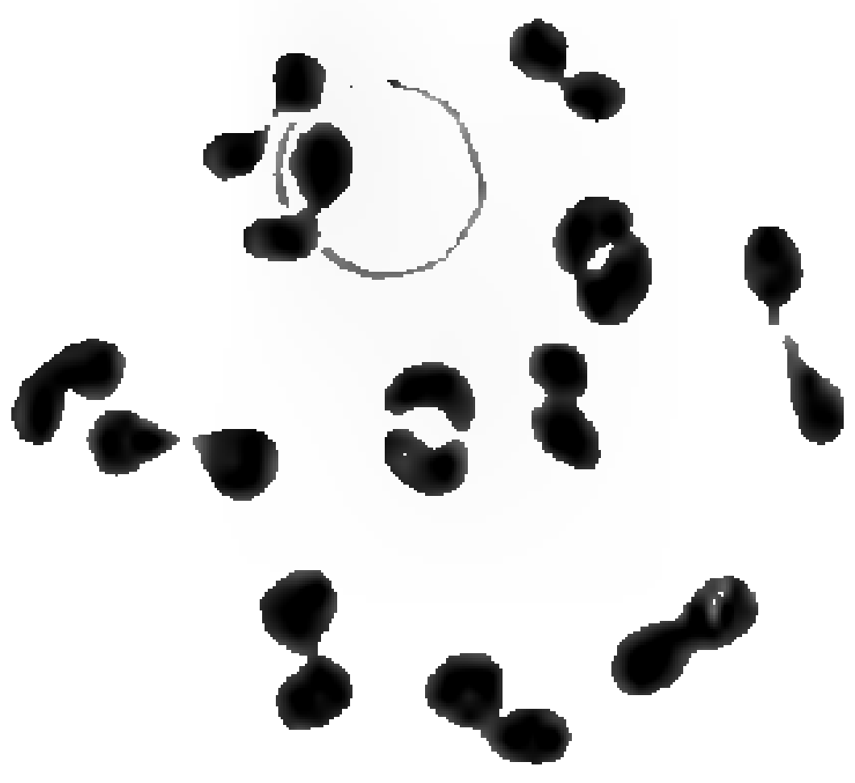
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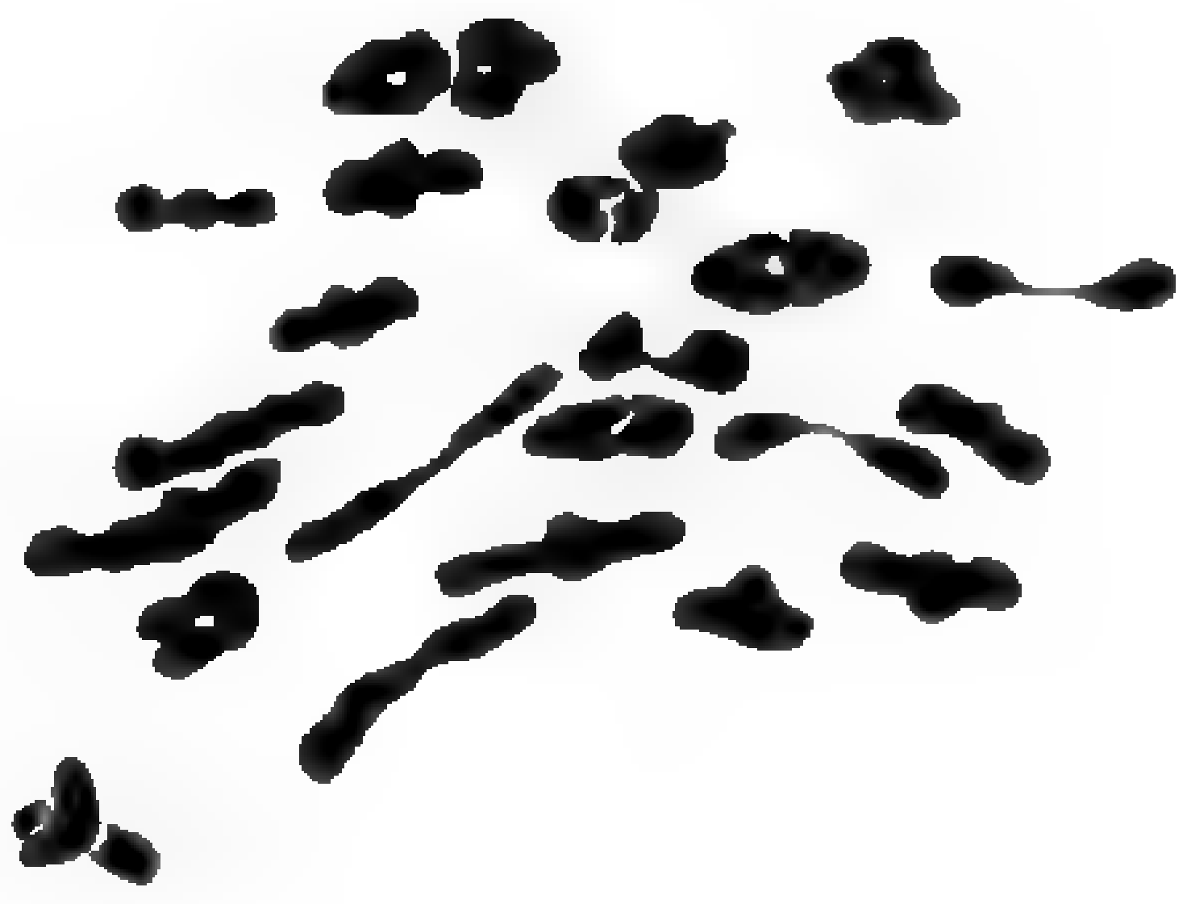
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Fig. 11. *B. anthemoides* ($n=24$). Fig. 12. *Dugesia mexicana* ($n=18$). Fig. 13. *Heterospermum pinnatum* ($n=25$). Fig. 14. *Verbesina hypomalaca* ($n=16$). Fig. 15. *V. serrata* ($n=17$). Fig. 16. *Zaluzania coulteri* ($n=16$). Fig. 17. *Zinnia angustifolia* ($n=11$). Fig. 18. *Bahia xylopoda* ($n=11$). Fig. 19. *Dyssodia pinnata* ($n=13$). Fig. 20. *Hymenoxys insignis* ($n=15$). Fig. 21. *H. odorata* ($n=15$). Fig. 22. *Nicolletia edwardsii* ($n=10$). Fig. 23. *Porophyllum amplexicaule* ($n=12$). Fig. 24. *Senecio toluccanus* ($n=20$). Fig. 25. *Senecio* cf. *cyclophyllus* ($n=23$).

Erigeron sp. ($n=9$). This collection, *Beaman 2698*, is apparently an undescribed species. *Erigeron* sp. *(Beaman 2693*, $n=36$) is likewise an undescribed species and is octoploid, there being 36 bivalents at Meiosis I.

Chromosome numbers for the genera *Gutierrezia* ($n=4$) and *Grindelia* ($n=6$) agree with the basic numbers established for these genera by other workers. Determination of a voucher specimen of *Gutierrezia glutinosa* was made by Dr. O. Solbrig. The count for *Chaetopappa* is a first report.

Machaeranthera gymnocephala ($n=4$). Jackson (1959) reported this species to be diploid with $n=5$; however, his New Mexican collection is apparently referable to *M. blepharipylla* (Gray) Shinners since Cronquist and Keck (1957) would recognize the latter as a valid taxon. It is a distinct perennial of the southwestern United States and adjacent Mexico. *M. gymnocephala* is a biennial (or annual?) or weak perennial of more southern distribution. If Jackson's count applies to *M. blephariphylla* ($n=5$) the present chromosome count for *M. gymnocephala* ($n=4$) lends support to the recognition of it as a separate species.

HELIANTHEAE — *Bidens angustissima* var. *linifolia* ($n=10$). This is the lowest chromosome number reported for the genus to date. Previous counts have all been on a base of $x=12$ or 11 (Turner, Ellison and King, 1961).

Verbesina hypomalaca ($n=16$). Turner, Ellison and King (1961) have reported counts of $n=17$ and 18 for this genus. Apparently *Verbesina (sens. lat.)* is multibasic with $x=18$, 17, 16.

Zaluzania coulteri ($n=16$). The species identification is tentative. Previous chromosome counts for the genus have been on a base of $x=18$ (Turner and Johnston, 1961).

Chromosome counts for *Cosmos*, *Perymenium*, *Sanvitalia*, *Viguiera* and *Zinnia* are consistent with basic numbers already established for these genera (Turner, Ellison and King, 1961).

Chromosome counts for the genera *Dugesia* ($n=18$) and *Heterospermum* ($n=25$) have not been previously reported.

HELENIEAE — *Dyssodia pinnata* ($n=13$). This count agrees with a number of unpublished counts for the species

(Johnston and Turner, unpublished).

Hymenoxys odorata ($n=15$). Chromosome counts of $n=11$ have been reported by previous workers for *H. odorata* (Speece and Baldwin, 1952; Raven, unpublished); identification of the material from which the present count was made was verified by Dr. K. Parker.

Nicolletia edwardsii ($n=10$). Raven & Kyhos (unpublished) have also found counts of $n=10$ for the genus.

Chromosome counts for the genera *Bahia, Baileya, Porophyllum, Psilostrophe* and *Tagetes* are consistent with the basic numbers already established for these genera (Darlington and Wylie, 1956; Towner, 1958; Turner, Ellison & King, 1961).

ANTHEMIDEAE — *Achillea lanulosa* ($n=18$). The species, as represented in Mexico, is similar morphologically to other collections from North America and has the same chromosome number.

SENECIONEAE — The chromosome counts for *Senecio toluccanus* ($n=20$) and *S. sanguisorbae* ($n=$ca. 30) are consistent with counts reported for other species of the genus.

Senecio cf. *cyclophyllus* ($n=23$). Darlington and Wylie (1956) list one other species, *S. resedifolius,* from Siberia on a base of $x=23$. Both species belong to the section Aurei (Greenman, 1903, 1907).

SUMMARY

Chromosome counts are reported for 47 taxa of Mexican Compositae. These include first reports for 34 species, some of which belong to previously unreported genera (*Chaetopappa,* $n=9$; *Dugesia,* $n=18$; *Heterospermum,* $n=25$; *Nicolletia,* $n=10$; and *Stevia,* $n=17$).

Astranthium, as presently understood, has been found to have species with $n=4$, 8, 9, 12 and 18. *Machaeranthera gymnocephala* was found to be diploid with $n=4$, instead of $n=5$ as reported by a different investigator. Exceptional counts for the genera *Bidens* ($n=10$), *Melampodium* ($n=11$) and *Verbesina* ($n=16$) are also recorded.

Hymenoxys odorata, reported as $n=11$ or $2n=22$ by previous workers, was found to have Mexican populations with $n=15$. A count of $n=23$ for a Mexican species of *Senecio* was also obtained; the only other counts of $n=23$ for this genus have been from a Siberian species.
— PLANT RESEARCH INSTITUTE, THE UNIVERSITY OF TEXAS, AUSTIN; BOTANY DEPARTMENT, MICHIGAN STATE UNIVERSITY, EAST LANSING; BIOLOGY DEPARTMENT, VANDERBILT UNIVERSITY, NASHVILLE.

TABLE 1. Summary of collections studied

Species	Locality	*n* chromosome number
EUPATORIEAE		
Ageratum corymbosum Zucc.	SAN LUIS POTOSI: La Capilla. (S. W. of San Luis Potosi) *Rock 456.*	20
Eupatorium glabratum H. B. K.	HIDALGO: *ca.* 1 km. north of Real del Monte, *ca.* 2770 m. alt. *Beaman 2370.*	17 (fig. 1)
Eupatorium pazcuarense H. B. K.	GUATEMALA: Dept. of Huehuetenango; Sierra de los Cuchumatanes, between kms. 324 and 325 on Ruta Nacional 9 N. (between Chemal and San Juan Ixcoy); *ca.* 3140 m. alt., *Beaman 3033.*	25
Eupatorium prunellaefolium H. B. K.	STATE OF MEXICO: at Puerto del Aire on Mexico-Puebla highway, 3196 m. alt. *Beaman 2903.*	50 all univalents (fig. 2)
Eupatorium scorodonioides Gray	SAN LUIS POTOSI: La Capilla. (S. W. of San Luis Potosi) *Rock 457.*	17
Stevia sp.	STATE OF MEXICO: Llano Grande. *Rock 352.*	34 all univalents (fig. 3)
ASTEREAE		
Astranthium guatemalense Blake	GUATEMALA: Dept. of Huehuetenango; Sierra de los Cuchumatanes, between kms. 324 and 325 on Ruta Nacional 9 N. (between Chemal and San Juan Ixcoy), *ca.* 3140 m. alt. *Beaman 3027.*	9
Astranthium mexicanum (Gray) Larsen	TLAXCALA: Llano Grande. *Rock 353.*	18
Astranthium purpurascens (Rob.) Larsen	HIDALGO: 6.7. mi. south of Jacala. *Rock 310.*	8
Astranthium xanthocomoides (Less.) Larsen	NUEVO LEON: *ca.* 26 mi. northeast of Dr. Arroyo on west side of mtn. known locally as Picacho Onofre, *ca.* 3230 m. alt. *Beaman 2697.*	8
Astranthium xanthocomoides (Less.) Larsen	HIDALGO: ridge *ca.* 2 kms. south of Real del Monte, *ca.* 2880 m. alt. *Beaman 2737.*	8 (fig. 4)

Astranthium sp.	NUEVO LEON: top of Cerro Potosi, *ca.* 3650 m. alt. *Beaman 2661.*	12 (fig. 5)
Chaetopappa bellioides Gray	NUEVO LEON: near Monterrey. *Rock 495.*	9
Erigeron pubescens H. B. K.	HIDALGO: ridge *ca.* 2 kms. south of Real del Monte, *ca.* 2880 m. alt. *Beaman 2733.*	36 univalents (rarely a few bivalents). (fig. 6)
Erigeron scaposus DC.	HIDALGO: ridge *ca.* 5 kms. northeast of Pachuca; *ca.* 2640 m. alt. *Beaman 2758.*	18
Erigeron sp.	NUEVO LEON: *ca.* 26 mi. northeast of Dr. Arroyo on west side of mtn. known locally as Picacho Onofre, *ca.* 3300 m. alt. *Beaman 2698.*	9
Erigeron sp.	NUEVO LEON: *ca.* 26 mi. northeast of Dr. Arroyo on west side of mtn. known locally as Picacho Onofre, *ca.* 2700 m. alt. *Beaman 2693.*	36 (fig. 7)
Grindelia oxylepis var. *eligulata* Steyermark	NUEVO LEON: 41.2 mi. south of Saltillo. *Rock 271.*	6 (fig. 8)
Gutierrezia glutinosa (Schauer) Sch. Bip.	NUEVO LEON: *ca.* 8 mi. east of Galeana on road to Linares, *ca.* 1850 m. alt. *Beaman 2679.*	4
Machaeranthera tanacetifolia (H. B. K.) Nees	NUEVO LEON: 41.2 mi. south of Saltillo. *Rock 268.*	4 (fig. 9)
Machaeranthera gymnocephala (DC.) Shinners	SAN LUIS POTOSI: La Capilla. (S. W. of San Luis Potosi). *Rock 451.*	4

HELIANTHEAE

Bidens angustissima var. *linifolia* (Sch. Bip. ex Klatt) Sherff	HIDALGO: ridge *ca.* 5 kms. northeast of Pachuca, *ca.* 2640 m. alt. *Beaman 2763.*	10 (fig. 10)
Bidens anthemoides (DC.) Sherff	VERACRUZ: Cofre de Perote. *Rock 391.*	24 (fig. 11)
Cosmos diversifolius Otto in Knowles & Westc.	HIDALGO: ridge *ca.* 2 kms. south of Real del Monte, *ca* 2880 m. alt. *Beaman 2741.*	12
Dugesia mexicana Gray	HIDALGO: ridge *ca.* 2 kms. south of Real del Monte, *ca.* 2770 m. alt. *Beaman 2756.*	18 (fig. 12)
Heterospermum pinnatum Cav.	SAN LUIS POTOSI: La Capilla (S. W. of San Luis Potosi). *Rock 463.*	25 (fig. 13)

Melampodium montanum Benth.	GUATEMALA: Dept. of Huehuetenango; Sierra de los Cuchumatanes, between kms. 324 and 325 on Ruta Nacional 9 N. (between Chemal and San Juan Ixcoy), *ca.* 3140 m. alt. *Beaman 3043.*	11
Perymenium mendezii DC.	HIDALGO: ridge *ca.* 5 kms. northeast of Pachuca, *ca.* 2640 m. alt. *Beaman 2764.*	15
Sanvitalia ocymoides DC.	QUERETARO: 4.7 mi. north of Queretaro. *Rock 435.*	16
Sanvitalia procumbens L.	HIDALGO: 6.7 mi. south of Jacala. *Rock 305.*	8
Verbesina hypomalaca Rob. & Greenm.	HIDALGO: ridge *ca.* 2 kms. south of Real del Monte, *ca.* 2880 m. alt. *Beaman 2742.*	16 (fig. 14)
Verbesina serrata Cav.	QUERETARO: 4.7 mi. north of Queretaro. *Rock 431.*	17 (fig. 15)
Viguiera stenoloba (Gray) Blake	COAHUILA: Canon de Tule, *ca.* Saltillo. *Rock 239.*	34
Zaluzania coulteri Hemsl.	HIDALGO: ridge *ca.* 2 kms. south of Real del Monte, *ca.* 2880 m. alt. *Beaman 2743.*	16 (fig. 16)
Zinnia angustifolia H. B. K.	SAN LUIS POTOSI: La Capilla (S. W. of San Luis Potosi). *Rock 449.*	11 (fig. 17)
HELENIEAE		
Bahia absinthifolia Benth.	DURANGO: 43.6 mi. northeast of Durango. *Rock 475.*	12
Bahia xylopoda Greenm.	HIDALGO: ridge *ca.* 5 kms. north of Pachuca, *ca.* 2640 m. alt. *Beaman 2762.*	11 (fig. 18)
Baileya pleniradiata Harv. & Gray	COAHUILA: Paila. *Rock 482.*	16
Dyssodia pinnata Rob.	NUEVO LEON: *ca.* 8 mi. east of Galeana on road to Linares, *ca.* 1850 m. alt. *Beaman 2680.*	13 (fig. 19)
Hymenoxys insignis (Gray) Cockerell	NUEVO LEON: top of Cerro Potosi, *ca.* 3650 m. alt. *Beaman 2649.*	15 (fig. 20)
Hymenoxys odorata DC.	NUEVO LEON: 41.2 mi. south of Saltillo. *Rock 264.*	15 (fig. 21)
Nicolletia edwardsii Gray	COAHUILA: Paila. *Rock 481.*	10 (fig. 22)
Porophyllum amplexicaule Engelm.	COAHUILA: Saltillo. *Rock 251.*	12 (fig. 23)
Psilostrophe gnaphaloides DC.	COAHUILA: Saltillo. *Rock 252.*	16

Tagetes lucida Cav.	HIDALGO: ridge *ca.* 5 kms. northeast of Pachuca, *ca.* 2640 m. alt. *Beaman 2761.*	11
ANTHEMIDEAE		
Achillea lanulosa Nutt.	STATE OF MEXICO: at Puerto del Aire on Mexico-Puebla highway, 3196 m. alt. *Beaman 2901.*	18
SENECIONEAE		
Senecio sanguisorbae DC.	NUEVO LEON: top of Cerro Potosi, *ca.* 3650 m. alt. *Beaman 2638.*	*ca.* 30
Senecio toluccanus DC.	NUEVO LEON: *ca.* 26 mi. northeast of Dr. Arroyo on west side of mtn. known locally as Picacho Onofre, *ca.* 2700 m. alt. *Beaman 2688.*	20 (fig. 24)
Senecio cf. *cyclophyllus* Greenm.	TLAXCALA: Llano Grande. *Rock 354.*	23 (fig. 25)

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NOTES ON THE GRASS FLORA OF THE CHICAGO REGION. II.

S. F. GLASSMAN

Since the publication of my last article on grasses of the Chicago region (1957), I have uncovered a substantial amount of additional information. This includes new county and regional records, notes on misidentified specimens or unverified records, a list of excluded species, and other pertinent information.

Specimens cited were examined by me at the following herbaria: Chicago Natural History Museum (F), University of Illinois, Navy Pier (CHI), University of Illinois, Urbana (ILL), Illinois Natural History Survey (ILLS), Butler University (B), Indiana University (I), University of Notre Dame (ND), Purdue University (PUR), and University of Wisconsin (WIS). I want to thank the curators of these herbaria for the privilege of studying their specimens.

Aegilops cylindrica Host. LAKE (Indiana): Hammond, *Glassman 4215* (CHI). A native of Europe which has been collected only in railroad yards in the region. First reported from the region (Cook county) by Thieret and Evers (1957).

Agropyron smithii Rydb. var. **smithii.** COOK: Chicago, *Thieret 2350, 2351, 2352* (F), *A. Johnson 3* (F); Morton Grove, *Glassman 3717, 4139, 4319* (CHI); Palos Park, *Umbach 3468* (WIS). LAKE: (Illinois): Along Milwaukee R. R., east of Round Lake Beach, *Glassman 4117, 4119* (CHI). Not previously recorded for Cook and Lake counties. This species is native west of the Mississippi River, but is adventive in the Chicago region where it occurs principally along railroad tracks.

The report of *A. smithii* by Deam et al. (1942) from La Porte county is based on a glaucous specimen *(Deam 52396,* I*)* which appears to be *A. repens* (L.) Beauv. The glaucous character was seen in many specimens of *repens* as well as *smithii.*

A number of specimens examined are rather atypical or abnormal for *A. smithii.* In *Hill 87/1897* and *Bebb 621, 980* from Lake county (Indiana) and *Glassman 4302, 4304* from Will county, some spikes have two spikelets at a node instead of one and some of these spikelets are unusually narrow. Otherwise, they fit this species. Some other specimens appear to be hybrids between *A. repens* and *A. smithii.* Before discussing them, a key distinguishing the two species is given below:

Glumes broadest near the middle, usually distinctly nerved, symmetrical, with acute tips or awn-pointed; lemmas awnless, awn-pointed or awned; upper blade surface shallowly grooved, blades 3-12 mm. wide, flat or involute, with soft or sharp pointed tips. ...... *A. repens*

Glumes broadest near the base, usually obscurely nerved, asymmetrical, with acuminate tips which are often awn-pointed; lemmas acuminate, mucronate or short awned; upper blade surface deeply and unevenly grooved, blades 2-5 mm. wide, usually involute, with sharp pointed tips .... *A. smithii.*

Umbach 3468 from Cook county, *Glassman 4227* and *Umbach* (no number) from Lake county (Indiana), and *Moffatt 142* from Du Page county, have glumes which are mostly strongly nerved. In *Umbach* (no number), however, they are with acute or mucronate tips, whereas in the others the glumes are broadest near the base and asymmetrical with acuminate tips. In one locality east of Round Lake Beach, a number of specimens were collected which apparently represent a hybrid swarm. *Glassman 4118, 4120* and *4121* have most of the characters of *A. repens,* but many of the glumes are shaped like *A. smithii* except that they are mostly strongly nerved; and *4119* is characteristic of *smithii* but most of the glumes are strongly nerved. *Glassman 4117* seems to be intermediate between the two species. The glumes are shaped like *smithii,* but almost all are distinctly nerved; and the blades are flat and up to 9 mm. wide with sharp tips, but some of the surfaces are deeply grooved like *smithii* while others are shallowly grooved like *repens.*

Agropyron smithii Rydb. var. **molle** (Scribn. & Smith) Jones. WILL: Gougars, *Glassman 4312a, 4313* (CHI). First reported from the region (Cook and Du Page counties) by Thieret and Evers (1957); these are new records for Will county. Both specimens are unusual in that some of the spikes have 2-4 spikelets per node instead of one. The reports of *A. dasystachyum* (Hook.) Vasey from the Chicago region by Mosher (1918), Pepoon (1927), Hitchcock (1935), Fernald (1950), Chase (1951), and Jones and Fuller (1955) are based on *Moffat 231* and *Umbach* (no number) from Du Page county. These specimens belong to *A. smithii* var. *molle*. Many of the reports of *A. dasystachyum* for Illinois state the habitat as "along the shores of Lake Michigan". This species is found in the above habitat in Wisconsin and Michigan, but not in Illinois or Indiana. *A. smithii* var. *molle*, on the other hand, occurs only in the vicinity of railroad tracks in the Chicago region. In the Lake Michigan region, the two taxa can be distinguished as follows:

Glumes usually asymmetrical, acuminate tipped, broadest below the middle, obscurely or distinctly nerved; lemmas and usually glumes scabrous to short pilose .... *A. smithii* var. *molle*.

Glumes usually symmetrical, acute, broadest above the middle, distinctly nerved; lemmas and often glumes more or less densely villous .... *A. dasystachyum*.

Andropogon scoparius Michx. DU PAGE: Wheaton, *Moffatt 3315* (WIS). First record from Du Page county.

Andropogon virginicus L. Apparently, a recent arrival in the Chicago region where it is found in sandy soil along roadsides. The first authentic reports of this species from Porter and La Porte counties were by Deam et al. (1951) and (1953). The Cook county reports of Higley and Raddin (1891), Mosher (1918) and Pepoon (1927) are based on a lost *Shipman* specimen which is probably *A. scoparius*.

Arrhenatherum elatius (L.) Presl. DU PAGE: Wheaton, *Glassman 4069* (CHI); WILL: Romeo, *Umbach* (CHI); Braidwood, *Vytanovych 4170* (CHI). First records for Du Page and Will counties.

Avena fatua L. LAKE (Illinois): Highland Park, *Glassman 4087* (CHI); LAKE (Indiana): Hammond, *Glassman 4214* (CHI). A European introduction found mainly along railroad tracks in the region. Both cited specimens are new records for those counties.

Brachyelytrum erectum (Schreb.) Beauv. LAKE (Illinois): Biltmore estates, *Steyermark 65948* (F). Also known from Cook and Porter counties.

Bromus commutatus Schrad. COOK: Chicago, *Glassman 3630, 3637, 4252;* Northlake, *Glassman 4089;* Lincolnwood, *Glassman 4093, 4094* (CHI); LAKE (Illinois): Grayslake, *Glassman 4110, 4112;* Libertyville, *Glassman 4116* (CHI); DU PAGE: Glen Ellyn, *Glassman 4050, 4093* (CHI); Wheaton, *Moffatt 3356* (WIS); West Chicago, *Glassman 4071, 4072* (CHI); WILL: Gougars, *Glassman 4297, 4307, 4310;* Romeo, *Umbach 1712* (CHI); LA PORTE: Trail Creek, *Potzger 10281* (B). Not listed from the Illinois portion of the Chicago region by Jones and Fuller (1955), therefore, all four county records are new. In Indiana, only specimens from Lake county have been seen, hence the La Porte county record is also new. This species resembles *B. racemosus* L. rather closely and both are often found growing together along railroad tracks. A key differentiating the two taxa in the Chicago region follows:

Plants about 50-70 cm. tall, panicles open, 10-20 cm. long, main branches stiff and ascending, up to 10 cm. long .... *B. commutatus.*
Plants usually 20-30 cm. tall, panicles somewhat contracted, 5-9 cm. long, main branches up to 4 cm. long .... *B. racemosus.*

Bromus inermis Leyss. DU PAGE: Glen Ellyn, *Glassman 4046* (CHI); WILL: Gougars, *Glassman 4311* (CHI). First records for Du Page and Will counties.

Bromus japonicus Thunb. COOK: Saganashkee Slough, *Glassman 4287, 4289* (CHI). Not previously reported from the Illinois part of the Chicago region. This species closely resembles *B. commutatus*, but can be distinguished from that taxon by the very wavy panicle branches which are spreading or drooping.

Bromus latiglumis (Shear) Hitch. LA PORTE: Along Kankakee River, *C. Ek* (B). First record for that county.

Bromus racemosus L. COOK: Chicago, *Drouet 12736a;* Lincolnwood, *Glassman 4093* (CHI); LAKE (Illinois): South of Grayslake, *Glassman 4110* (CHI); DU PAGE: Villa Park, *Glassman 4082* (CHI). First specimens I have seen for the Chicago region. No specimens were found to verify the reports of Pepoon (1927) or Jones and Fuller (1955) for Cook County.

Bromus secalinus L. WILL: Four miles east of Steger, *Drouet and Louderback 13524* (CHI). Not previously reported from Will county.

Bromus squarrosus L. PORTER: Dunes State Park, *Drouet 12715* (CHI). First reported from the region (Lake county, Indiana) by Steyermark and Swink (1955).

Diplachne fascicularis (Lam.) Beauv. Jones (1950) and Jones and Fuller (1955) list this taxon as *Leptochloa fascicularis* (Lam.) Gray; however, Fernald (1950) splits off *Diplachne* from *Leptochloa* and assigns each genus to separate tribes. Only known in the Chicago region from three specimens (*Moffatt 485, 554* and *Moffatt*, no number) from Chicago. One of these specimens, *Moffatt* (no number), is the basis for the report of *Triplasis purpurea* (Walt.) Chapm. by Pepoon (1927).

Echinochloa walteri (Pursh) Heller. No specimens have been seen for the Lake county (Illinois) report of Jones and Fuller (1955). A specimen collected from Algonquin by *Nason* (ILL) in 1879, however, was mistakenly placed in Lake county instead of McHenry county where it belongs.

Eleusine indica (L.) Gaertn. WILL: Braidwood, *Evers 34800* (ILLS); LAKE (Indiana): Gary, *Thieret 1417* (CHI). First records for these two counties.

Elymus villosus Muhl. f. **villosus.** LAKE (Illinois): Biltmore Estates, *Steyermark 65947* (F); WILL: Wheatland, *Umbach 4016, 4032, 7926* (WIS). Not previously reported from Lake and Will counties. Otherwise known from Cook and Porter counties in the region.

Elymus villosus f. **arkansanus** (Scribn. and Ball) Fern. PORTER: Five miles west of Michigan City, *Kriebel 10310* (PUR). First reported from the region (Du Page county) by Glassman (1957).

Eragrostis capillaris (L.) Nees. LAKE (Indiana): Gary, *Thieret 1509* (CHI). The first specimen I have seen for the Indiana part of the Chicago region. Listed by Peattie (1930) from the Indiana Dunes but no specimen was cited. The Du Page county report of Pepoon (1927) from Wheaton, based on *Moffatt 3413* (CHI), is actually *E. frankii* C. A. Meyer.

Eragrostis poaeoides Beauv. COOK: Chicago, *Glassman*

4240; Burnham, *Glassman 4194;* Northlake, *Glassman 4086* (CHI); DU PAGE: West Chicago, *Glassman 4076* (CHI); WILL: Gougars, *Glassman 3837* (CHI); LAKE (Indiana): Gary, *Glassman 3922;* Hammond, *Glassman 4108* (CHI). First reported from the Indiana part of the region by Glassman (1957) from Porter county; the Lake county records are new. No specimens have been found to support the Cook and Du Page county listings of Jones and Fuller (1955); these are the first plants seen by me for the Illinois portion of the region.

Festuca rubra L. COOK: Chicago, *Glassman 3637a;* Skokie, *Glassman 5300* (CHI); LAKE (Illinois): Grayslake, *Glassman 4111;* Wauconda, *Glassman 4128* (CHI). Probably introduced into the region as a pasture or lawn grass. At present, found along roadsides and in vacant lots. Originally reported from the region by Deam et al. (1947) from Porter county; the Cook and Lake county records are new.

Glyceria grandis Wats. ex Gray. LAKE (Illinois): Four miles N.E. of Volo, *Glassman 4129* (CHI); PORTER: Beverly Shores, *Glassman 3875* (CHI). First authentic specimens seen by me for the Chicago region. No specimens were found to verify the listing of Pepoon (1927).

Leptoloma cognatum (Schult.) Chase. WILL: Custer Park, *Steyermark 64831, Swink 2489* (F). First record for Will county.

Muhlenbergia mexicana (L.) Trin. f. **ambigua** (Torr.) Fern. LAKE (Illinois): Lake Villa, *Evers 41719* (ILLS). First record for the Chicago region. Differs from the species in having long awned (4-10 mm.) lemmas.

Panicum clandestinum L. WILL: Custer Park, *Swink 2433* (F). First record for Will county. Otherwise known from Cook and Porter counties.

Panicum dichotomiflorum Michx. var. **puritanorum** Svenson. COOK: Morton Grove, *Glassman 5591* (CHI). This is the first authentic record for the Chicago region. Chase (1951) listed this variety from Indiana which was probably based on a Jasper county specimen cited by Deam (1940). The following key differentiates the species from its variety:

Culms rather robust, 50-100 cm. long; spikelets acute, averaging 2.5 mm. long; plants of dry soil .... *P. dichotomiflorum.*

Clums rather slender, usually less than 50 cm. long; spikelets less pointed, averaging 2.0 mm. long; plants of damp or wet soil .... var. *puritanorum.*

Poa palustris L. LA PORTE: Eight miles S.W. of La Porte, *Kriebel 8248* (PUR). Not previously reported from this county.

Setaria glauca (L.) Beauv. WILL: Monee, *Evers 21548* (ILLS); Plainfield, *D. Chapp 1* (CHI). First records for Will county. Now reported from all counties in the Chicago region. Deam (1929), (1940), Deam et al. (1946), Chase (1951), and Jones and Fuller (1955) call this plant *S. lutescens* (Weigel) Hubb., but Fernald (1950), Reeder (1951) and Gleason (1952) maintain that the valid name is *S. glauca.*

Sporobolus asper (Michx.) Kunth. DU PAGE: Glen Ellyn, *Swink* (F). The first specimen I have seen for this county. Pepoon (1927) cites a *Moffatt* specimen from Glen Ellyn, but it is *S. neglectus* Nash.

Triplasis purpurea (Walt.) Chapm. COOK: Along Belt R.R., Chicago, *Thieret 1019* (F). Jones and Fuller (1955) list this species for Cook and Lake counties. The Cook county report is based on *Moffatt*, Chicago, Center Ave. and 47th St. (ILL), but the specimen is actually *Diplachne fascicularis.* I have not seen a Lake county, Illinois, specimen; *Thieret 1019* may be the first authentic record for the Illinois part of the Chicago region. Otherwise known from all three counties in Indiana.

EXCLUDED SPECIES

Cinna latifolia (Trev.) Griseb. No specimens have been seen to support the reports of Mosher (1918) and Pepoon (1927) from Lake county, Illinois (based on *Gates*, Beach, in 1909); Jones (1945), (1950) and Jones and Fuller (1955) from Cook and Lake counties; and Peattie (1930) from Lake county, Indiana. These entries probably should be referred to *C. arundinacea* L., a similar species. Deam (1940) lists *C. latifolia* under excluded species for Indiana.

Eragrostis reptans (Michx.) Nees. The listings of Higley and Raddin (1891) and Jones and Fuller (1955) for Cook, Lake and Du Page counties are based on specimens of *E. hypnoides* (Lam.) B.S.P., a closely related species.

Leersia lenticularis Michx. No specimens have been seen to verify the reports of Pepoon (1927) and Fernald (1937). The listings of Jones and Fuller (1955) and Mosher (1918), as *Homalocenchrus lenticularis* Michx., for Cook county (based on *Hill 76.1892*, ILL, from Wolf Lake) and Will county (based on *Hill 17.1911*, ILL, from Homer) are actually *Leersia virginica* Willd.

Muhlenbergia sobolifera (Muhl.) Trin. No specimens have been found to substantiate the reports of Higley and Raddin (1891) and Pepoon (1927), based on *Babcock* in 1885, Stony Island, Cook county; or Peattie (1930) from Clarke, Lake county, Indiana. Not listed by Deam (1929), (1940) or Jones and Fuller (1955) from the Chicago region. These reports most likely refer to *M. tenuiflora* (Willd.) B.S.P., a similar species.

Oryzopsis racemosa (Sm.) Ricker. The report of Mosher (1918) from Cook county (based on *Johnson*, Glencoe) has not been verified. Deam (1929) cited this species for Porter county (based on *Lyon*, ND). In 1940, he omitted *O. racemosa* from the Chicago region and transferred the *Lyon* specimen, which I have seen, to *O. asperifolia* Michx.

Sporobolus brevifolius (Nutt.) Scribn. This entry is based on *Hill 185.1906* (F, ILL) from Joliet, Will county (Hill, 1915). The specimen is *Muhlenbergia cuspidata* (Torr.) Rydb.

Sporobolus clandestinus (Bieler) Hitch. The specimen is *Sporobolus vaginiflorus* (Torr.) Wood. *Gates 1488*, (F), from Leyden, Cook county, is the basis of this entry by Mosher (1918), Pepoon (1927) and Jones and Fuller (1955).

Sporobolus virginicus L. This listing by Pepoon (1927) is based on *Umbach 2290* (WIS) from Lake county, Illinois; but the specimen is actually *Agrostis palustris* Huds.

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SOME NOTES ON MYRIOPHYLLUM SPICATUM

Áskell Löve

In the distant past it was generally assumed that the majority of species of higher plants of the boreal zone had a circumpolar distribution, perhaps somewhat interrupted in climatically adverse regions. Many species originally described from northern Europe were found to be represented also in America and eastern Asia. Although some students did observe a few differences between these populations, others minimized this, and the general hypothesis of circumpolar distribution of most of these plants was regarded as an indisputable fact despite the limited evidence.

When larger collections were accumulated from different parts of the globe and critical botanists started to make detailed studies of the circumpolar species, several of these were found to be composed of morphologically distinct taxa each of which was characterized by its more or less defined area. In case such taxa are only races of the same species, classifiable at the subspecific level or lower, their combined area is that of a truly circumpolar species. However, many are doubtlessly better regarded as species, and it is then a fallacy to classify them only as a part of a circumpolar species. Such a grouping may be very misleading from all geobotanical points of view because it indicates identity of units that are evolutionarily dissimilar, or could at least be expected to be so. In many cases such taxa are known to differ not only in morphology and distribution but also in chromosome number, so they cannot logically be interfertile races but must be regarded as evolutionarily distinct species on basis of their strong reproductive isolation. This was pointed out recently by Löve (1954a, b, 1955) in connection with studies of some such taxa from Eurasia and North America. Collectively speaking, these taxa appear circumpolar, but from the point of view of modern evolutionary taxonomy and geobotany they are only quasi-circumpolar, because each such collective taxon is composed of two or more false vicariants that are true species of a more limited range and often of a different origin.

One of the species that is still regarded as circumpolar by many is the aquatic *Myriophyllum spicatum s. lat.*, originally described by Linnaeus (1753) from quiet waters in Europe, with references to localities from Lappland in the north to Montpellier in the south. A North American plant was identified as the same species by Pursh (1814) and these two were regarded as being completely conspecific until Fernald (1919) pointed out that they differ in several characters so essential that he did not hesitate to give the American plant a new name, *M. exalbescens.* Although Fernald (l. c.) clearly showed that each of the two taxa has a wide and distinct geographical range, in addition to their morphological differences, later authors have often either ignored *M. exalbescens* (Rydberg, 1932; Tidestrom & Kittel, 1941) or agreed with Hultén (1947) in regarding it as only an American subspecies *exalbescens*, of the circumpolar species *M. spicatum.*

Only a few chromosome numbers have so far been reported for species of the genus *Myriophyllum.* The first report, $2n=14$, was made by Scheerer (1939) on German populations of *M. alterniflorum* L., and this has later been confirmed for Icelandic and American material by Löve & Löve (1956, 1958) and for Greenland plants by Jörgensen, Sörensen & Westergaard (1958). Scheerer (1940) also reported the number $2n=28$ for German plants of *M. verticillatum* L., whereas Japanese plants so named have $2n=42$, according to Harada (1952). *M. tenellum* Bigel. is diploid with $2n=14$ chromosomes, as determined by the present writer on material from Lac Ouareau in the Laurentian Mountains of Quebec. Reports of the chromosome number of *M. spicatum* L. *s. str.* first were made by Löve & Löve (1948), who then had counted $2n=c.\ 36$ in an inferior fixation of Icelandic material, whereas later Löve (1954a, b) corrected this to $2n=28$ also on the basis of faulty preparations from plants of two Icelandic localities. Recently better fixed material from Mývatn in northern Iceland has been found to have $2n=42$ chromosomes so the plant is apparently a hexaploid.

In connection with the corrected report of $2n=28$ chromosomes for *M. spicatum*, Löve (l. c.) reported that *M. exalbe-*

scens is a diploid with $2n=14$ chromosomes, as had been counted on material from Lake Manitoba. Consequently, since this indicated that these two related taxa were not only morphologically and geographically distinct as shown by Fernald (l. c.) but also separated by a reproductive barrier as indicated by the difference in chromosome number, it was concluded that this added considerable strength to the separation of these taxa at the specific level. Unfortunately, however, this report has later been found to be erroneous due to a mixup of notes; the material in question belonged to *M. alterniflorum* L. Specimens of true *M. exalbescens*, from Lake Manitoba and its marshes at Delta on its southern shores (cf. Löve & Löve, 1954), were found to have $2n=42$ chromosomes. That number has later been confirmed on plants from several places in the Rocky Mountains of British Columbia and Alberta, several lakes in different parts of Manitoba where material was fixed by the present writer or by Dr. J. C. Ritchie, and from some localities in western Ontario and in the Laurentian Mountains of Quebec. There is no doubt, therefore, that all over the area of *M. exalbescens* it is characterized by the hexaploid number $2n=42$ chromosomes. Since the chromosome number is the same in both taxa, observational cytotaxonomy cannot contribute a more certain solution to their problem of classification than could morphology and chorology; in fact the occurrence of some reproductive barrier between *M. spicatum s. str.* and *M. exalbescens* can only be inferred as long as biosystematic experiments have not been performed including various populations of both. However, the present writer is of the opinion that these taxa may be biologically more effectively isolated than, e. g., *Populus tremula* and *P. tremuloides* and several other species pairs without differences in chromosome number, and thus favors their being retained at the species level until experiments prove this to be wrong.

The morphological differences between *M. spicatum* and *M. exalbescens* include many characteristics, but the most distinctive ones seem to be the following: (1) The number of pairs of leaf-divisions on each primary rachis is usually

14-24 in *M. spicatum*, but only 4-14 in *M. exalbescens*. (2) Winter buds are unknown from *M. spicatum*, whereas they are typical of *M. exalbescens*. (3) The floral bracts are rhombic to elongate in *M. spicatum* but typically spathulate-ovate or even oblong-cochleiform in *M. exalbescens*. (4) The female bracts in *M. spicatum* are longer than the fruits, but rarely equal the fruits in length in *M. exalbescens*. (5) The bracteoles are reniform or suborbicular in *M. spicatum*, but always ovate in *M. exalbescens*. (6) The bracteoles are broader than long in *M. spicatum*, whereas they are longer than broad or of equal dimensions in length and breadth in *M. exalbescens*. (7) The stem of the dried plant is usually fulvous or olivaceous in colour but rarely somewhat whitened in *M. spicatum*, whereas it always is distinctly whitened in *M. exalbescens*. The species also differ in several quantative characters, but since these seem to overlap, as such characters usually do, they are useful only when many measurements can be made and compared statistically. However, the differences between these two species are so obvious that even without knowledge of the occurrence of reproductive isolation between them, they can confidently be considered to be separate species. The differences are of a magnitude greater than that separating many good species delimited by classical taxonomists, and hundreds of species pairs with similar distribution but based on much weaker morphological characteristics could easily be listed.

In a paper reporting the results of a detailed study of populations in a New Jersey lake, Patten (1954) concluded that not only *M. exalbescens* but also *M. spicatum* must be met with in New Jersey. He was of the opinion that these species intergrade and should be regarded as races only of the same species. Unfortunately, no cytological studies have so far been performed on the material reported by Patten (l. c.) and the pollen fertility of the putative hybrids was not observed, nor was the fertility of the seeds, as far as the report goes. Based on the present knowledge of the differences between the parents Patten (l. c.) presumed were involved in the hybridization, some introgression could perhaps be expected if they happened to grow together at the same place.

One may perhaps venture to suppose that the results reported by Patten (l. c.) in fact do not support his assumption of the occurrence and introgression of *M. spicatum* in New Jersey, but that his presumed hybrids may rather have been formed between *M. exalbescens* and another more certainly North American species. Such a hybrid may or may not show some degree of fertility so that some introgression could be possible, although experimental studies are needed before it can be regarded as an acceptable solution of the problem pondered by Patten (l. c.). Such an assumption is, however, far more plausible and much less far fetched than is the hypothesis of the occurrence and introgression of *M. spicatum*, a species of another continent which is nowhere else even indicated from North America east of southwestern Alaska.

When Fernald (1919) distinguished *M. exalbescens* and excluded *M. spicatum* from North America, he also described another new species, *M. magdalense*, later (Fernald, 1924) corrected to *M. magdalenense*. This latter taxon is closely related to *M. exalbescens*, differing mainly in more or less dubious fruit characters. It is met with only on the Magdalene Islands and certainly belongs to the group of endemic races, from the regions adjacent to the Gulf of St. Lawrence, which have been unduly classified at a much too high level. The present writer is of the opinion that this taxon is quite comparable to the few local variations known in Europe from *M. spicatum* and so proposes that it be reduced to the level of variety: **M. exalbescens** var. **magdalenense** (Fern.) Löve, stat. nov. (based on *M. magdalense* Fernald, in Rhodora 21, 1919, p. 122, and *M. magdalenense* Fernald, in Rhodora 26, 1924, p. 198). Variations at the same level are expected to be discovered when detailed studies are made of other somewhat isolated populations elsewhere on the continent, as indicated already by Fernald (1919) in mentioning the occurrence in Colorado of specimens with elongate bracts, and, thus, in this character reminding one of *M. spicatum*.

The distribution area of *M. exalbescens*, according to Hultén (1947), includes the North American continent from westernmost Alaska to Greenland, south to California, Arizona, New Mexico, Kansas, northern Indiana, and Connecticut. It seems to be replaced by *M. spicatum* in southwestern Alaska and the Aleutian Islands. It is likely that the species also occurs in easternmost Asia, though it is ignored by the authors of the Flora USSR and other recent Asiatic floras. In Greenland, the species is met with only in the west-central parts of the country, between Söndre Strömfjord and Umanak (cf. Böcher, Holmen & Jakobsen, 1957). There it belongs to a group of American plants of limited distribution the origin of which has not yet been properly settled (cf. Iversen, 1953; Böcher, 1954). — LABORATORY OF BIOSYSTEMATICS, BOTANICAL INSTITUTE, UNIVERSITY OF MONTREAL.

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BIDENS CONNATA VAR. GRACILIPES FERN. IN WESTERN MICHIGAN. — In a former article (Brittonia **11**: 190. 1959), I reported the occurrence of this interesting variety as growing on the east shore of Eagle Lake, Kalamazoo County, of southwestern Michigan. This location marked the farthest point west at which the variety was known to occur. It was originally described from Massachusetts, and subsequently cited by me (The Genus Bidens, Bot. Ser. Field Mus. Nat. Hist. **16**: 261. 1937) for "Maine and southward to Connecticut".

More recently I found a specimen of this same variety among additional materials sent me for examination from the Herbarium of the University of Michigan at Ann Arbor, *C. W. Bazuin 4282*, wet, sandy shore of Wolf Lake, 3-4 miles east of Muskegon, Michigan, Oct. 5, 1941. Wolf Lake is roughly seventy miles farther north and twenty miles farther west than the previously known habitat, Eagle Lake: in Kalamazoo County. To learn if the variety was still present and perhaps well established at Wolf Lake, I made a journey there on October 7th, 1960, visiting the southwest shore. Many specimens were observed growing in the wet sand almost immediately at the water's edge. Twenty or more plants were gathered for making dried herbarium specimens. These will be sent to various herbaria for record purposes in the course of time. — EARL EDWARD SHERFF.

NEW PLANT RECORDS FROM KANSAS

Ronald L. McGregor, Vernon L. Harms and
Jerold D. Poindexter

Continued botanical exploration centered in southeastern Kansas has resulted in several additions to the state flora. The area in which all but one of the new records were found is one of a few square miles in the extreme southeastern corner of the state where Mississippian rocks, mainly limestone, are exposed. This area has a strong Ozarkian floristic element and has more species of vascular plants than any of the other much larger physiographic areas of Kansas. A few species known in Kansas from this area only are: *Isoëtes butleri, Erythronium americanum, Saururus cernuus, Arabis laevigata, Vaccinium stamineum, Gillenia stipulacea, Crataegus* spp., *Cornus florida, Physocarpus opulifolius* var. *intermedius, Aster turbinellus,* and *Hieracium gronovii.*

All specimens listed are in the herbarium of The University of Kansas, Lawrence, and were collected by the senior author in company with the others.

Scirpus koilolepis (Steud.) Gleason. CHEROKEE CO.: low abandoned field, 1 mile northwest of Baxter Springs, April 30, 1960, *R. L. McGregor 15343.*

This small rush occurred abundantly with *Myosurus minimus, Sagina decumbens,* and *Lepidium densiflorum.* Its range is extended west from southern Missouri and north from Oklahoma.

Carex stipata Muhl. var. **oklahomensis** (Mackenzie) Gleason. CHEROKEE CO.: open wooded creek valley, 1 mile northwest of Galena, June 18, 1960, *R. L. McGregor 15728.*

A large colony of this sedge was found. The leaves averaged 3-5 mm. wide and perigynia averaging 4.2 mm. long and nearly as wide as high. It was known previously from southwest Missouri to eastern Texas.

Carex squarrosa L. CHEROKEE CO.: moist ravine in woods, 3 miles east and 1 mile south of Crestline, July 16, 1960, *R. L. McGregor 15822.*

We have seen no specimen to validate the previous report of this species from Kansas. Its range is extended west from Missouri.

Sisyrinchium varians Bickn. CHEROKEE CO.: prairie at edge of oak-hickory woods, 5 miles east of Baxter Springs, May 15, 1960, *R. L. McGregor 15588.*

Intergrades so completely with *S. pruinosum* Bickn.. that it should, perhaps, be included with that more southern species. Our collection extends the range to the north from Oklahoma.

Mentzelia albescens (Gill.) Griseb. CHEROKEE CO.: cherty waste land in old lead and zinc mine area, 4 miles east and 1 mile south of Crestline, July 16, 1960, *R. L. McGregor 15823.*

Darlington (Ann. Mo. Bot. Gard. **21**: 160. 1934) gave the range of this species as Oklahoma southward through Mexico, Chile, and Argentina. The Oklahoma part of the range was based on a collection in Comanche County which is some 280 miles southwest of our station. It was a pleasant surprise, then, to find a colony of several hundred plants flourishing in southeastern Kansas. The colony extended eastward a few hundred yards into Missouri to a point 3 miles southwest of Carl in Jasper County.

Gonolobus gonocarpos (Walt.) Perry. CHEROKEE CO.: rocky wooded ravine, 5 miles north of Galena, July 16, 1960, *R. L. McGregor 15809.*

A few plants in the area extend the range a little west from Missouri and north from Oklahoma.

Erigeron tenuis T. & G. CHEROKEE CO.: sandy prairie bank, 1 mile northwest of Baxter Springs, May 14, 1960, *R. L. McGregor 15577.*

This slender annual was abundant in the area and its known range is extended north and west from Oklahoma and Missouri.

Lactuca saligna L. ANDERSON CO.: edge of low woods and roadside, 2 miles north of Garnett, August 13, 1960, *R. L. McGregor 15972.* Also collected in Douglas and Franklin Counties.

This naturalized weedy plant was scattered in the area.

Two plants had lanceolate to linear and entire leaves and are referable to the forma *ruppiana* (Wallr.) G. Beck. Our collection extends the known range westward from Missouri.

Rudbeckia grandiflora (D. Don) DC. CHEROKEE CO.: bluestem prairie hay meadow, 8 miles west of Baxter Springs, June 18, 1960. *R. L. McGregor 15752.*

The range of this species is extended west from Missouri and north from Oklahoma. Though previously reported from Kansas by Stevens (Kans. Wild Flowers, Univ. of Kans. Press, 1947) his determination was based on a dwarf form of *R. subtomentosa.* — DEPARTMENT OF BOTANY, THE UNIVERSITY OF KANSAS, LAWRENCE.

ERAGROSTIS CURVULA FROM ILLINOIS. — The spontaneous appearance and subsequent collection of an introduced plant is not likely to prompt comment unless it is useful or an unwelcome arrival. However, the presence of *Eragrostis curvula* (Schrad.) Nees in an Illinois locality may be of some interest to conservationists. This perennial South African bunchgrass was first introduced in the southwestern U. S. in 1934. Since it is easily established from seed there is little reason to doubt its spread from areas of previous introduction. This writer has no reports of *E. curvula* from other areas in Illinois or from adjacent areas.

The collector of the Illinois specimens is R. T. Rexroat who stated in habitat notes that the grass was "growing in sand on the east side of woods and in a tight clump up to a foot across." It seems from Rexroat's observations that the plants had been there for some time and have persisted. According to information from the collector there were no "conservation area" plantings in the vicinity. The grass was not likely to have been deliberately seeded in that particular area. Identity was verified by Dr. Jason Swallen. Collection data: Morgan County, Illinois, east of Meredosia. Sept. 21, 1960, *R. T. Rexroat 7214, 7214A.* Specimens are deposited in herbaria of the Illinois State Museum and the U. S. National Museum. — GLEN S. WINTERRINGER, ILLINOIS STATE MUSEUM, SPRINGFIELD.

NOTES ON THE FLORA OF PENIKESE ISLAND, MASSACHUSETTS

EDWIN T. MOUL

Through the courtesy of the staff of the Botany course of the Marine Biological Laboratory at Woods Hole, the author had the opportunity to revisit Penikese Island on July 6, 1960. In the short time available some significant changes in the vegetation were noted, since my observation of 1948, which should be recorded. This island is famous as the site of the Anderson School of Natural History, conducted by Louis Agassiz in 1873. The flora of the island was first recorded by David Starr Jordan (1874). Later surveys were made by Lewis (1924), Fogg (1930) and Moul (1948).

The island has remained essentially grass covered, but two species of plants that formerly were very common everywhere have become extremely rare. These are the wild carrot *(Daucus carota L.)* and the daisy *(Chrysanthemum leucanthemum* L. var. *pinnatifidum* Lecoq. & LaMotte). In 1947 when these plants were common, the nesting bird population consisted almost exclusively of the Common and Roseate Terns. Today the population is dominantly Herring Gulls with a few Black Backed Gulls. It is possible that the great population of larger birds has been responsible for the eradication of these plants.

The two ferns, *Dennstaedtia punctilobula* (Michx.) Moore and *Dryopteris thelypteris* (L.) Gray var. *pubescens* (Lawson) Nakai, are no longer growing at their former sites. *Datura stramonium* L. was formerly very common along the strand line and around the ruins of the buildings, but only one plant was located this year. *Raphanus raphanistrum* L. which was confined to the vicinity of South Pond in 1947 has become established in large pure stands at the edge of the morainal cliffs, along the south shore.

A number of the shrubs are spreading. *Rubus laciniatus* Willd., which formed a single thicket in a hollow near the south shore in 1947, has grown vigorously and spread, forming three large distinct clumps. *Rhus copallina* L. grew only along the shore near the wharf in 1947, now it completely covers the crest of a grassy hillside to the west of the old cottage, growing to two feet in height. The thickets of *Sambucus canadensis* L. have spread, forming large thickets; this is particularly noticeable on the north side of the island near the Leper Cemetery.

The tree population has decreased. All of the *Pinus sylvestris* L. planted some years ago is dead. The maples *(Acer pseudoplatanus* L.) maintain a constant height, level with the top of the protective morainal hill. They have recovered from the severe hurricane damage, which was evident in 1947. The single specimen of *Populus deltoides* Marsh., east of the wharf, represented by sucker only in 1947, still exists, but is shrub-like and about 6 feet tall. Dead twigs indicate killing back by wind laden with salt spray. *Populus alba* L. still forms extensive thickets on the slope above the cottage, but none of these trees is more than 5 feet tall.

In 1948, I expressed the belief that the original tree cover, mentioned by Gosnold's naturalists in 1602, might return, but today the evidence indicates that a grass "subclimax" may persist into the future. — RUTGERS UNIVERSITY, NEW BRUNSWICK, N. J.

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SYNOPSIS OF THE GENUS XANTHOCEPHALUM (COMPOSITAE)

OTTO T. SOLBRIG[1]

Xanthocephalum is a small genus of homochromous *Compositae-Astereae*. It is composed of stout annuals or short-lived perennials which are characterized by a reduced pappus, glutinous campanulate or hemispheric involucre, and conspicuous yellow-rayed heads with a relatively large number of flowers, both ligulate and tubular. The genus is found in central and northern Mexico, from the state of Puebla to the United States border and in southern Arizona, New Mexico and Texas.

The present investigation was prompted by the lack of any taxonomic work covering the species in their entirety. Its aim is therefore only to delimit somewhat precisely the taxa and to present a key to the species, and is not intended as a monograph. In a previous paper (Solbrig, 1960), the characters of *Xanthocephalum* and related genera were discussed. The present investigation supplements that work by correcting information presented there and by adding some new data on generic characters.

Material from the Gray Herbarium (GH) of Harvard University, the U. S. National Herbarium (US), and the herbaria of the University of California at Berkeley (UC) and the University of Michigan (MICH) was examined. In addition, type material from these herbaria and the Royal Botanical Gardens, Kew (K) was examined. To the direc-

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[1] I am very grateful to Dr. Carroll Wood for reading the manuscript and making valuable suggestions.

tors and curators of all these institutions I am very grateful for making the material in their custody available.

HISTORY OF THE GENUS

Xanthocephalum was described by Willdenow in 1807, apparently based on material collected and described by Humboldt. No specific name was given in the original description. Kunth (Humboldt, Bonpland and Kunth, 1820) referred the species *X. centauroides* (without a description) to Willdenow's description, stating that he had not seen any material of it. This is, to my knowledge, the first specific epithet ascribed to *Xanthocephalum*, and may therefore be considered the type species. In the same work, Kunth described the genus *Xanthocoma* with the species *X. humile.* He also redescribed *Xanthocephalum centauroides* as *Pyrethrum Bonplandianum.* Lessing (1832) realized the true identity of *Pyrethrum Bonplandianum* Kunth, but not that of *Xanthocoma humile* which he maintained. De Candolle (1836, 1837) also accepted both genera, describing a new species of *Xanthocephalum, X. suffruticosum.* He failed to realize the true identity of *Pyrethrum Bonplandianum*, with the result that he coined the name *Xanthocephalum Bonplandianum*, and redescribed under *X. suffruticosum*, what is in reality, *X. centauroides.* Another new species of *Xanthocephalum* is described by him as *Keerlia linearifolia.* In 1852 Asa Gray transferred this last to the genus *Gutierrezia* in which, the epithet *linearifolia* being preoccupied, he coined the combination *Gutierrezia Alamani.* A year later, Gray described two more species of *Xanthocephalum* under *Gutierrezia: G. gymnospermoides* and *G. Wrightii.* In 1857 Regel, realizing that *Gutierrezia gymnospermoides* is not a true *Gutierrezia*, but apparently unaware of the existence of *Xanthocephalum*, described *Guenthera viscosa*, based on *Gutierrezia gymnospermoides* Gray. The following year, still another name, *Grindeliopsis* (invalid according to the present rules) was created for the same plant by Schultz Bipontinus. George Bentham (Bentham and Hooker, 1873) recognized the synonymy of all these generic names. In 1880, Asa Gray accepted Bentham's concept and described still another species, *Xanthocephalum sericocarpum.* Hemsley (1881-82) in *Biology of Central America* attempted the first and only revision of the genus. He also described in

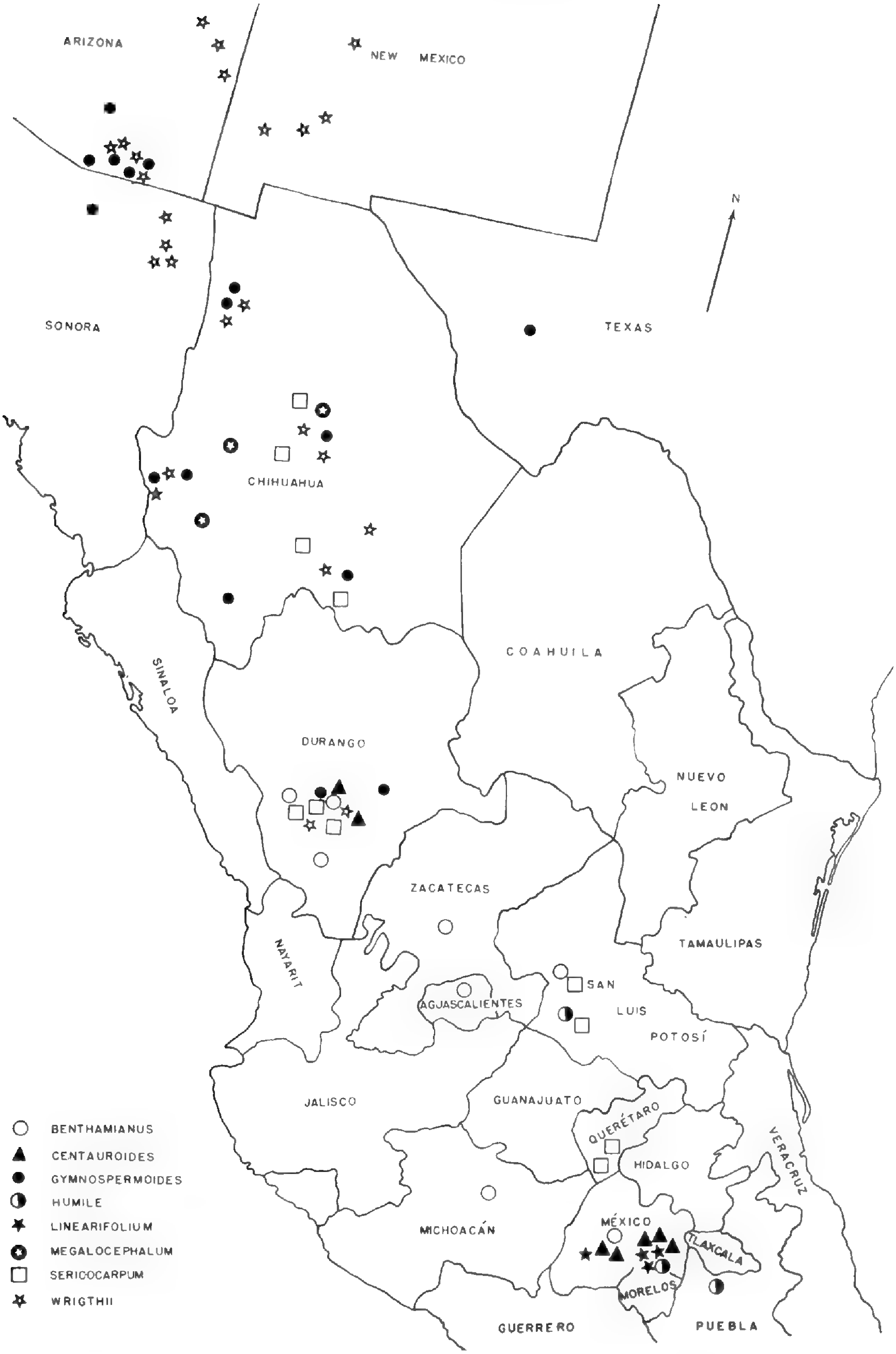

FIG. 1. Distribution of the species of *Xanthocephalum*. Each symbol represents a locality, regardless the number of collections. Above, for Benthamianus, read Benthamianum.

that work two new species. Since then new species have been described by Fernald (1901) and Robinson (1893). Thus in all, four generic names and over fifteen species have been ascribed to *Xanthocephalum.*

MORPHOLOGICAL AND CYTOLOGICAL CHARACTERS

A detailed comparative account of the principal morphological features has been presented elsewhere (Solbrig, 1960). It should be added that, contrary to what was stated then, not all species of *Xanthocephalum* are annuals, a few being short-lived perennials. Nevertheless, none are globose shrubs like species of *Gutierrezia* and *Amphipappus.* Likewise, the blooming period is not strictly fall (that is the period between September 21 and December 21), but late summer and fall. This applies to all the genera indicated in that work as fall bloomers. Nevertheless no species blooms normally in the spring, as is the case with *Amphipappus.* It may be added that most species of *Xanthocephalum* seem to be restricted to the mountainous areas of central and northwestern Mexico and border areas of the United States, usually in dry pine forests. Two species are adapted to marshy habitats in central Mexico (fig. 1).

Xanthocephalum gymnospermoides, with six pairs of chromosomes, was the only species of the genus known cytologically (Raven, Solbrig, Kyhos and Snow, 1960). Since then I have had the opportunity to get a count on material of *Xanthocephalum Wrightii* from near Alpine, Arizona (*Solbrig 3218,* GH) which had only four pairs of chromosomes. In addition Dr. B. L. Turner[2] has also found n=4 for *Xanthocephalum linearifolium,* from La Cima Station, Distrito Federal, México (*Beaman 3653,* MSC). This eliminates one of the generic differences between *Xanthocephalum and Gutierrezia* (which has x=4). It is interesting to note that *Xanthocephalum Wrightii* is the species morphologically closest to *Gutierrezia.* Nevertheless, these results do not require a reassessment of the status of *Xanthocephalum* as a genus as outlined elsewhere (Solbrig, 1960).

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[2] I am grateful to Dr. Turner for permission to use this hitherto unpublished count.

TAXONOMIC TREATMENT

Xanthocephalum Willd. Ges. Naturf. Fr. Berlin. Mag. 1: 140. 1807. *Xanthocoma* HBK. Nov. Gen. et Sp. Plant. 4: 310. 1820. (Type: *X. humile* = *Xanthocephalum humile*). *Guenthera* Regel, Gartenflora 7: 44. 1858. (Type: *G. viscosa* = *Xanthocephalum gymnospermoides*). *Grindeliopsis* Sch. Bip. Bonplandia 6: 356. 1858 (Nomen nudum).

Stout annuals or short-lived perennials, erect, glabrous to tomentose, often glandular-pubescent or resinous. Leaves petiolate, the cauline sometimes sessile, alternate, thin to subcoriaceous, linear-lanceolate to lanceolate, simple, entire, or divided. Heads solitary at the end of the branchlets, usually cymosely arranged, peduncles of variable length. Heads campanulate or hemispheric, involucral bracts in two to many rows, imbricate, yellowish, reddish or green, with or without green midribs and tips. Flowers pale to golden yellow, ligules usually more than twice the length of the involucre, numerous; tubular flowers campanulate, with a short tube and usually an expanded throat and five small triangular lobes; stamens five, tailless; styles of tubular flowers with triangular or elongate tips with collecting hairs occupying varying degrees of the outer surface of the stylar branches and with the stigmatic papillae always occupying the margins of the lower halves of the stylar branches below the collecting hairs; styles of ligulate flowers only papillate; pappus usually reduced to a low crown less than 0.5 mm. long, infrequently formed by short, irregular squamellae; achenes turbinate, swollen or flat, glabrous or tomentose. TYPE SPECIES: *Xanthocephalum centauroides* Willd.

KEY TO THE SPECIES

A. Achenes white-hairy at maturity. Receptacle conical........................ ....6. *X. sericocarpum.*

A. Achenes glabrous or sparsely pubescent. Receptacle flat or convex, not conical.

  B. Plants 5-10 cm. high with entire leaves with entire margins......... ....2. *X. humile.*

  B. Plants more than 20 cm. high, or if less, then with serrate-dentate leaves.

    C. Leaves usually pinnatifid, sometimes serrulate, if serrulate then not glandular dotted............................1. *X. centauroides.*

    C. Leaves entire or dentate, occasionally serrated.

      D. Stems longitudinally grooved, without conspicuous glandular hairs.

        E. Heads 1.5 cm. or more in diameter, ligules 15 mm. or more in length, leaves broad (5-10 mm.)........................ ....8. *X. megalocephalum.*

E. Heads less than 1.5 cm. in diameter, ligules not more than 15 mm. in length, leaves narrow or broad.
  F. Leaves linear, 1-2 mm. broad, ligules 1-2 mm. wide. Plants from an annual rootstock, usually profusely branched............................5. *X. Wrightii.*
  F. Leaves lanceolate more than 2 mm. broad, ligules 3 mm. wide. Plants from a perennial rootstock, usually little branched................3. *X. linearifolium.*

D. Stems round, with conspicuous glandular hairs.
  G. Involucres glabrous-resinous, leaves usually entire, but sometimes with dentate or serrated margins........ ....4. *X. gymnospermoides.*
  G. Involucres glandular-pubescent, leaves always dentate-serrate margined................7. *X. Benthamianum.*

1. **Xanthocephalum centauroides** Willd. ex HBK. Nov. Gen. et Sp. 4: 312. 1820.

Pyrethrum Bonplandianum HBK. Nov. Gen. et Sp. 4: 300. 1820; *Xanthocephalum Bonplandianum* (HBK.) DC. Prodr. **6**: 44. 1837. Based upon *Humboldt & Bonpland* "in Mexici locis altis prope Valladolid de Mechoacan". *Xanthocephalum suffruticosum* DC. Prodr. **6**: 44. 1837. Based upon *Berlandier 538*, "circa urbem Mexici" (G!). *Grindelia coronopifolia* Lehm. Linnaea **5**: 376. 1830. Based upon cultivated material (presumably living) of the Botanical Garden in Hamburg. *Xanthocoma dentata* Schauer, Linnaea **19**: 723. 1847; *Xanthocephalum dentatum* (Schauer) Hemsley, Biol. Centr.-Am. Bot. **2**: 111. 1881. Based upon *Aschenborn 10* "Mexico".

Annual or short-lived perennial, 15-50 cm. high. Shoots usually several from base, racemose branched, grayish-green or green, glabrous. Leaves lanceolate, 3-8 cm. long, 1-5 mm. wide, glabrous, borders usually serrate or toothed, sometimes almost entire, the teeth distinct and spaced. Heads cymosely arranged at the end of branchlets, involucres campanulate or hemispheric, 4-11 mm. wide, 3-6 mm. high; involucral bracts numerous, lanceolate, appressed, glabrous, arranged in 2-5 loose series, with green upper portions. Ligulate flowers 20-40, ligules 4-6 mm. long, 1-3 mm. wide, tube ca. 2 mm. long; tubular flowers numerous 40-60, with a very narrow tube expanding into an upper throat at least three times as wide; stylar branches with triangular tips covered with collecting hairs, and a long stigmatic portion. Pappus minute, achenes glabrous, terete or slightly appressed.

TYPE LOCALITY: Not known. (see under history of the genus).

DISTRIBUTION: Central México, from México City to San Luis Potosí and Durango.

MATERIAL STUDIED: **México.** DISTRITO FEDERAL. México City, *Orcutt 4112* (GH), *Pringle 6441* (GH, MICH, UC, US); près México, *Bourgeau 369* (GH, US); Valle de México, *Schmitz s. n.* (GH), *Schaffner 207* (GH); no loc., *Ghiesbreght 118* (GH). DURANGO. City of Durango and Vicinity, *E. Palmer 265* (GH, MICH, UC, US), *501* (GH, UC, US). SAN LUIS POTOSÍ. San Luis Potosí *Schaffner 312* (GH). VERA CRUZ. Mt. Orizaba, Maltrata, *Seaton 10* (GH, US).

2. **Xanthocephalum humile** (HBK.) Sch. Bip. ex Hemsley, Biol. Centr.-Am. Bot. 2: 111. 1881.

Xanthocoma humile HBK. Nov. Gen. et Sp. 4: 311. 1820; *Chrysanthemum humile* (HBK.) Spreng., Linn. Syst. ed. 16, 3: 584. 1826.

Annual or short-lived perennial herb 10-15 cm. high. Shoots few, unbranched from the base, brownish gray, glabrous and slightly fistulose. Leaves lanceolate, 0.5-5.0 cm. long, 0.5-3.0 mm. wide, the lower petiolate and large, forming a loose basal rosette, the upper sessile and short, glabrous, acute, entire. Heads solitary at the end of the branches, involucre hemispheric, 5-10 mm. wide, 3-6 mm. high; involucral bracts lanceolate, glabrous, arranged in two loose series, with midrib and tips green. Ligulate flowers 20-30, ligule 4-6 mm. long, tube 1-2 mm. long; tubular flowers 30-50, not more than twice the number of ligulate flowers, the corolla with a narrow tube app. 2 mm. in length provided with a few trichomes, broadening into an upper throat of same length and app. twice as broad; stigmatic branches of styles of tubular flowers with a triangular tip covered with collecting hairs and a lower papillate region; pappus a very short tube; achenes terete or prismatic, glabrous.

ILLUSTRATION: HBK. Nov. Gen. et Sp. 4: t. 412, 1820.

TYPE LOCALITY: "Crescit locis humidis Regni Mexicani, inter pagum Carpio et locum Sancti Christophori, Alt. 1180 hex. . ." *(Humboldt)*. (Not seen).

DISTRIBUTION: Central México. Known from a few localities in northern Puebla, México City and San Luis Potosí.

MATERIAL STUDIED: **México.** DISTRITO FEDERAL. Valle de México, *Schmitz 43* (GH), *Pringle 3202* (GH, UC, US), *Pringle 7422* (US); México, *Bourgeau 163* (GH, US). PUEBLA. Near Lago Salado, 253 km. e. of México City, *Weaver 865* (GH, US). SAN LUIS POTOSÍ. San Luis Potosí, *C. Parry and E. Palmer 525* (GH, US).

3. **Xanthocephalum linearifolium** (DC.) Greenman, Publ. Field Mus. Nat. Hist. Bot. 2: 345. 1912.

Keerlia linearifolia DC. Prodr. 5: 310. 1836; *Gutierrezia Alamani* Gray, Pl. Wright. 1: 91. 1852; *Xanthocephalum Alamani* (Gray) Benth. & Hook. ex Hemsley, Biol. Centr.-Am. Bot. 2: 109. 1881.

Rhizomatous perennial 10-35 cm. high, forming a dense mat. Shoots sparsely branched, greenish, somewhat fistulous, glabrous. Leaves 2-8 cm. long, 2-8 mm. wide, lanceolate-spathulate, acute, glabrous, the margins entire, sessile or with a poorly defined petiole. Heads solitary at the end of the branches, involucre hemispheric, 6-15 mm. wide, 4-6 mm. high; involucral bracts broadly lance-triangular, glabrous, glutinous, appressed in 2 or 3 loose series, with green tips. Ray flowers few (10-20), conspicuous, ligule 5-10 mm. long, 2-4 mm. wide, tube 2-3 mm. long; tubular flowers numerous (60-80), about 5 times more than ligulate flowers, corollas broadly campanulate, 3-4 mm. high; appendages of the style covered almost entirely by collecting hairs, the papillate region short; pappus variable, usually a short crown or formed by minute paleae; achenes turbinate, 1-2 mm. long, glabrous or pubescent, but never densely silky-pubescent.

TYPE LOCALITY: ". . . in Mexico . . ." *(Alaman)*. (Not seen).

DISTRIBUTION: Restricted to the valleys of México City and Toluca and neighboring areas.

MATERIAL STUDIED: **México.** DISTRITO FEDERAL. Cima Station, *Pringle 11613* (GH, MICH, US), *Moore 3439* (GH, US), *Orcutt 3784* (GH, US), *Lyonnet 841* (US), *Harshberger 120* (GH); 38 km. s. of México, *Hitchcock & Stanford 7039* (UC, US); 40 km. s. of México City, *Schoonberger 8562* (MICH); Valley of México, *Reiche 1* (US), *s. n.* (US). STATE OF MÉXICO. 12 mi. s. of Tlalpan, *W. E. & Margaret Manning 531040* (GH); calcareous bluffs, valley of Toluca, *Pringle 4195* (GH, MICH, UC, US); Las Cruces, *Hinton 1036* (US); 30 mi. w. of Toluca, *Hitchcock & Stanford 7217* (US).

4. **Xanthocephalum gymnospermoides** (Gray) Benth. & Hook. ex Rothrock, in Wheeler, U. S. Geogr. Survey W. of 100th meridian 6: 140. 1878. (Incorrectly ascribed to Benth. & Hook. Gen. Pl. 2: 249. 1873).

Gutierrezia gymnospermoides Gray, Pl. Wright. 2: 78. 1853. *Guenthera viscosa* Regel, Gartenflora 7: 44. 1858. (based on *Gutierrezia gymnospermoides*). *Grindeliopsis gymnospermoides* Sch. Bip. Bonplandia 6: 356. 1858 (nomen nudum).

Stout annual up to two meters tall. Stem with brownish-green bark, little branched at the base, somewhat more towards the top. Leaves lanceolate, of variable size, about 0.5-3.0 cm. broad and 3-15 cm. long, glabrous, the margins entire, toothed or slightly serrated, acute, the upper surface shiny and somewhat glutinous, the midrib prominent on lower surface, sometimes somewhat reddish in color. Branchlets, flowering shoots and pedicels often reddish, with prominent capitate glands in varying density. Heads numerous, cymosely arranged in crowded groups at the end of the branchlets. Involucre campanulate, glutinous, 3-7 mm. in diameter and 3-6 mm. in height; involucral bracts numerous, arranged in two loose series, glabrous, glutinous, tightly appressed, usually with green midrib and tips, the ends usually spreading. Receptacle flat or slightly convex, alveolate. Ligulate flowers 50-70, yellow, ligules 2-4 mm. in length, 1-1.5 mm. wide, about the same length as the filiform tube; tubular flowers 150-200, two to three times as many as ligulate flowers, corolla about 4 mm. long, with a narrow tube and expanded throat; style with collecting hairs restricted to the short triangular tips. Pappus variable, sometimes a low crown, sometimes a few irregular awns up to half as long as the tubular corolla. Achenes terete, glabrous or slightly pubescent, 1-2 mm. long.

TYPE LOCALITY: "Low banks of the San Pedro, Sonora (now Arizona)" *Wright* (GH!).

DISTRIBUTION: Along the mountains, northwestern México from Durango to the Arizona border; area of the Huachuca Mts. in Arizona, and Davis Mts. in Texas.

MATERIAL STUDIED: **México.** CHIHUAHUA. Prezón Ortega, *Shreve 8894* (US), *I. M. Johnston 7935* (GH, US); Majalca, *LeSueur, Mex-242* (GH), *White 2378* (GH, MICH); Rio Sta. Maria, *Thurber 747* (GH); between Casas Grandes and Sabinal, *E. W. Nelson 6381* (US), *6379* (GH, US); near Colonia Juárez, *E. W. Nelson 6321* (GH, US); 40 mi. from Guadalupe y Calvo, *E. W. Nelson 4815* (GH, US); Memelichi, Rio Mayo, *Gentry 2736* (GH, UC, US); Loreto, Rio Mayo, *Gentry 2573* (GH, UC, US); s.w. Chihuahua, *E. Palmer 439* (GH, US); near Parral, *Goldman 127* (GH, US). DURANGO. 5 mi. s.w. of Guadalupe Victoria, *Gentry 8412* (GH, MICH, UC); El Salto to Pueblo Nuevo, *Maysilles 7752* (MICH); Otinapa, *E. Palmer 455* (US). SONORA. Cananea, *Ponnelly 7* (UC). **United States.** ARIZONA. Cochise Co.: San Pedro River, *Smart 404* (US); W. of Huachuca Mts., *Shreve 7728* (MICH); Ft. Huachuca, *Patzky 38* (US); Ramsey Canyon, Huachuca Mts., *Hood 181* (US); Huachuca Mts., *M. E. Jones s. n.* (US), *Lemmon 2738* (GH, UC, US); near Ft. Huachuca, *Wilcox 38* (US). Pima Co.: Silver Lake, near Tucson, *Toumey 608* (US); Sacaton, *G. J. Harrison 6016* (GH). Santa Cruz Co.: Alkaline plains, *Pringle s. n.* (GH, US); Patagonia Mts., *Kearney & Peebles 14832* (US); near Nogales, *Peebles & Harrison 4726* (US); Nogales, *Hood 174* (US); South Arizona, *Rothrock 667* (GH, US). TEXAS. Davis Co.: Ft. Davis, *Reed 866* (US); Davis Mts., *Young s. n.* (UC).

NOTE: Some of the specimens from Chihuahua (*Gentry 2736, 2573*) were devoid of ligulate flowers, although undistinguishable from normal ligulate plants in all other respects. This rayless form which apparently is geographically isolated might deserve varietal status. Nevertheless, since in some Compositae raylessness has proved to be determined by a single gene, it is felt that before giving formal recognition to this form, more work, especially of an experimental nature, is needed.

5. **Xanthocephalum Wrightii** (Gray) Gray, Proc. Am. Acad. 8: 632. 1873.

Gutierrezia Wrightii Gray, Pl. Wright. 2: 78. 1853.

Stout annual not more than 75-100 cm. high. Shoots striate, often branching from the base. Leaves linear-lanceolate, usually 4-6 cm. in length, occasionally up to 10 cm. long, not more than 3-5 mm. wide, surface glabrous, the margins entire, sometimes short-ciliate. A loose basal rosette of leaves is present in young plants, but absent in more mature ones. Heads disposed in loose, cymose arrangements. Involucre hemispheric, 4-10 mm. wide, 4-6 mm. high; involucral bracts imbricated, appressed, glutinous, with a green tip, sometimes slightly spreading. Ray flowers few (14-20), with a long and showy ligule 5-7 mm. long, 2-3 mm. wide and a short tube, 2-3 mm. long; tubular corollas about four times more numerous than the ligulate ones (50-60), with a broad throat and short tube; style of tubular flowers with long subulate appendages covered with collecting hairs and with only a short lower papillate portion; pappus a low crown; achenes terete, glabrous, somewhat striate, 1-2 mm. long.

TYPE LOCALITY: "between Barbacomori and Santa Cruz, Sonora" *Wright 1177* (GH!).

DISTRIBUTION: Northwestern México (Chihuahua, Durango, and Sonora) and southwestern United States (Arizona and New Mexico), in moist places at mid-altitudes in the mountains.

MATERIAL STUDIED: **México.** CHIHUAHUA. Cañon de San Diego, *Lumholtz 765* (GH, US); near Colonia Garcia, *E. W. Nelson 6203 a* (GH, US), *Townsend & Barber 304* (GH, UC, US); 5 mi. S. of Garcia, *Leopold 234* (UC); near Chichupa, *Townsend & Barber 421* (GH, UC, US); lake near Chichupa, *LeSueur 1370* (GH); Chuhuichupa, *LeSueur 992* (GH); Sierra Madre, *E. W. Nelson 6307* (GH, US), *Pringle 1631* (UC); foothills, base of Sierra Madre, *Pringle 1280* (GH, MICH, US), *1629* (UC); los Cascarones, Rio Mayo, *Gentry 2681* (GH, UC, US); Canelo, Rio Mayo. *Gentry 2008* (GH, UC, US); Majalca, *Le Seuer, Mex-30* (GH, UC); 38.2 mi. w. of viejas Casas Grandes, *Tucker 2489* (UC, US). DURANGO. City of Durango, *E. Palmer 823* (UC, US), *E. W. Nelson 4623* (US); 34 mi. w. of Ciudad Durango, *Maysilles 7547* (US). SONORA. El Rancho del Roble, *White 4261* (GH, MICH), *4247* (MICH);

between Las Tierritas and El Tigre, *Phillips 684* (GH, MICH), *White 3451* (GH, MICH); Las Tierritas del Temblor, *White 3410* (GH, MICH); Barbacomori to Sta. Cruz, *Thurber 1007* (GH); El Billito, *White 4834* (MICH). **United States.** ARIZONA. Apache Co.: 8 mi. n. of Hannagan Meadow, White Mts., *Kearney & Peebles 12428* (GH); White Mts. *Gould & Robinson 4978* (UC); Mc Nary, *Whitehead 1633* (MICH); Buffalo Junction, *Solbrig 3218* (GH), *Parker & McClintock 7643* (UC, US). Cochise Co.: Mule Mts., *Harrison & Kearney 6236* (GH); Rucker Canyon, Chiricahua Mts., *Gould & Haskell 4603* (GH); Chiricahua Mts., *Lemmon s.n.* (UC); Carr Peak, Huachuca Mts., *Goodding 869* (GH, US); upper Miller Canyon, Huachuca Mts., *Goodding 420* (GH); Reef Mine, Huachuca Mts., *Darrow, Phillips, Gould & Pultz 1418* (GH); Ramsey Canyon, Huachuca Mts., *Shreve 5038* (MICH), *M. E. Jones s. n.* (GH, UC); Huachuca Mts., *Peebles, Harrison & Kearney 3387* (US), *Harrison & Kearney 5777* (US), *Holzner 2025* (US), *Shreve 5074* (UC), *Gould, Darrow, Phillips & Pultz 2486* (UC), *Gould & Haskell 3375* (UC); Santa Cruz Co.: Wrighton Peak, Santa Rita Mts., *Clark 12310* (GH); Santa Rita Mts., *Griffiths & Thornber 169* (US); near Washington, Patagonia Mts., *Kearney & Peebles 10107* (MICH, US); Roberts Ranch, *Wooton s. n.* (US). NEW MEXICO. Catron Co.: Mogollon Mts., *Wooton s. n.* (US), *Saunders s. n.* (UC), *Metcalfe 458* (US); Grant Co.: Pinos Altos Mts., *Greene 200* (GH); Black Range, *Pilsbury s. n.* (US); Black Mts., *Archer 358* (MICH); Silver City, *Holzinger s. n.* (US); Head of Cow Creek, *Eggleston 16030* (GH); Iron Creek, *Metcalfe 1481* (GH, UC, US).

6. **Xanthocephalum sericocarpum** Gray, Proc. Am. Acad. **15**: 31. 1880.

Xanthocephalum conoideum Hemsley, Biol. Centr.-Am. Bot. 2: 110. 1881. Based upon *Coulter 299*, "Real del Monte to Zacatecas" [Mexico] (K) (Isotype GH!).

Stout annual 30-50 cm. tall, usually branching profusely from the base. Shoots greenish, fistulous, less than 5 mm. in diameter at the base and not more than 1-2 mm. at the upper ends, glabrous, often with minute bracteoles. Leaves linear, 3 to 5 cm. long, 1-3 mm. wide, glabrous, acute, border entire, petiole very short or absent. Heads solitary at the end of branchlets, sometimes forming a loose cyme. Involucres hemispheric, 6-12 mm. wide, 5-7 mm. high, involucral bracts broadly lanceolate, acute, tightly appressed in two loose rows, with green tips and midribs; receptacle conical, grooved; ligulate flowers 25-40, ligules 6-12 mm. long, 2-3 mm. wide, tube 2-3 mm. long; tubular flowers 100-150, about four times as many as ligulate flowers, the tube broadly campanulate, 2-3 mm. long; styles of tubular flowers with the distal halves of the stigmatic portions covered with collecting hairs, the lower half papillate; pappus a relatively well developed crown, 0.5 to 1.5 mm. long; achenes terete, silky pubescent at maturity.

TYPE LOCALITY: "Near San Luis Potosi . . ." *Parry and Palmer 369* (GH!).

DISTRIBUTION: Northern México, from Jalisco and Querétaro northward.

MATERIAL STUDIED: **México.** CHIHUAHUA. Pine plains, base of Sierra Madre, *Pringle 1278* (GH, MICH, US); Namaquipa, *LeSueur, Mex-337* (GH); near Balleza, *Goldman 141* (GH, US); 12 mi. w. of San Antonio, *C. Muller 3380* (GH, MICH, US); southwestern Chihuahua, *E. Palmer 412* (GH, US); Mapula Mts., *Pringle 1150* (GH); 34 mi. s. of Parral, *Waterfall 12528* (MICH). DURANGO. City of Durango and vicinity, *E. Palmer 823* (GH), *143* (GH, MICH, UC, US); Sandía Station, *Pringle 13580* (GH, MICH, US); 34 mi. w. of Durango, *Maysilles 7547* (MICH), *7689* (MICH, US). JALISCO. Road between Huajnilla and Mesquite, *Rose 2560* (US). QUERÉTARO. Cazadero Station, *Pringle 10066* (GH, UC, US); 15 mi. se. of San Juan del Rio, *Waterfall 13987* (US). SAN LUIS POTOSÍ. San Luis Potosí, *Schaffner 744* (US).

7. **Xanthocephalum Benthamianum** Hemsley, Biol. Centr.-Am. Bot. 2: 110. 1881.

Stout annual 20-50 cm. tall with little or no branching from the base, and only slightly branching above. Stems greenish, greenish brown or reddish, slightly fistulous at times, 1-3 mm. in diameter, usually covered with capitate glands, especially in the upper portions. Leaves broadly lanceolate, 2-8 cm. long, 5-10 mm. wide, the lower shortly petiolate, the upper ones sessile, glabrous or slightly pubescent, the margins coarsely serrate. Heads solitary at the end of branchlets, sometimes arranged in loose cymes. Involucres campanulate, 8-15 mm. broad, 4-7 mm. high; involucral bracts numerous, variously covered with capitate glands, loosely arranged in several series, the upper portions green, the tip usually extended. Ligulate flowers 30-40, ligules 6-10 mm. long, tube app. 2 mm. long; tubular flowers numerous (100-200), four to six times as many as the ligulate, the very narrow tube followed by a wide throat; tips of stylar branches triangular, covered with collecting hairs, and with a large papillate region. Pappus a low crown; achenes terete, glabrous, 1-2 mm. high.

TYPE LOCALITY: "South México, Aguas Calientes" *Hartweg 110* (Isotype GH!).

DISTRIBUTION: Central México, from México City to Durango.

MATERIAL STUDIED: **México.** AGUASCALIENTES. *Hartwegg 110* (GH). DURANGO. W. of Durango, *Forber 17* (UC); 5 mi. n. of Coyotes, *Maysilles 8171* (MICH); Coyotes Hacienda, *Maysilles 7853* (MICH); 60 mi. sw. of Durango, *Maysilles 7781* (MICH); Rio Chico, *Maysilles 7656* (MICH). STATE OF MÉXICO. Del Rio, *Pringle 5336* (GH). MICHOACAN.

Patzcuaro, *Kenoyer 1690* (GH). SAN LUIS POTOSÍ. Chiefly in the region of San Luis Potosí, *C. Parry & E. Palmer 526* (GH, UC). ZACATECAS. Near Plateado, *Rose 2720* (US).

NOTE: *Xanthocephalum Benthamianum* is closely allied to *X. gymnospermoides* and might possibly be only a southern form of this last species. The serrated leaves and the glandular dotted involucres, the increased general pubescence and the more southern distribution (with a considerable overlap) of *X. Benthamianum* seem nevertheless sufficient specific distinction from a typological point of view. Only field studies and crossing experiments which are lacking at present can determine the true status of *X. Benthamianum.*

8. **Xanthocephalum megalocephalum** Fernald, Proc. Am. Acad. **36**: 505. 1900.

Rhizomatous perennial 30-70 cm. high. Stems glabrous, greenish, slightly fistulous, little or not branched at the base, moderately so above. Basal rosette leaves spatulate-lanceolate when present, 10-15 cm. long, 5-10 mm. broad, petiolate, acute, glabrous. Cauline leaves sessile, lanceolate, 4-6 cm. long, 5-15 mm. broad, glabrous. Heads borne singly or in pairs at the end of branchlets; involucre hemispheric, 10-20 mm. broad, resinous, with a green tip; ligulate flowers 15-30, ligules large, 12-20 mm. long, the tube 3 mm. long; tubular flowers 80-100, about four times as many as ligulate flowers, campanulate, with a short tube and broad throat; stigmatic branches subulate, almost completely covered with collecting hairs, the stigmatic papillae restricted to the lower portion; pappus a short crown not more than half a millimeter in length. Achenes terete, 1-2 mm. long, glabrous.

TYPE LOCALITY: "Chihuahua, Mt. Mohinora" *E. W. Nelson 4890* (GH!).

DISTRIBUTION: Uncommon in northern Durango and western Chihuahua, México.

MATERIAL STUDIED: **México.** CHIHUAHUA. Near Guachichi, *Goldman 174* (GH, US); along road to Parral, near San Julián, *E. W. Nelson 4932* (GH, US); Sierra Madre, *Pringle 1630* (UC), *1279*, (GH, UC, US); mountains north of Chihuahua, *LeSueur 1377* (GH). DURANGO. State of Durango, *Ibarra Garcia 412* (US).

NOTE: This rare species shows close similarities to *X. Wrightii* and to *X. linearifolium.* Nevertheless the large heads and long ligules were sufficiently distinct to permit an easy identification of *X. megalocephalum* in the material studied. — GRAY HERBARIUM, HARVARD UNIVERSITY.

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ROOTS AND THE TAXONOMIC DIFFERENCES BETWEEN BOTRYCHIUM ONEIDENSE AND B. DISSECTUM

W. H. WAGNER, JR.[1]

Since first distinguished nearly sixty years ago, the plant here treated as *Botrychium oneidense* (Gilbert) House has been a continuous source of taxonomic disagreement. It has been interpreted as a variety of *B. multifidum* (Gmel.) Rupr. or as a variety of *B. dissectum* Spreng. (Wagner, 1960a). It was originally described as a variety of a third species, *B. ternatum* (Thunb.) Sw. Only House (1921) seems to have recognized *B. oneidense* as a distinct species; but he changed his mind just three years later, and made it a vari-

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ety of *B. obliquum* Muhl. (1924). In general, then, we can find agreement on only one point, viz., that — whatever it is — taxon *oneidense* must be a variety of some other species. No author, at least for any length of time, seems to have thought that *B. oneidense* is truly a distinct species, or that the difficulty of placing it with one or another of the several species of which it has been made a variety might be due to that fact.

After personal observations of over sixty localities where the plants grow together in Ohio, Ontario, and Michigan, as well as fresh, living materials sent by others from southern Indiana and Maryland — a total of over 4,500 specimens of *B. dissectum* and 2,000 of *B. oneidense* — I feel convinced that these are distinct species (Wagner, 1955, 1960a). *Botrychium dissectum* is a highly variable plant, the most common and "normal" form of which is f. *obliquum* (Muhl.) Fern. The type form, *dissectum*, is often so lacerated that botanists have frequently treated it as a variety, or even as a species, distinct from taxon *obliquum*. However, I cannot find any differences between f. *dissectum* and f. *obliquum* other than those of marginal cutting, and there are numerous intermediates. In spite of the rather spectacular contrast in their appearance, I cannot treat even the extremes as more than minor forms of the same species. On the contrary, *B. multifidum*, *B. oneidense*, and *B. ternatum* each have a series of differences from one another and from *B. dissectum* that justify their interpretation as distinct species. This conclusion is substantially bolstered by the fact that all four of these species co-exist side-by-side in the same habitats in any combination, over a tremendous area of the northeastern United States (Wagner, 1960a, 1960b). The most significant point is perhaps that, in spite of overlap in practically every character that differentiates these plants, there are correlated series of central tendencies for each taxon that in totality are clearly different. These ensembles of average differences maintain themselves, whereever these plants grow together, with monotonous regularity. I do not, in fact, believe that all of the differences between them have yet been found. The present report will

PLATE 1259. Habitat forms of *Botrychium oneidense:* Top two rows, deep shade, Saginaw Co., woods along M-83, Sect. 22, R.6E, T.10N, Sept. 20, 1959, 9110. Bottom two rows, edges of cleared old fields, St. Clair Co., along Belle River, Sect. 28, T.5N, R.15E, May 12, 1957, 8393.

PLATE 1260. Habitat forms of *Botrychium dissectum:* Top two rows (9109) and bottom two rows (8394) from same localities as Plate 1259.

describe a newly uncovered contrast between two of the species that was quite unexpected and apparently completely overlooked, not only by previous workers but by the present author as well. It involves the root differences between *Botrychium oneidense* and *B. dissectum.*

In making studies of critical characters among these species, *the populations must be compared in the same habitats* (e.g., a shaded swamp; a low, wet, brushy field; or a second-growth wood). Differing localities and differing habitats produce strong modifications as shown in Plates 1259 and 1260, which will be discussed below. To ensure as precise a comparison as possible the rule followed in this study was to collect *only paired plants of the two species.* To obtain each pair, a spot was sought where a plant of *B. oneidense* grew close to a comparable (i.e., of approximately equal size) plant of *B. dissectum.* The arbitrary limit of permissible distance between them was five feet. Then the plant of *B oneidense* was dug up, along with the neighboring one of *B. dissectum.* Thus the average distance between the members of the pairs was between two and three feet. (The same rule was followed to compare other species, to be mentioned below.) The measurements of the diameters of the two largest roots of each living specimen were made 1 cm. from the stem to the nearest 0.1 mm., using calipers.

RESULTS. The habitat variation of roots in *B. oneidense* is probably fairly well represented by the data of this study, but the same cannot necessarily be said for *B. dissectum.* The reason for this is that the morphological differences found between various localities of *B. oneidense* are considerably less pronounced than those in the other species of evergreen grapeferns (*B. dissectum, B. multifidum,* and *B. ternatum*). *Botrychium oneidense* seems to be the least variable of the species. The reason for its lesser environmental variability seems very likely to be due to its narrower definition of habitat: it is confined almost exclusively to low, wet, acid secondary woods and swamps. The most extreme leaf forms that have been found in this species are illustrated in Plate 1259. The lower two rows are from the most exposed habitat we have yet discovered — exposed mossy areas along the edge of a dry field bordering a woods. The upper two rows are from a very deeply shaded habitat along the edge of a swamp. Corresponding specimens of *B. dissectum* from the same habitats are shown in Pl. 1260. Much more extreme specimens are known of the latter species. The five habitats we selected in which to compare the roots of these two species are what might be called approximately average for *B. oneidense* — neither the most exposed nor the most deeply shaded.

Differences between the means in root diameter of the two taxa in the different localities turned out to vary from 0.5 to 1.0 mm., as shown in Table 1. The roots of *B. dissectum* were always larger. This difference is readily evident to the naked eye when examining the root systems of a series of freshly collected specimens that have been washed. The greater thickness of the roots of *B. dissectum* is accentuated by the fact that they tend to be dark gray-brown in the region 1-5 cm. from the stem especially, but those of *B. oneidense* are paler, more delicate, and dominantly ivory-gray. Also the roots of the latter tend to have much less developed circular ridges on the roots. This is shown in the samples in Plate 1261.

TABLE 1. Root diameters of mature plants, the two largest roots of each plant measured 1 cm. from the stem. All (except *) paired specimens in same habitat.

	B. dissectum	*B. oneidense*
1.	9218a (5 plants)	9219a (5 plants)
	2.87	2.10
2.*	9218b (9)	9219b (10)
	3.08	2.15
3.	9263 (14)	9264 (14)
	2.90	2.20
4.	9265 (19)	9266 (19)
	2.92	2.20
5.	9289 (28)	9290 (28)
	3.05	2.53
6.	9307 (18)	9309 (18)
	3.06	2.48

An anatomical examination was made of the histological nature of these differences. Specimens fixed in formalinacetic-alcohol solution sectioned nicely on the freezing microtome, and were examined under the compound microscope. The roots of both species are very fleshy, composed of a large cortex of starch-filled parenchyma cells and traversed by a narrow stele, the latter only 10-15 per cent the diameter of the whole root. The root steles of both are most commonly triarch, although the tetrarch condition is frequent near the rhizome, and small roots may be diarch. The primary variation of the roots at the anatomical level seems to involve the relative development of the cortex and the modification of the superficial layers. A thin-walled corky tissue

PLATE 1261. Root systems of Botrychium: Three plants on left, 9264, *B. oneidense*; three on right, 9263, *B. dissectum*. (Photographed on frosted glass plate, with light from above and below).

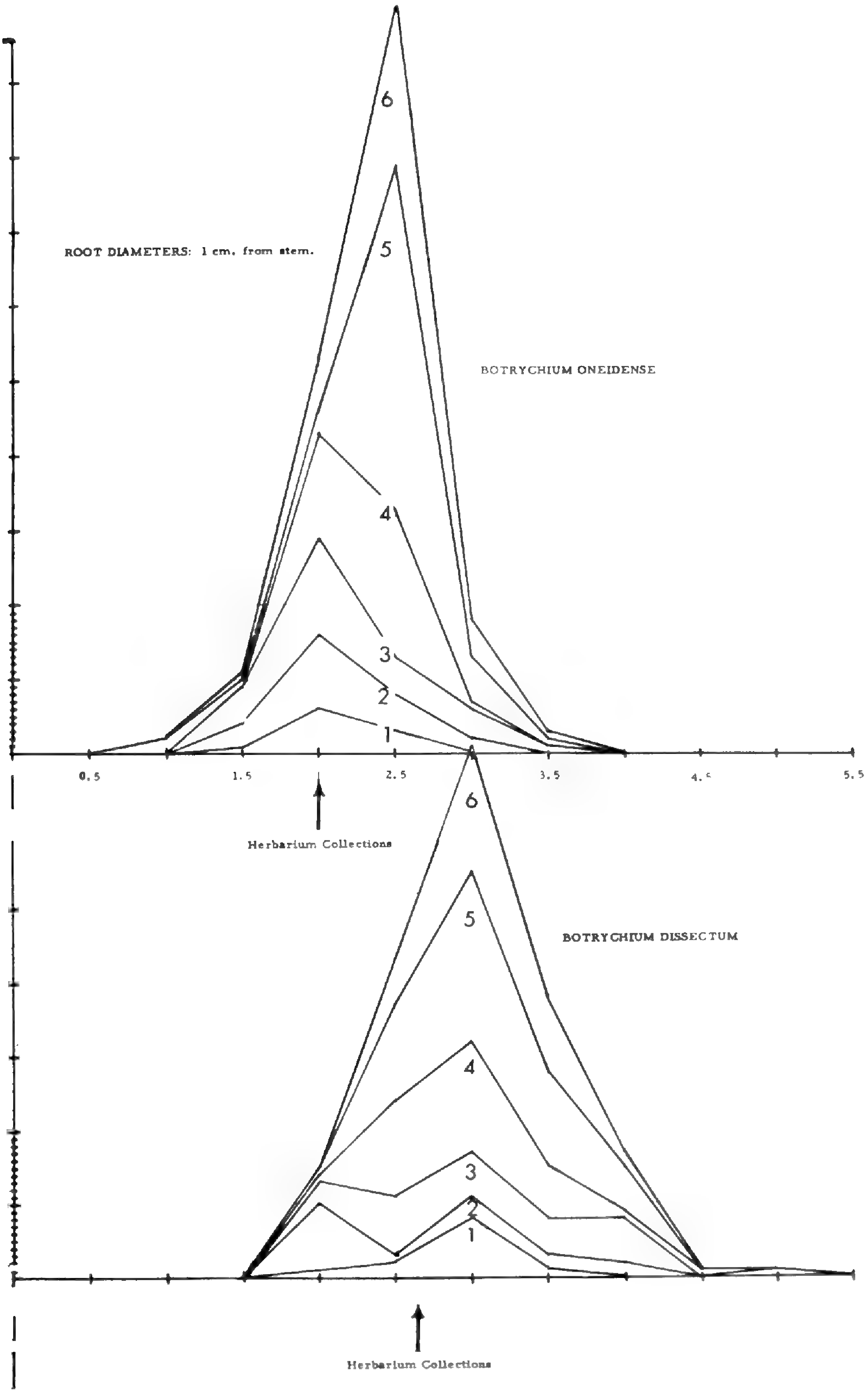

FIGURE 1. Root diameters of Botrychium. Curve numbers correspond to Table 1. Vertical scale represents number of individuals.

forms in a varying number of layers from a cambium in the outer cortex, and this tissue, comprising dead, brown-walled cells, is responsible for the darker color of the roots of *Botrychium dissectum.* The same development is found in *B. oneidense*, but its extent is less, and thus the roots appear much paler on the average and have smoother surfaces. The development of the root periderm is associated with the formation of circular ridges, these more strongly developed in *B. dissectum* but only weakly developed in all but the most robust roots of *B. oneidense.*

The differences between *B. dissectum* and the other species of evergreen grapeferns, *B. multifidum* and *B. ternatum*, proved to be negligible or inconsistent. In drier field habitats, *B. multifidum* exceeded the associated *B. dissectum* in root diameter, but in very damp habitats (two localities, one at the edge of a bog, the other in low swampy woods) it tended to have narrower roots than *B. dissectum. Botrychium ternatum* in three localities had roots the same thickness or somewhat more slender than those of *B. dissectum* growing with it. In general, the roots of *B. multifidum* and *B. ternatum* are more like those of *B. dissectum*; only *B. oneidense* showed a constant average difference, so far as our studies have been able to show.

In order to test whether the difference in root diameter between *B. dissectum* and *B. oneidense* would also be shown in random herbarium collections, 18 specimens each of the two species were measured from the United States National Herbarium. The results showed an average of 2.6 mm. in diameter in the former, and 2.0 mm. in the latter, as measured 1 cm. from the stem. A remeasurement of dried materials that have been compared in the living state first shows that there is almost exactly 20 per cent reduction in thickness. The original differences between species will thus remain in the dry state but on a somewhat smaller scale. According to this contraction of dried material, the National Herbarium samples would have averaged in the living state 3.1 mm. in diameter for *B. dissectum* and 2.4 for *B. oneidense.* These values compare favorably with those in Table 1.

DISCUSSION. Although this report is based upon a sample of 187 plants from only 5 habitats, the methods used seem to be sufficiently reliable to say that the average difference we found is a valid one. The fact that a random collection of herbarium sheets gave essentially the same results is an indication that the root differences between *B. dissectum* and *B. oneidense* are probably characteristic of the two species over their range.

One of the reasons that special care has been taken to assure that the differences between the roots are not environmentally induced ones is that there is some reason to believe that several of the previously accepted "differences"

TABLE 2. Summary of average differences of *B. oneidense* and *B. dissectum.*

	B. oneidense	*B. dissectum*
Habitat:	Mainly uniform: low, wet, acid secondary woods and swamps; local and rare in most of its area.	Diverse: open fields, brushy meadows, dry woods, wet woods, swamps; ubiquitous and common in much of its area.
Range:	Narrow: New Brunswick and Wisc. S. to Indiana and Maryland; and to North Carolina and Tennessee in the mountains.	Wide: Nova Scotia and Minnesota S. to Mexico and Jamaica.
Leaf Blade:	Segments few, large, rounded, with nearly entire to shallowly denticulate margins. Mature surfaces duller, smoother (less "veiny").	Segments numerous, smaller, pointed, with variable margins denticulate to very deeply and coarsely lacerate. Mature surfaces shiny, "veiny."
Pigmentation:	Unfolding leaves in spring lime green; late summer mature blade axes with av. 3-15 per cent pigmentation below; midwinter laminae mostly green where well exposed.	Unfolding leaves in spring reddish; late summer mature blade axes with av. 10-40 per cent pigment beneath; midwinter laminae bronze where well exposed.
Periodicity:	Vernation beginning in May, the new leaf averaging twice as tall during vernation stages; maturation of sporangia in last half of September.	Vernation beginning in early June, the new leaf averaging one-half as tall during vernation stages; maturation of sporangia in October.
Roots:	Root diameter 1 cm. from stem av. 2.5 mm. alive, 2.0 dried; circular ridges sparse in proximal 1-5 cm.; color dominantly ivory-gray to tan, only occasional large roots completely dark in basal 1-5 cm.	Root diameter 1 cm. from stem av. 3.0 mm. alive, 2.5 mm. dried; circular ridges well developed in proximal 1-5 cm.; color dominantly dark gray-brown in proximal 1-5 cm.

between these species are actually based upon habitat modifications. For example, we have found no evidence that *B. oneidense* has a distinctively "thin texture of the blade" when growing with *B. dissectum* (Wagner, 1960b, table 4, p. 318). Likewise, we have found no evidence of a "marked tendency toward lower fertility": indeed, when growing sympatrically in the habitats, the two species are very much alike (Wagner, 1961). We examined the spores to find differences but they too are similar.

However, there are a number of real average differences between these plants. It is, of course, possible that one or a few important genes could somehow control all of the differences, but this seems unlikely because the characters involved are so diverse. The differences lie in six categories (listed in Table 2). It is probable that many of the details of contrasts within several of the categories are inter-related and are aspects of the same thing: for example, the three contrasts under "roots" are probably all correlated. Those under periodicity, under pigmentation, and under leaf structure, may be also — but this is questionable. For example, the size and the shape of segments must surely be under different genetic control, judging from these characters in the other species. Therefore, the best statement of the differences between these two species, *B. oneidense* and *B. dissectum*, that we can make (including here the new root characters, as well as those studied previously) is as follows: they are sympatric species in northeastern North America, the range of one *(B. dissectum)* completely overlapping the other *(B. oneidense)*, and they differ in the central tendencies of differences in six known categories: (1) Habitat; (2) Range; (3) Leaf blade structure; (4) Pigmentation; (5) Periodicity; and (6) Root size and development.

VOUCHER SPECIMENS: (All Michigan field collections). Wayne Co., junct. Flat Rock Rd. and Expressway, R.9E, T.3S, Sect. 19, May 20, 1960, 9218a (Dissectum), 9219a (Oneidense), 9218b and 9219b unpaired in same habitat. Monroe Co., woods W. side of Secor Rd., 0.4 mi. s. of Todd Rd., R.7E, T.8S, Sect. 30, August 4, 1960, 9263 (D), 9264 (O). Monroe Co., S.W. corner of Nolan and Exeter Rd., R.8E, T.5S, Sect. 24, August 4, 1960, 9265 (D), 9266 (O). Saginaw Co., Fordney R., N. of Brady Rd., Sect. 11, R.2E, T.9N, Aug. 13, 1960, 9289 (D), 9290 (O). St. Clair Co.: N. side of Rt. 21, 0.4 mi. W. of Beach Rd., Sect. 6, R.17E, T.6N, August 23, 1960, 9307 (D), 9309 (O). — UNIVERSITY OF MICHIGAN, ANN ARBOR.

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TWO NEW ORCHID RECORDS FOR ONTARIO. — While orchid hunting last year, I met Mrs. J. C. Higgins of Komoka, Ont., who told me that she had *Liparis lilifolia* growing in her woodlot. I was skeptical of her identification, since this species had not been reported previously in Ontario, and since the province is not included in the range given for the species in Gray's Manual. I was invited to visit the site this year, and on June 18th, accompanied by several friends, I went to Komoka and was delighted to see *Liparis lilifolia* (L.) Richard for the first time. It was growing in a predominantly beech-maple woods on the southwest facing slope of the Oxbow Creek, among herbaceous species usually found in this type of woods. Mrs. Higgins told us that this year she had counted 83 plants and she first noticed the orchid in this vicinity about 10 to 15 years ago. Photographs were taken, and Prof. Montgomery took one specimen for the herbarium of the Ontario Agricultural College, Guelph.

On July 10th, on my return trip from observing orchids in the vicinity of Moosonee, James Bay, I visited Timmins, Ont., and was shown *Orchis purpurella* T. & T. A. Stephenson by Mr. Fred Cowell, local naturalist and nature photographer. About 20 plants were found growing along the margin of Gillies Lake in the town of Timmins. Prof. Montgomery and I revisited the stand on July 16th and observed that the lake shore at this point had been filled in with rock, sand and gravel to make room for a roadway. The local residents occasionally discarded waste along this roadway, and the remains of packing material was still evident among the grass and weeds which made up most of the plant cover. It was probably the source of this orchid, native to Europe and Asia.

Specimens have been deposited in the herbarium of the Ontario Agricultural College, Guelph, and of the National Museum of Canada, Ottawa. — H. ANDREWS, ROYAL ONTARIO MUSEUM, TORONTO, ONT.

A RANGE EXTENSION FOR PARAPHOLIS INCURVA. — On May 4, 1960, specimens of *Parapholis incurva* (L.) C. E. Hubb. were collected (R. J. Lemaire 650) on Freemason Island, St. Bernard Parish, Louisiana. The various manuals report this grass, introduced from Europe, as occurring in the United States along the Atlantic coast from New Jersey and Pennsylvania to Virginia, on the Pacific coast in California and Oregon (Portland), and in Michigan.

Since it appeared that a significant range extension for the species may be represented by this collection, a search was made of the limited amount of pertinent literature available to me, concerned with the states bordering the Gulf of Mexico. No published record of the species for Louisana or the gulf coast was found.

Subsequent correspondence with Dr. Jason R. Swallen of the U. S. National Herbarium established that two collections had previously been made on the gulf coast, both in Refugio County, Texas. Swallen collected this grass between Aransas Pass and Rockport (10276), and Whitehouse collected it at Bayside (21209). The collection site on Freemason Island is about 485 miles east of the Texas records and appears to be a first record for Louisiana.

Freemason Island is a small, elongated, sand and shell island in the Gulf of Mexico about 40 miles south of Biloxi, Mississippi and about 6 miles west of the main north-south arc of the Chandeleur Islands.

Several small colonies of this grass were observed on the higher (three to four feet above mean gulf level) parts of the island. Some of the associated plants were *Lepidium virginicum* L., *Oenothera humifusa* Nutt., *Sonchus oleraceus* L., *Solidago sempervirens* var. *mexicana* (L.) Fern., and *Chloris petraea* Swartz.

Specimens have been deposited in the herbaria of Tulane University, New Orleans, Louisiana; Southwestern Louisiana University, Lafayette; Florida State University, Tallahassee; and the U. S. National Herbarium, Washington, D. C. — R. J. LEMAIRE, U. S. FISH AND WILDLIFE SERVICE, GRAND ISLAND, NEBRASKA.

A NEW SPECIES OF HAPLOPAPPUS FROM MEXICO. — **Haplopappus rhizomatus** sp. nov. Plantae perennes, fasciculos laxos ad 20 cm. alt., ad 100 cm. lat. formantes; rhizomata 2-3 mm. crass. longa ramosa; internodi 1-2 mm. long. Folia lineari-lanceolata, 3-4 cm. long., 2 mm., lat., spinuloso-mucronata, marginibus integris, fimbrias villosas habentibus. Pedunculi breviores quam 1 cm. Capitula singula terminalia radiata, ca. 1 cm. diam. Receptaculum fimbrillatum. Phyllaria maculis apicalibus herbaceis perspicuis subviridibus praedita. Achaenia copiose sericeo-pubescentia. Pappus e setis multis inaequis grossis rigidis antrorsaliter barbellatis luteo-albidis constans.

Subcespitose, very leafy, pubescent, perennial herbs forming loose clumps 15-20 cm. tall and 50-100 cm. across; rhizomes 2-3 mm. thick, rather elongated and branching. Stems 1-2 mm. thick, arcuate-erect, the branches many, diverging at low angles (30-40°); internodes only 1-2 mm. long or to 7 mm. just beneath the heads, sordid-cinereous with rather closely-set antrorse villous hairs. Leaves alternate, sessile, linear-lanceolate, near midstem 3-4 cm. long but reduced to

1-2 cm. just beneath the heads, ca. 2 mm. broad, apically acuminate and spinulose-mucronate, basally subamplexicaul, marginally entire, tending to roll upwards on drying and with a dense fringe of villous hairs, especially toward the base, superficially sordid olive-green and sparsely appressed pubescent with antrorse villous hairs, with an inconspicuous midvein and a close inconspicuous network of dark lateral veins. Peduncles mostly shorter than 1 cm. Heads solitary and terminal on each branch, ca. 1 cm. in diameter, radiate. Receptacle slightly convex, 4-5 mm. in diameter, alveolate and fimbrillate with irregularly subulate-lobed, persistent, chaffy structures ca. 0.7 mm. long surrounding the points of attachment of the florets. Involucre broadly campanulate, ca. 5 mm. high (entire structure reflexed after deciduation of the achenes); phyllaries in ca. 3 ranks, lanceolate, the inner phyllaries longest, whitish chartaceous but with prominent greenish herbaceous tip-spots which are produced downward into narrow green mid-lines, the outer phyllaries short and mostly green-herbaceous. Ray-florets ca. 15-20 per head, pistillate and fertile, the corolla tube narrow, ca. 2-3 mm. long, the ligule yellow, oblong to oblanceolate, 6-8 mm. long, apically shortly acute. Disk-florets 40-60 per head, perfect, the corolla yellow, narrowly tubular, ca. 4.5 mm. long, 5-toothed. Achenes of the ray-florets shorter than those of the disk but otherwise similar, 1-1.5 mm. long, trigonally or tetragonally prismatic, copiously pubescent with long silky-white stiffly ascending hairs. Pappus of the disk longer than that of the ray-florets but otherwise similar, of 70-100 coarse stiff antrorsely-barbellated, buffy-white bristles very unequal in length, the longest of the disk ca. 4 mm. long, and of the ray-florets ca. 3 mm. long. Gametic chromosome number as determined by B. L. Turner from pollen mother cells, $n=4$.

TYPE: Nuevo León, Saltillo-Matehuala highway 5 miles north of the junction of the side road to Galeana, elev. ca. 6,000 ft., *J. Graham and M. C. Johnston 4203*, October 8, 1959. Holotype in the herbarium of the University of Texas, isotypes in the herbaria of the Universidad Nacional de México and the University of Kansas.

The species is known only from the type collection. Only a few of these plants were seen. They grew on the road embankment of a highway which was scarcely five years old, indicating a relatively short age and perhaps a weedy tendency. The surrounding country is a high, intermontane desert plain of interior, or in places karst, drainage, with fine calcareous subsaline or alkaline soil. The plain is a vast prairie-dog town. It lies in the rain shadow of the high Cerro Potosí (ca. 12,500 ft.) and adjacent mountains, to the east.

The closest relationship of this species seems to be to one of the "subspecies" of *Haplopappus lanceolatus* (Hook.) T. & G., as treated by H. M. Hall (The Genus Haplopappus . . . , Carn. Inst. Publ. 389, pp. 114-120, 1928) showing reduction of the "inflorescence." But that our plants are substantially distinct is evident from a study of herbarium specimens and of Hall's work, and is attested to by the specialist in the genus, Dr. Ray C. Jackson of the University of Kansas, who kindly examined isotype material.

The type locality and surrounding area were searched in the fall of 1960, but no further plants of this species were found. It seems desirable to place the species on record even though it is known only from the one collection. This collection was made during field study in northeastern Mexico supported by the National Science Foundation through NSF-G9234 at the Plant Research Institute, The University of Texas, and carried out under the direction of Dr. Calvin McMillan. The Latin diagnosis is the work of Hannah Croasdale. — MARSHALL C. JOHNSTON, THE PLANT RESEARCH INSTITUTE, THE UNIVERSITY OF TEXAS, AUSTIN.

CONTEMPORARY NOTES ON POWELL'S EXPEDITIONS IN THE WEST[1]. — From the book's foreword we learn that this is a supplement to a chapter [ten] of Prof. Watson's *Illinois Wesleyan Story: 1850-1950* (Ill. Wesleyan Univ. Press, 1950) prepared by his widow, Julia S. Watson. Had not this journalism instructor retrieved these reports of the per-

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[1] *Professor Goes West: Illinois Wesleyan University — Reports of Major John Wesley Powell's Expeditions: 1867-1874.* Edited by Elmo Scott Watson. Illinois Wesleyan Univ. Press, Bloomington, 1951. 138 pp. Sold exclusively by Frank Glenn, bookseller, 627 E. 46 St., Kansas City, Mo. $3.00.

sonnel, routes, and general results of the various expeditions from contemporary newspaper accounts, they would rest unnoticed in the files of the *Chicago Tribune*, *Rocky Mountain News*, *Western Mountaineer*, etc., and the forgotten issues of the Illinois Wesleyan *Alumni Journal.* Our botanical interest in this book centers around ascertaining more exact localities for the plant collections made on the various surveys of Major Powell and his associates, than those recorded in the literature (e.g. *Amaranthus powellii* S. Wats.). The reader will be only partially successful on this score but here are recorded now in more accessible form the names of the persons who accompanied Powell and some information on their itineraries. For example, the precise identity of Mrs. Almon Harris Thompson (*née* Ellen Powell), the sister of Major Powell, is established as the object of commemoration in the name *Astragalus thompsoniae* S. Wats.; the early Illinois years of George Vasey are alluded to; random notes are woven into the reports of Francis Marion Bishop (1843-1933), a student of Powell who later became professor of natural science at the University of Deseret, then politician, judge, and bailiff. Incidentally, the answer to my query on the captaincy of Bishop (*Rocky Mountain Naturalists*, 165) is answered by Ralph V. Chamberlain, *Life Sciences at the University of Utah: background and history* (Salt Lake City, 1950), a useful collateral reference book for the *Professor Goes West* and in general for the history of biological exploration in the Far West.

An index is sadly missed and Prof. Watson made no exhaustive search in the Illinois Wesleyan University records to learn the full identity of all the persons mentioned in the narrative. However, for an unhurried story of Major Powell and his parties of students in the Old West here is good reading. Certainly these expeditions were among the first field laboratory attempts in this country which set off a succession of college-sponsored excursions. — JOSEPH EWAN, TULANE UNIVERSITY, NEW ORLEANS, LA.

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SPORE STUDIES IN THE GENUS CYSTOPTERIS. I. THE DISTRIBUTION OF CYSTOPTERIS WITH NON-SPINY SPORES IN NORTH AMERICA

Dale J. Hagenah

In an article entitled "An Overlooked North American Fern" the late A. H. G. Alston (1951), of the British Museum, called attention to a number of western collections of *Cystopteris* with rugose-verrucose spores (Fig. 1, C, B and D) rather than the spiny spores (Fig. 1, A) found in normal *Cystopteris fragilis.* Such plants had been known from Eurasia for many years and were frequently treated as a distinct species, *C. dickieana* Sim or *C. Baenitzii* Dörfl., by European botanists. In the past ten years Irene Manton (1950) has dealt with the history and cytology of such plants from Europe and Greenland; Ira L. Wiggins (1954) has compared the morphology of such plants from Alaska with that of *Woodsia glabella*; while D. Löve and N. J. Freedman (1956) have published a review of the literature in regard to the nomenclature and distribution of these plants and reported a number of new localities.

My own interest in the spores of this genus was the result of the finding of rugose-verrucose spores in two puzzling collections from Northern Michigan. After the publication of the Alston article I made a survey of all collections of *Cystopteris* from Michigan then in the herbaria of the University of Michigan and the Cranbrook Institute of Science. Three more collections with such spores were found and reported (Hagenah, 1955). In the meantime non-spiny spores had been reported in material from Ontario and Minnesota by C. V. Morton (1952). In discussing *Cystopteris fragilis* as a subject for intensive research he wrote as follows (l.c.), "The whole problem has been complicated recently by Mr. Alston's report of another species, *Cystopteris Dickieana*, from the United States. What is this plant, indistinguishable from *fragilis* morphologically (or is it?), but with spores similar to those of a *Woodsia*? Can a really valid species have the improbable range Scotland, Scandinavia, Siberia, Spain, Algeria, Turkey, Persia, Alaska, Alberta, California and Mexico? It seems as though *"Dickieana"* occurs sporadically throughout the range of *fragilis*. The study of this question will involve field work, as well as the examination of the spores of hundreds of specimens." That

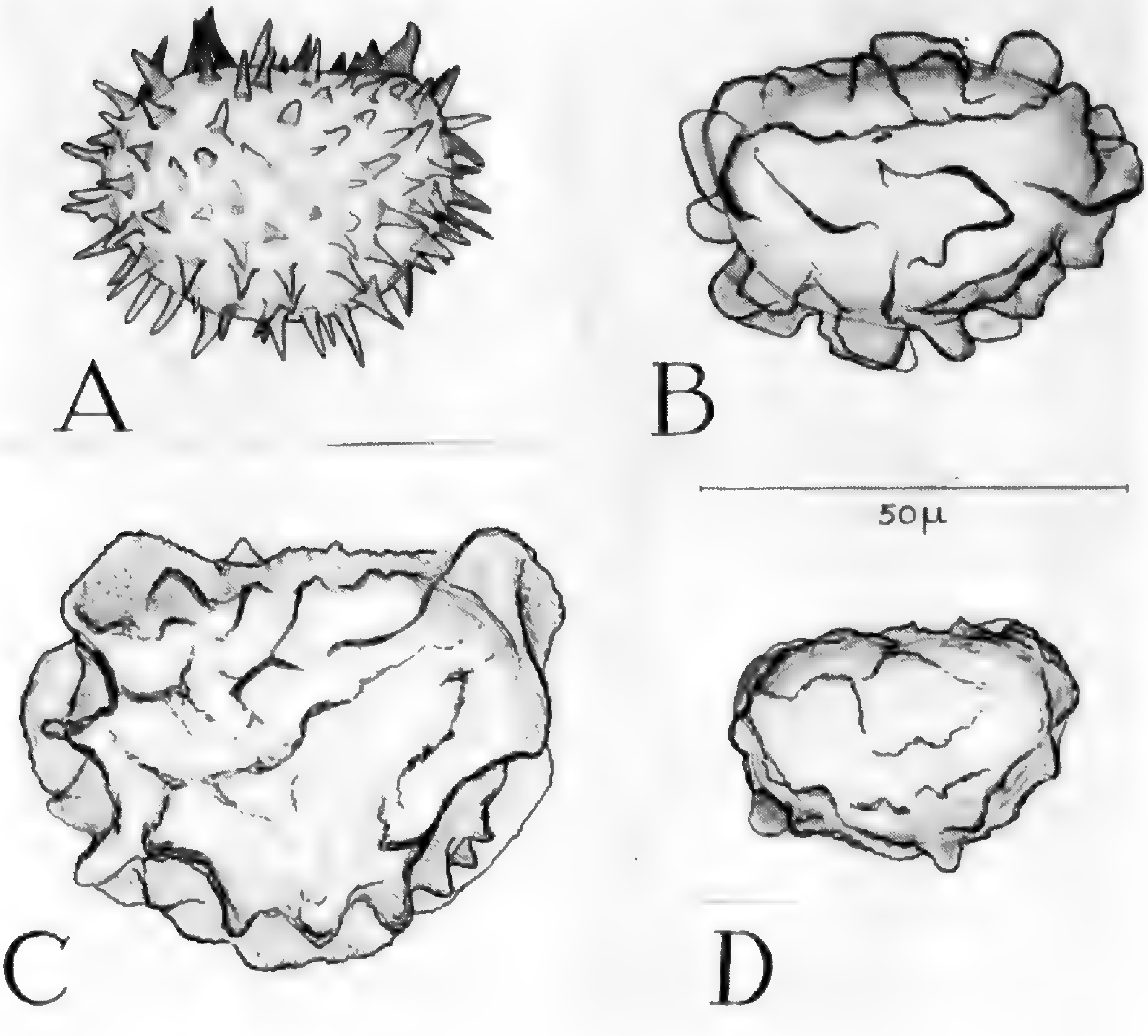

FIGURE 1. A. Typical spiny spore, Lake Michigamme, Marquette County, Michigan, *Hagenah 2580* (BLH). B. C. and D. Non-spiny spores:
B. Steamboat Springs, Routt County, Colorado, *Goodding 1625* (GH);
C. Diana Bay, Hudson Strait, Quebec, *Gardner 39570* (GH);
D. Wiseman, Alaska, *Scamman 2179* (GH). Camera lucida drawings by W. H. Wagner, Jr.

same year, and again in 1953, I revisited the location at Mt. Bohemia, Keweenaw County, Michigan, where I had made my first collection of such plants. Both years the plants in that colony had non-spiny spores, showing that this was the regular condition for that colony. A plant transferred from this station to the University of Michigan Botanic Gardens was studied cytologically by W. H. Wagner, Jr. (1955), and found to have the same chromosome number ($n=84$) as that reported by Manton for plants from Scotland, Norway and Greenland.

Stimulated by Morton's comments (l. c.) and by the findings just described in Michigan collections, I decided to map the distribution of the non-spiny (rugose-verrucose) type of spore in North America. This work was undertaken as part of a comparative study of some American members of the genus. Some results of these studies have been reported elsewhere (Wagner and Hagenah, 1956a and 1956b). A comprehensive survey was made possible through the loan of the North American collections of *Cystopteris* by the Gray Herbarium. I wish to thank the staff of the Gray Herbarium for the opportunity of examining this fine series of specimens. This collection, containing over 900 sheets of specimens and including material from nearly every state and all of the Canadian provinces, provided an exceptional cross-section of the genus as it occurs in North America. In addition to the wide coverage it provided, a survey of this material was desirable because the collections from the northeastern United States and Canada had been studied and named by C. A. Weatherby (1935) during his investigation of the *C. fragilis* complex in that region. I am grateful to the Department of Botany of the University of Michigan for providing laboratory facilities during the preparation of the slides and especially to Dr. Warren H. Wagner, Jr., of that department, for his many suggestions and invaluable assistance, including preparation of the spore drawings.

In the spore survey, preparations were made from all collections on which there seemed to be a chance that the spores were sufficiently mature for study. In some cases this resulted in slides with no mature spores although a likely pinnule had been selected by examination under magnification. In many cases where there were two or more well-developed plants on the same sheet, preparations were made from each, especially when there seemed to be some variation in their appearance. To make the preparations a drop of Euparal was placed on a slide, a drop or two of alcohol placed on the spore-bearing pinnule selected, the sporangia and spores picked up with a needle and placed in the Euparal. Between each preparation the needle was flamed over an alcohol burner to prevent mixing. After stirring to distribute the spores in the medium, a cover-slip was added and pressure applied. While this method resulted in a fairly thick slide due to the presence of numerous sporangia, it was felt that the presence of sporangia, especially some with the spores still inside, was desirable. In a few cases some contamination on the herbarium sheet was found through the presence of more than one type of spore. New preparations were made in such cases.

The spores of *Cystopteris* may be described briefly as bilateral, monolete, convex on one side, and either flat or concave on the other. The latter condition results in a "bean-shaped" profile. The outer layer, called the "sculptine" by Harris (1955) in his study of the spores of New Zealand ferns, has been found by Robert F. Blasdell (1959) to have three basic patterns of which only two, the echinate or spiny type (Fig. 1, A), and the rugose-verrucose type (Fig. 1, B, C and D), occur in North America. There is considerable variation in sculpturing within these basic types. In this study I have not as yet separated the rugose-verrucose spores into sculpturing sub-types and will refer to any of the variants of this type as "non-spiny."

When prepared in the manner just described it was found that the outer layer was generally more darkly pigmented in the non-spiny spores than in the spiny members of the *fragilis* complex. The outer layer seemed to be more brittle in the non-spiny spores and in a few cases cracked and flaked off under pressure. Both spiny and non-spiny spores showed a considerable tendency for the spores to fail to fill out to normal size or shape. However, the two basic types could still be distinguished for the outer layer tended to assume normal sculpturing in such aborted spores. Even in small, completely aborted spores from plants with spiny spores some definite spines were evident. The sculptine pattern could be determined under 100x magnification. For more detailed examination and for measurements, 430x was used.

The genus *Cystopteris* in North America consists of *C. bulbifera*, *C. montana*, and the *C. fragilis* complex, the last being the most widely distributed and the most variable. In the collections which were sufficiently mature for the spore sculptine type to be determined, only spiny spores were found in *C. bulbifera* (117 collections) and *C. montana* (17 collections). However, in the *C. fragilis* complex non-spiny (rugose-verrucose) spores were found in slightly more than 26 per cent of the 538 collections in which the sculptine pattern was identified. The percentage varied greatly from one geographic area to another, as shown in the table. The non-spiny spore type predominated in collections from the Rocky Mountain and Pacific Coast States and from Western Canada. Other areas of relative abundance of this type were around the Upper Great Lakes and from the Gulf of St. Lawrence north into the Arctic. In most of the states east of the Rockies the *C. fragilis* complex is represented for the

Spiny and non-spiny spore types in *Cystopteris fragilis* as represented in the Gray Herbarium collections.

	Area	Total Colls.	Percent Non-spiny	Percent Spiny
I	No. Quebec, Labrador, E. Arctic incl. Greenland	48	52.1%	47.9%
II	So. Quebec, New Brunswick, Nova Scotia & Newfoundland	91	3.3	96.7
III	Eastern United States except Mich., Wisc., & Minn.	125	0.8	99.2
IV	Great Lakes Region: Ontario, Mich., Wisc., & Minn.	48	16.7	83.3
V	U. S. from Mississippi R. to the Rockies	37	5.4	94.6
VI	Rocky Mt. & Pacific Coast States & Western Canada	162	60.5	39.5
VII	Alaska	27	18.5	81.5
	Total	538	26.4%	73.6%

most part by the taxa which have been designated by the varietal names *mackayii*, *protrusa*, *simulans*, *tennesseensis*, and *laurentiana*. Only spiny spores were found in the collections which had been identified as these varieties. Thus, at least in North America, the non-spiny type of spore is confined to plants which, by the characters used in the current manuals, would be identified as *C. f.* var *fragilis*.

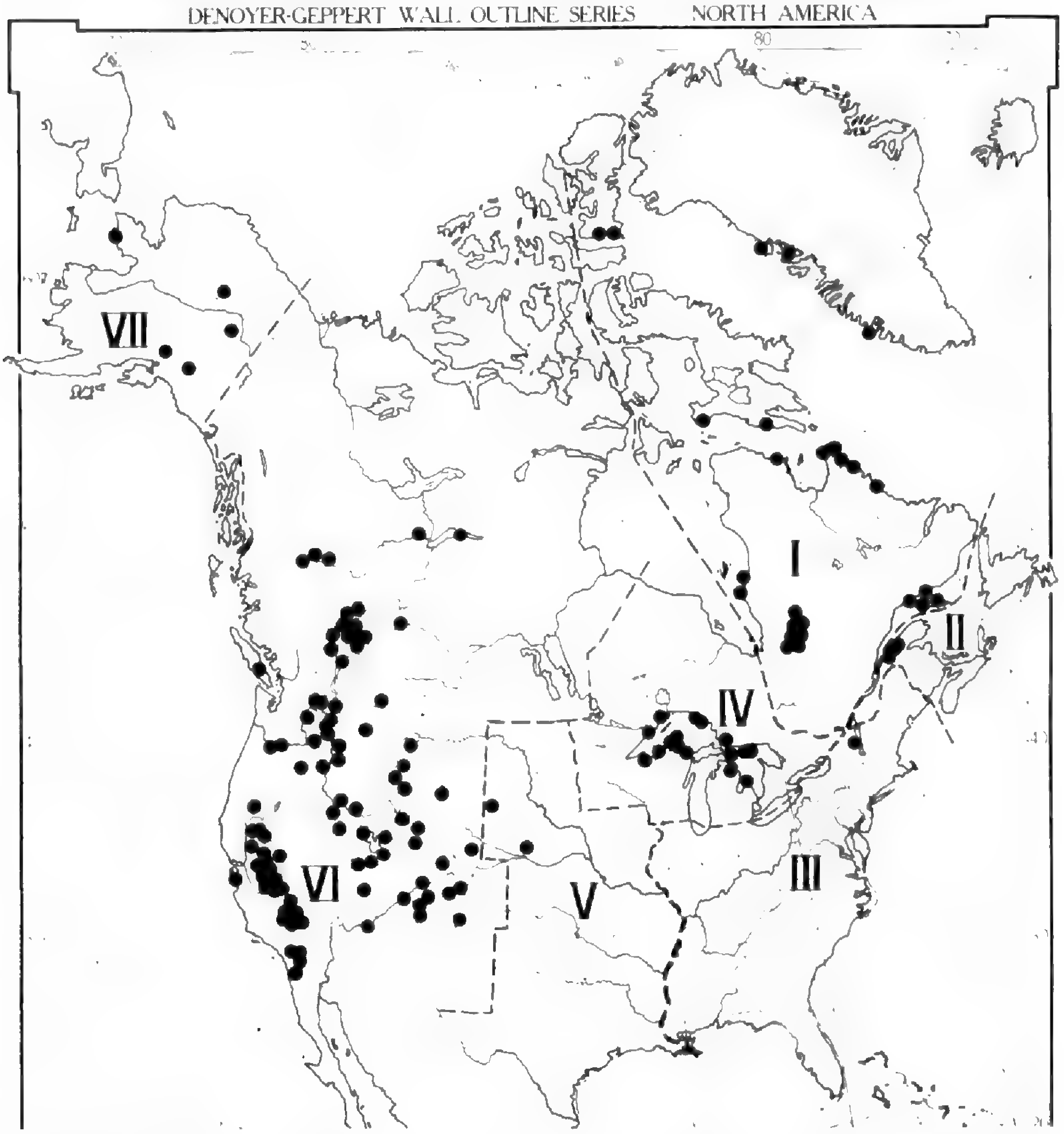

FIGURE 2. Map of distribution of Cystopteris with non-spiny spores in North America, all localities except those in Michigan based on specimens in the Gray Herbarium.

Newfoundland, the Maritime Provinces, and Gaspé were well represented in the Gray Herbarium material with a large proportion of the collections being *C. f.* var. *fragilis*. However, only three collections had non-spiny spores. All were from the vicinity of Bic, Rimouski County, Quebec, on the south shore of the St. Lawrence. Although not as plentiful as the other varieties, typical *fragilis* does occur in the Northeastern States. Only one collection had non-spiny spores. The locality data on the label is "Shores of Lake Champlain, N. Y." Four more stations have been found in Michigan since my prior report, but again the percentage of plants with non-spiny spores was small in proportion to the number of specimens examined.

Since interpretation of the plants with non-spiny spores as a species or sub-species has been based on supposed Arctic affinities it is surprising to find that this type of spore was more abundant in collections from California (83%) than in those from either Alaska (18%) or Greenland (33%).

The distribution of *Cystopteris* with non-spiny spores as found during this study is shown on the map (Fig. 2). Only collections examined by me have been mapped. Additional records, mostly for Canada and the Arctic, may be found in the literature cited.

Before the distinctive spores had been discovered the original *C. dickieana* was based on a characteristic frond pattern involving what has been described as "congested" pinnae and which still persists in cultivated plants descended from the original stock, according to Manton. However, both Manton and Löve note that non-spiny spores are found in plants with a diversity of leaf form. This was found true in the specimens in this study. Attempts to predict the spore type of herbarium specimens from their leaf architecture were incorrect more times than they were right. As described, two or more preparations were made from the same collection number where there were two or more plants. In eight such cases, plants with non-spiny and with spiny spores were found to have been collected and distributed under the same collection number. In another case, a California collection (New York Falls, Amador County, *Hansen 646*) cited by Alston as having non-spiny spores in the specimen in the British Museum was found to have spiny spores in the Gray Herbarium specimen. This seems to indicate that the field differences between plants with the two spore types are not sufficient to prevent experienced field botanists from collecting the two types as one where they grow together. Although some collections do simulate small *Woodsias*, as noted by both Wiggins and Löve, the tendency toward confusion between these two genera, as shown by the original specimen labels, is not confined to the plants with non-spiny spores. From blade texture of the specimens as well as the specimen data it was apparent that non-spiny spores occur in both sun and shade plants. The same is true for spiny spores. This bears out my own experience with the two types in Michigan.

Considerable variation in spore size was noted early in the survey. A correlation between spore size and chromosome number has been found to exist in the spiny-spored members of the genus in both Europe and North America so the scope of the survey was enlarged to include measurements of spore length. Random samples of ten spores from each slide were measured. In a sampling of more than 1,400 non-spiny spores the length, excluding the sculptured layer, was found to vary from 27 mu to 55.5 mu. This spread is nearly as great as that found for the three-leveled polyploid series in the spiny-spored types in the eastern United States. That series includes diploids ($n=42$), tetraploids ($n=84$), and hexaploids ($n=126$), of which, in Michigan material, the varieties *protrusa*, *mackayii*, and *laurentiana* are examples of the three levels. In the non-spiny spores the average size for the majority of collections falls within the sizes found for the tetraploid varieties of spiny-spored *fragilis*. The spores of the Mt. Bohemia, Michigan, plants which were investigated cytologically fall in this size class and the chromosome counts showed the plants to be tetraploid. This suggests that there may well be a three-level series in the non-spiny types (Fig. 1, B, C and D). With the exception of one collection from the Mistassini region of Quebec, all of the specimens with spores small enough to indicate a possible diploid condition were from the western United States and Alaska, but not concentrated in any one area. On the other hand, plants with spores large enough to indicate a possible hexaploid condition were mostly from Canada and Alaska, nearly all outside the range of currently known hexaploids in the spiny-spored species. More study is needed on the average size and variation in the non-spiny spores of plants for which the chromosome number is known. This will be handled best by growing the plants either from living rhizomes or from recent collections of spores, preferably the former.

Cultivation of plants from various localities is desirable also for another phase of the problem, the investigation of the various types of sculpturing. Some collections seem somewhat intermediate between spiny and non-spiny spores, and Larsen (1952) has reported intermediates from Greenland. More cytological investigation and possibly even experimental hybridization may be necessary before we can determine the relation of the non-spiny spored plants to the *fragilis* complex.

Research on the spore size and sculpturing pattern problems is limited by the fact that plants with non-spiny spores are not readily obtainable because they cannot be distinguished except by microscopic examination of the spores, a test not easily applied under even the best of field conditions. However, in June, 1960, I was able to obtain about twenty such plants from two Michigan localities. The living plants were obtained by random sampling along transects in stations for which I was fortunate in having very precise locality data. At one of these stations the sampling yielded about one-third plants with non-spiny spores while the other had a small but apparently pure stand of such plants, although plants with spiny spores were found only a few yards away. I would be glad to receive either living plants or collections with mature spores from other parts of the range.

SPECIMENS WITH NON-SPINY SPORES EXAMINED DURING THIS STUDY

All specimens cited are in the Gray Herbarium (GH) with the exception of those from Michigan which are in the Herbarium of the University of Michigan (MICH) or the herbarium of Cranbrook Institute of Science (BLH).

NEW YORK: Shores of Lake Champlain, *F. H. Horsford, June 1882.* MICHIGAN: Alpena County: near Bolton, *Hagenah 4506* (BLH); Chippew County: Near Drummond, Drummond Island, *McVaugh 11360* (MICH, BLH); Huron County: Port Austin, *C. A. Davis* (MICH); Keweenaw County: Cliff Mine, near Phoenix, *Hagenah*

3046; Mt. Bohemia, *Hagenah 2001, 2003, 3021, Hagenah & Hall 777* (BLH); Marquette County: Huron Mountains, *Hagenah 4014* (BLH); Partridge Island, Lake Superior, *A. Dachnowski* (MICH); Ontonagon County; Porcupine Mountains, *Hagenah 1166* (BLH). WISCONSIN: Ashland County: Vogt Knob, *Fassett 9220.* MINNESOTA: Cook County: Grand Portage, *Pease & Bean 26364.* SOUTH DAKOTA: Mead County: Near Tilford, *Palmer 37331.* NEBRASKA: Thomas County: Plummer Ford, Dismal River, *Rydberg 1452 (in part).* MONTANA: Little Belt Mountains, *Scribner 445*; White Sulfur Springs, *Scribner 443*; Big Fork, Flathead Lake, *Mrs. Jos. Clemens, Aug. 5, 1908*; Gallatin County: Cottonwood Creek, *Suksdorf 552 (in part).* IDAHO: Blaine County; Near Martin, *Macbride & Payson 3052*; Elmore County: Upper Trinity Lake, *Hitchcock & Muhlick 10368*; Latah County: Kendrick, *Henderson 4791*; Nez Perces County: Valley of Peter Creek, *Sandberg, MacDougall & Heller 119*; Owyhee County: Hot Hole, East Bruneau, *Nelson & Macbride 1905.* WYOMING: Yellowstone Falls, *Rydberg & Bessey 3506 (in part)*; Laramie Hills, *Nelson 9035*; Lincoln Gulch, *Nelson 2606*; Owens Creek, Bighorn Mountains, *J. G. Jack (in part)*; Fremont County: Sweetwater River at Farson-Lander Road, *Porter 4980*; Lincoln County: East of Afton, *Payson & Armstrong 4980*; Sweetwater County: Leucite Hills, *Merrill & Wilcox 474.* COLORADO: Rocky Mountains, Lat. 40-41, *Dr. Geo. Vasey, Powell's Colorado Exploring Expedition*; no locality, *Addison Brown* (type of *C. fragilis* var. *laciniata* Davenport); Crystal Creek, Gunnison Watershed, *Baker 261;* Tabeguache Basin, *Payson 179*; Horsetooth Mountain, *Crandall 3976*; Castillo County: Wagon Creek, *Charlotte Horner (in part)*; Montrose County: Paradox Creek, *Walker 224 (in part)*; Ute, *Payson & Payson 3911*; Park County: South Park, *Miss E. L. Hughes*; Routt County: Steamboat Springs, *Goodding 1625*; San Miguel County: Near Trout Lake, *Payson & Payson 4120.* UTAH: American Fork Canon, *Watson 1367 (in part)*; Beaver County: Delano Ranger Station, Beaver Canyon, *Maguire 19865*; Box Elder County: Drum Canyon, Raft River Range, *Maguire & Holmgren 22216*; Cache County: Between Tony Grove Lake and Naomi Peak, *Holmgren, Walker & Drummond 3576*; Grand County: LaSal Mountains, *Payson & Payson 4027*; Juab County: Granite Canyon, Deep Creek Mountains, *Maguire & Becroft 2465*; Salt Lake County: Twin Lake outlet, near Brighton, *Maguire 18656.* NEVADA: Washoe Mountains, *Watson 1367 (in part)*; Elko County: Cooper Mountain, Jarbridge Mountains, *Maguire & Holmgren 22386.* ARIZONA: Grand Canyon of the Colorado, *MacDougal 196.* CALIFORNIA: Kina River, *Rothrock 364*; High Mountain near Donner Pass, *Torrey 596*; Glen Alpine, Tahoe, *Smiley 200*; Alpine County: Pigeon Flat, *Hoover 5355*; Butte County: *Mrs. R. M. Austin, June 1879*; Butte Creek, Jonesville, *Copeland, U. of C. Plants of Calif. 602*; Eldorado County: Angora Lake, *Smiley 10*; Inyo County: Third

Lake, Cottonwood Lakes, *Alexander & Kellogg 3335;* Onion Valley, west of Independence, *Alexander & Kellogg 3162*; Lone Pine Canyon east of Mt. Muir, *Sharsmith 3298*; Los Angeles County: Bear Creek below Bear Valley Dam, San Bernardino Mountains, *Ewan 4880;* Mariposa County: Merced River Canyon, *Ware 536*; Yosemite Valley, *Abrams 4459*; Mono County: Conness Cirque near Saddlebag Lake, Tioga Pass Region, *Mason 11439*; Nevada County: Ridge south of Donner Pass, *Heller 7179*; Placer County: Mt. Lincoln south of Summit Valley, *Heller 12931*; Plumas County: *Mrs. R. M. Austin, Aug. 1882*; American Valley, *Mrs. R. M. Austin, July 1887*; Riverside County: Strawberry Valley, San Jacinto Mountains, *Grant 464;* San Bernardino County: Bear Valley, San Bernardino Mountains, *Abrams 4873;* San Diego County: Spencer Valley, near Julian, *Abrams 3798*; Santa Cruz County: Santa Cruz, *Dr. Anderson*; Tulare County: Lower Kern River Canyon, *Bacigalupi & Ferris 2451*; Crabtree Meadow, *Culbertson, C. F. Baker Dist. 4352*; South Fork Kaweah River, *Culbertson, C. F. Baker Dist. 4515;* Tuolumne County; Dardanelle, *Alexander & Kellogg 3744;* Dana Fork of Tuolumne River, Tuolumne Meadows, *Sharsmith 324*; Siskiyou County: Panther Creek Meadows, Mt. Shasta, *Cooke 13999.* OREGON: Baker County: Alder Springs, Wallowa Mountains, *Jones 6612*; Grant County: Dixie Mountain, Blue Mountains, John Day Valley, *Henderson 5587*; Hood River County: *Henderson 762*; Wasco County: Dalles of the Columbia, *Major Bullies.* WASHINGTON: Douglas County: Egbert Spring, *Sandberg & Leiberg 351*; Okanogon County: Muchamuch Lookout, *Thompson 6992*; Chesaw, *St. John, Courtney & Parker 5064;* Pend Oreille County: Z Canyon, *St. John 6469*; Spokane County: Bank of Spokane River, opposite Fort Wright, *Jennings & Jennings 8132*; Cheney, *Mrs. Susan Tucker;* Newman Lake, *Jennings & Jennings 8519*; Walla Walla County: Waitsburg, *R. M. Horner, May 1897.* ALASKA: Rapids Lodge, Richardson Highway, *Scamman 4*; Eagle Summit, Steese Highway, *Scamman 1970B*; Wiseman, *Scamman 2179*; Nome, Anvil Creek and Dexter Creek, Seward Peninsula, *Porsild & Porsild 1301*; Camp Eilson, Mt. McKinley National Park, *Nelson & Nelson 4100 (in part).*

GREENLAND: Uniîorfik Fjord, Vestside, Niaqornaq, *M. P. Porsild, Sept. 1934*; Agpatsiait, 71° 5′ N., *M. P. Porsild, July 1935*; Gothaab, *Wetherill 31.*

ELLESMERELAND: Fram Harbour, *H. G. Simmonds, July 1889*; Harbour Fjord, *Simmonds 2553.* BAFFIN LAND: Lake Harbour, *Malte 463*; Cape Dorset, *Malte 532.* LABRADOR: Razorback Harbor, Torngat Region, *Abbe 9*; Valley of the Bryant Lakes, Kangalaksiorvik, Torngat Region, *Abbe 8*; Flint Island near Manvers, *Bryant 1.* QUEBEC: Rimouski County: Bic, *Fernald & Collins 804, 808 and 809*; Anticosti Island: Riviere de la Chute, *Victorin & Rolland 27 037*; Riviere Des Caps, *Victorin & Rolland 27 051*; Mingan Islands: Ile au Fantome, *Victorin & Rolland 18090;* Grande Ile, *Victorin & Rolland*

18086; Mistassini District: Ile Andre-Michaux, *Rousseau & Rouleau 201;* Ile Manitounouk, *Rousseau & Rouleau 9;* Baie de la Chute-Cachee, Peninsule du Dauphin, *Rousseau & Rouleau 1084*; Pointe de Basalte, Peninsule du Dauphin, *Rousseau & Rouleau 1050 and 1051*; Lac Wachagami, *Rousseau & Rouleau 1306*; Opitchouane, Peninsule D'Orvel, *Rousseau & Rouleau 1157*; Ungava District: Boat Opening, Manitounok Islands, *Dutilly & Lepage 12990*; Cape Jones, James Bay, *Gardner 391237*; Diana Bay, Hudson Strait, *Gardner 39570*; Port Burwell, Hudson Strait, *Malte 121048 and 121057.* ONTARIO: Manitoulin Island: Gore Bay, *Pease & Ogden 25014*; West Bay, *Pease & Ogden 25034*; Algoma District: Garden River, *Fassett 13312;* Thunder Bay District: Jackfish, *Pease & Bean 23713 and 23717 (in part);* Sibley Township, *Taylor, Losie & Bannan 22.* SASKATCHEWAN: Cornwall Bay, Lake Athabaska, *Raup 6573.* ALBERTA: Peace Point, Wood Buffalo Park, *Raup 1454*; Edmonton, *Moss 2701a*; Nordagg, Mt. Coliseum, *Malte & Watson 1527 and 1554*; Bertha Lake, Waterton Lakes National Park, *Malte & Watson 2705*; Jasper National Park: Pyramid and Patricia Lakes, *Scamman 2789*; Miette Hot Springs, *Scamman 2400*; Medicine Lake, *Scamman 2485*; Maligne Lake, *Scamman 2576*; Athabaska Glacier, Columbia Ice Field, *Scamman 2726*; Angel Glacier, Mt. Edith Cavell, *Scamman 3401*; Jasper, *Scamman 3379.* BRITISH COLUMBIA: Selkirk Mountains, *Shaw 1095*; Asulkan Glacier Trail, Selkirk Mountains, *F. C. Prince, Aug. 1900*; Carbonate Draw, Selkirk Mountains, *Hacock, C. H. Shaw Dist. 285*; Gorge, Carbonate Draw, Selkirk Mountains, *Shaw 271*; North bank of Peace River, below Wicked River, *Raup & Abbe 4008*; Mt. Selwyn, *Raup & Abbe 3936*; Hudson Hope, Peace River Valley, *Raup & Abbe 3956*; Alberni Region, Vancouver Island, *Rosendahl 2054.*

SUMMARY: Plants distinguished only by the non-spiny (rugose-verrucose) sculpturing of the outer layer of their spores have been shown to be widespread and not uncommon in North America within most of the range of *Cystopteris fragilis* var. *fragilis.* This spore type was not found in plants identified as any of the Eastern North American members of the *C. fragilis* complex, i.e., the varieties *mackayii, protrusa, simulans, tennesseensis,* and *laurentiana;* in the endemic American species *C. bulbifera;* or in American collections of the circumpolar species *C. montana.* The presence of two entirely different spore sculpturing types in plants which cannot be distinguished by any currently known field characters or ensemble of characters seems most remarkable. However, the recognition of species on the grounds of spore sculpturing alone does not seem

justifiable at this time. The significance of spore pattern as a taxonomic character in this genus and the relationships between plants of the two spore types are problems which are likely to be resolved only by such techniques as experimental hybridization and the cytological study of the resulting progeny. — CRANBROOK INSTITUTE OF SCIENCE, BLOOMFIELD HILLS, MICHIGAN.

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THE GENUS PTERIS OF COSTA RICA

EDITH SCAMMAN

This paper on Pteris is the second of my studies of a genus of Costa Rica ferns. The first on Adiantum was published in Contributions from the Gray Herbarium **187**: 3-22. 1960.

This small country is truly a fern lover's paradise, and the days I spent collecting there during February and March, in 1951, 1953, 1955, and 1956, proved to be rewarding and worthwhile.[1]

Due to the large size and the multiple and complex branching of some species of Pteris it is often difficult to obtain satisfactory specimens, and frequently only the extreme upper portion of a frond or a single pinna is found on herbarium sheets. The specimens that have been seen and cited here are from the U. S. National Herbarium, the Gray Herbarium, and a few from the New York Botanical Garden.

They are arranged geographically and listed under the seven provinces into which Costa Rica is divided — Limón on the Atlantic, Guanacaste and Puntarenas on the Pacific, and Heredia, Alajuela, San José and Cartago in the interior of the country.

The habitat and altitude given for each species refer only to the specimens seen from Costa Rica.

PTERIS L.

A large genus of mostly coarse ferns, herbaceous to coriaceous, with erect or ascending fronds. Blades 1-4-pinnate, often only the basal parts decompound; veins all free, or only the basal pair joined, or joined in several rows of angular areoles. Sori linear and continuous, but not usually reaching the apices and sinuses of the segments, sporangia borne

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[1] I was greatly aided during my experiences in the field by Dr. Leslie R. Holdridge of the staff of the Interamerican Institute of Agricultural Sciences at Turrialba, who was most generous in sharing with me his time and his knowledge of the country, and in providing means of transportation for procuring desired specimens.

To Dr. Rolla M. Tryon of Harvard University I am deeply indebted for his continued interest in this project and for his stimulating suggestions and help in many ways. The drawings were prepared by Mrs. Joyce Todd, most of them for Dr. Tryon's Ferns of Peru.

on a marginal connecting-vein, protected by the membranous, reflexed margin, which serves as an indusium.

KEY TO SPECIES

a. Pinnae (at least above the basal ones) entire, narrowly linear, not lobed or pinnatifid. b.
  b. Fronds large, usually over 1 m. long; veins freely areolate toward the margins..........1. *P. grandifolia.*
  b. Fronds small, rarely up to 1 m. long; veins all free..........2. *P. cretica.*
a. Pinnae (at least above the basal ones) deeply pinnatifid or more deeply divided. c.
  c. Veins all free. d.
    d. Basal pinnae deeply pinnatifid beyond the basal pinnules. e.
      e. One or two veins between costules arising from the costa of the pinna (at least toward base of pinna). Fig. 4. f.
        f. Sinuses mostly asymmetrical, pinna axils smooth to slightly muricate..........3. *P. paucinervata.*
        f. Sinuses uniformly symmetrical, pinna axils strongly muricate..........4. *P. pungens.*
      e. Veins all arising from the costule (of the pinnule). Fig. 5b. ....5. *P. quadriaurita.*
    d. Basal pinnae regularly pinnate-pinnatifid beyond the basal pinnules. g.
      g. Leaf-tissue coriaceous; segments acute and mucronate; short, firm awns on the upper surface of the costae; rachises and costae muricate beneath..........6. *P. muricata.*
      g. Leaf-tissue soft, herbaceous; segments obtuse, crenulate at the apex; long, soft, whitish awns on the upper surface of the costae; rachises and costae smooth beneath..........7. ***P. muricella.***
c. Veins joined (at least along the costae; fig. 8b). h.
  h. Basal pinnae pinnatifid beyond the basal pinnules; basal veins joined in a narrow costal arc, the others free..........8. ***P. biaurita.***
  h. Basal pinnae pinnate-pinnatifid (or more divided) beyond the basal pinnules; veins joined in several rows of angular areoles. i.
    i. Basal veins monoarcuate, one large areole along the costa between the costules. j.
      j. Pinnatifid pinnae with the herbaceous tissue decurrent onto the rachis, especially in the apical ones..........9. ***P. propinqua.***
      j. Pinnatifid pinnae with the herbaceous tissue not decurrent onto the rachis. k.
        k. Apex of ultimate segments crenulate. 1.
          1. Ultimate segments usually 5-10 cm. long (rarely 3 cm.), pinnatifid pinnae or pinnules definitely petiolulate, usually once pinnate at the base .... 10. ***P. livida.***

1. Ultimate segments usually about 1 cm. long (rarely to 2 cm.), pinnatifid pinnae or pinnules subsessile or some shortly petiolulate, usually pinnatifid to the base. ....13. *P. tripartita.*

k. Apex of ultimate segments sharply serrate. Segments numerous, close, oval-falcate, leaf-tissue coriaceous........ ....12. *P. podophylla.*

i. Two or more long areoles along the costa between costules. Segments lance-attenuate, oblique, sterile tips sharply serrate, leaf-tissue firm-herbaceous...................................11. *P. altissima.*

1. PTERIS GRANDIFOLIA L. Sp. Pl. 2: 1073. 1753

A large fern, simply pinnate, with long narrow pinnae, mostly oblique, with entire thinly cartilaginous margins and sori continuous nearly to the attenuate tips. The veins are close and parallel, free near the costa, but anastomosing toward the margin. The rhizome is stout and creeping; the texture of the pinnae is membrano-herbaceous and translucent.

Mexico to Panama, to Peru; West Indies.

Specimens seen: ALAJUELA: Cebadilla, *Valerio 278* (US); Gorges of Machuca River near San Mateo, *Biolley 2019* (US), Río Machuca, *Biolley 17389* (GH, NY, US).

2. PTERIS CRETICA L. Mant. 130. 1767

This well-known fern of wide distribution is characterized by the lower pair or pairs of pinnae that are forked nearly to the base into long, narrow attenuate segments. The margins of the sterile pinnae and tips of the fertile ones are usually spinulose-serrated.

Tropical and subtropical regions in many parts of the world, either native or naturalized.

Rocky woods and forested slopes from 1600 to 1900 m.

Specimens seen: CARTAGO: La Banderilla, *R. Torres 243* (US); Reventado, *Lankester 721* (US).

3. PTERIS PAUCINERVATA Fée, Mém. Fam. Foug. 8: 73. 1857

The stipe of this seemingly rare fern is reddish brown, erect from a short ascending rhizome, which has long concolorous brown scales. The terminal and lateral pinnae, usually 5-7 pairs, end in a long caudate tip; the linear-oblong segments are decurrent at the base, the sterile ones with crenulate margins, the fertile ones slightly falcate. The lowest pinnae are irregularly forked; the texture of the blade is subcoriaceous. Veins are few (hence the name) and conspicuous, well-spaced at the base; some of them arise from the costa.

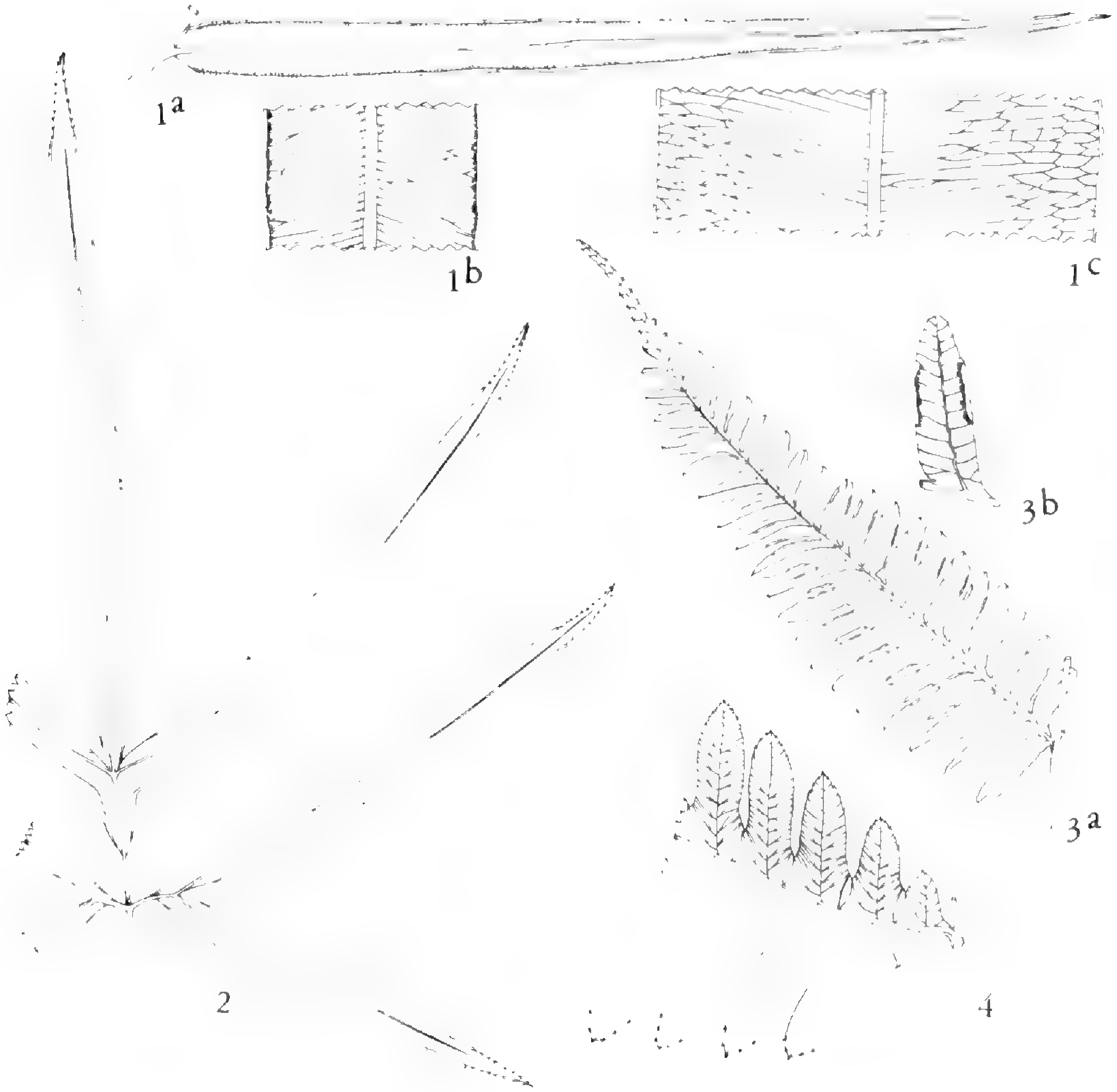

FIG. 1-4. Fig. 1. *P. grandifolia*: 1a, a fertile pinna, × 1/4; 1b, portion of fertile pinna, × 1; 1c, portion of sterile pinna, × 1. Fig. 2. *P. cretica*: a fertile frond, × 1/2. Fig. 3. *P. paucinervata*: 3a, a fertile pinna, × 1/2; 3b, a fertile segment, × 1. Fig. 4. *P. pungens*: base of sterile pinna, × 3/4.

This fern is variable and rare; perhaps it is a hybrid of *P. pungens* and *P. muricella* (or others).

Mexico to Panama.

Ravines in forests and on slopes of volcanoes from 1300 to 1800 m.

Specimens seen: HEREDIA: Vara Blanca de Sarapiquí, between Poás and Braba volcanoes, *Skutch 3636* (US). SAN JOSE: Tablazo, *Valerio 265* (US).

4. PTERIS PUNGENS Willd. Sp. Pl. 5: 387. 1810

The erect stipe, which is castaneous at the base, is slightly muricate, as is the rachis especially at the axils of the pinnae. The pinnae are from 2-5 pairs, with only the lowest 2-partite. The linear-lanceolate obtuse segments are close, parallel, and have a regular appearance as compared with those of *P. paucinervata.*

As the rounded or pointed tubercles on the stipe and rachis can be observed in some other species, the distinguishing character of this Pteris is found in the short lowermost vein or veins which arise from the costa. The linear sori extend from the sinuses of the segments almost to its serrate tip.

Mexico to Panama, to Peru and Bolivia; West Indies.

In humid forests from 200 to 1100 m.

Specimens seen: LIMON: Tsâki, Talamanca, *Tonduz 9471* (US); Finca Montecristo, on the Río Reventazón below Cairo, *Standley & Valerio 48626* (US); Los Diamantes, Rubber Plant Station, *Scamman 5908, 7036* (GH); Hacienda Parismine Banana Co., *Jimenez 1060* (NY, US). HEREDIA: Santa Clara — Las Delicias, *Biolley 10683* (US); Finca La Selva, Río Puerto Viejo, *Scamman & Holdridge 7443, 7915* (GH). ALAJUELA: Llanuras de San Carlos, *Brade 314* (US); Surubres near San Mateo, Feb. 1906 *Biolley* (NY, US). SAN JOSE: San José, 1906 *Biolley* (US); Vicinity of El General, *Skutch 2200* (GH, NY, US). CARTAGO: Turrialba, *Maxon 182* (NY, US).

5. PTERIS QUADRIAURITA Retz. Obs. Bot. 6: 38. 1791

This common, widely distributed fern varies greatly in size from 15 cm. to 1 m. The leaf has 7-15 pairs of pinnae, and the basal pair are 2-partite; it is suberect from a woody rhizome clothed with small, acicular dark scales with lighter margins. The segments are oblong to linear, rounded-obtuse, thin to firm-herbaceous and translucent.

Mexico to Panama, to Brazil; West Indies. Tropics of Old World.

On shaded stream banks and in deep ravines from 1000 to 1800 m.

Representative specimens: 1901-1905 *Wercklé* (NY, US). LIMON:

Talamanca, *Tonduz 8579* (US). HEREDIA: Confluence of Río Puerto Viejo and Sarapiquí, *Pittier 7475* (US); Barba, *Scamman 7038* (GH). ALAJUELA: Alajuela, *Alfaro 6045* (GH, US); La Verbena près Alajuelita, *Tonduz 8791* (US); Near Zapote, *Scamman 7622* (GH); San Ramón, *Tonduz 17581* (NY, US). SAN JOSE: Aserrí, *Hunnewell 16535* (GH); San Sebastian near San José, *Standley 49294* (US); Río Torres, *Alfaro 12, 18* (US); Forêts du Copey, *Tonduz 11684* (US); Santa Ana, *Scamman 5906* (GH); Finca Ortuna, Desamparados, *Scamman & Holdridge 7916* (GH). CARTAGO: Navarro, *R. Torres 58* (US); Juan Viñas, *Cook & Doyle 187, 200, 241* (US); Cerro de La Carpintera, *Standley 34270* (US); Turrialba, *Scamman 5904, 5907* (GH); Tapanti, in Valley of Río Reventazón, *Scamman & Holdridge 7917* (GH). PUNTARENAS: Cours superieur du Diquís, *Pittier 10571* (US).

6. PTERIS MURICATA Hook. Sp. Fil. 2: 193. 1858

Commonly called *P. coriacea* Desv. (a South American species).

The stipe which is dark chestnut at the base arises from a thick, woody rhizome with dark scales with light dentate margins. Both stipe and rachis are flexuous with the coriaceous pinnae stalked at the base, the lower pair bi- to tripinnate. Segments are linear-oblong, subfalcate, mucronate at the tip. This species is characterized by the hard spinous points on the rachises and costae.

Costa Rica to Panama, to Peru and Bolivia.

In wooded ravines and moist forests at high altitudes from 1300 to 3000 m.

Specimens seen: Costa Rica 1901-1905 *Wercklé* (US), Vicinity of Col'blanco, *Maxon 314* (NY, US). HEREDIA: Volcán Barba, *R. Torres 229* (US). ALAJUELA: Candelaria, *Hoffmann 889* (US). SAN JOSE: Forêts du Copey, *Tonduz 11898* (US); La Hondura, *Standley 37721* (GH, US), Along the road to La Hondura, *Scamman & Holdridge 7912* (GH). CARTAGO: Cerro de La Carpintera, *Standley 34489* (US); Robert's on the road to Volcán Irazú, *Scamman 5903* (GH).

7. PTERIS MURICELLA Fée, Mém. Fam. Foug. 8: 73. 1857

Pteris mollis Christ, Bull. Herb. Boiss. 4: 658. 1896. Costa Rica: Forêts de San Marcos, *Tonduz 7565;* isotype US!

This fern is unusual and distinctive among Costa Rican Pteris because of the soft and delicate tissue. The smooth, reddish-brown stipes rise erect from a thick rhizome with concolorous brown scales; segments are oblong, obtuse, crenulated at the apex, with the sori occupying only the middle of the lobes. Long soft awns are common on the costae on their upper surface.

Mexico to Panama.

In moist dense forests from 1000 to 1800 m.

Specimens seen: 1901-1905 *Wercklé* (US). ALAJUELA: La Palma, near San Ramón, *Brenes 5364* (GH, US); Santiago, near San Ramón, *Tonduz 17582* (US); Zarcero, Jan. 19 & 30, 1948, *Austin Smith* (US). SAN JOSE: Forêts de San Marcos, *Tonduz 7565* (US); Vicinity of Santa María de Dota, *Standley 41863* (GH, US); Cultures du Copey, *Tonduz 11705* (US); Vicinity of El General, *Skutch 2240* (GH, NY, US). CARTAGO: Valle del Río Navarro, *Wercklé 16771* (US).

8. PTERIS BIAURITA L. Sp. Pl. 2: 1076. 1753

The stipe and rachis are light-colored, rising from a suberect, woody rhizome; the blade may have from 5-15 pairs of opposite pinnae, the basal pair 2-partite; segments oblong to linear, obtuse, with entire margins, the fertile with rounded sinuses, the sterile acute. In this species only the basal veins are joined in a narrow costal arc.

Mexico to Panama to Brazil; West Indies. Tropics of Old World.

In light woods at edge of forest; wet thickets, from 100 to 1000 m.

Specimens seen: LIMON: La Colombiana Farm of United Fruit Co., *Standley 36715* (US); Port Limón, June 15, 1874, *Kuntze* (NY). ALAJUELA: Surubres près de San Mateo, *Pittier 7009* (US), Surubres near San Mateo, Feb. 1906 *Biolley* (NY, US); La Palma de San Ramón, *Brenes 6396* (NY); San Pedro de San Ramón, *Brenes 15085* (NY). SAN JOSE: El General, *Skutch 2203, 2224, 3931* (GH, NY, US). GUANACASTE: Nicoya, *Cook & Doyle 678* (US).

9. PTERIS PROPINQUA Ag. Rec. Spec. Gen. Pterid. 65. 1839

Pteris costaricensis Rosenst. Fedde Rep. Spec. Nov. 22: 7. 1925. Costa Rica, *Brade 461;* isotype NY!

Stipe and rachis smooth, light-colored to the base; scales on the rhizome with dark centers; frond bipinnate below with especially the upper pinnae decurrent to the rachis; segments lanceolate, subfalcate, rather obtuse, mucronate and sharply serrated. Basal veins monoarcuate.

Mexico to Panama, to Brazil; West Indies.

In other Central American countries it has been found in open places and swamps from sea level to 300 m.

Specimen seen: ALAJUELA: Llanuras de San Carlos, *Brade 461* (NY).

10. PTERIS LIVIDA Mett. Ann. Sc. Nat. V. 2: 222. 1864

Blades tripartite, the pinnatifid pinnae petiolulate, the long segments usually cut to the rachis at the base of their pinna; sori not reaching the inciso-crenate tips. The vivid green color of the leaf-tissue is distinctive.

Costa Rica to Peru and Bolivia.

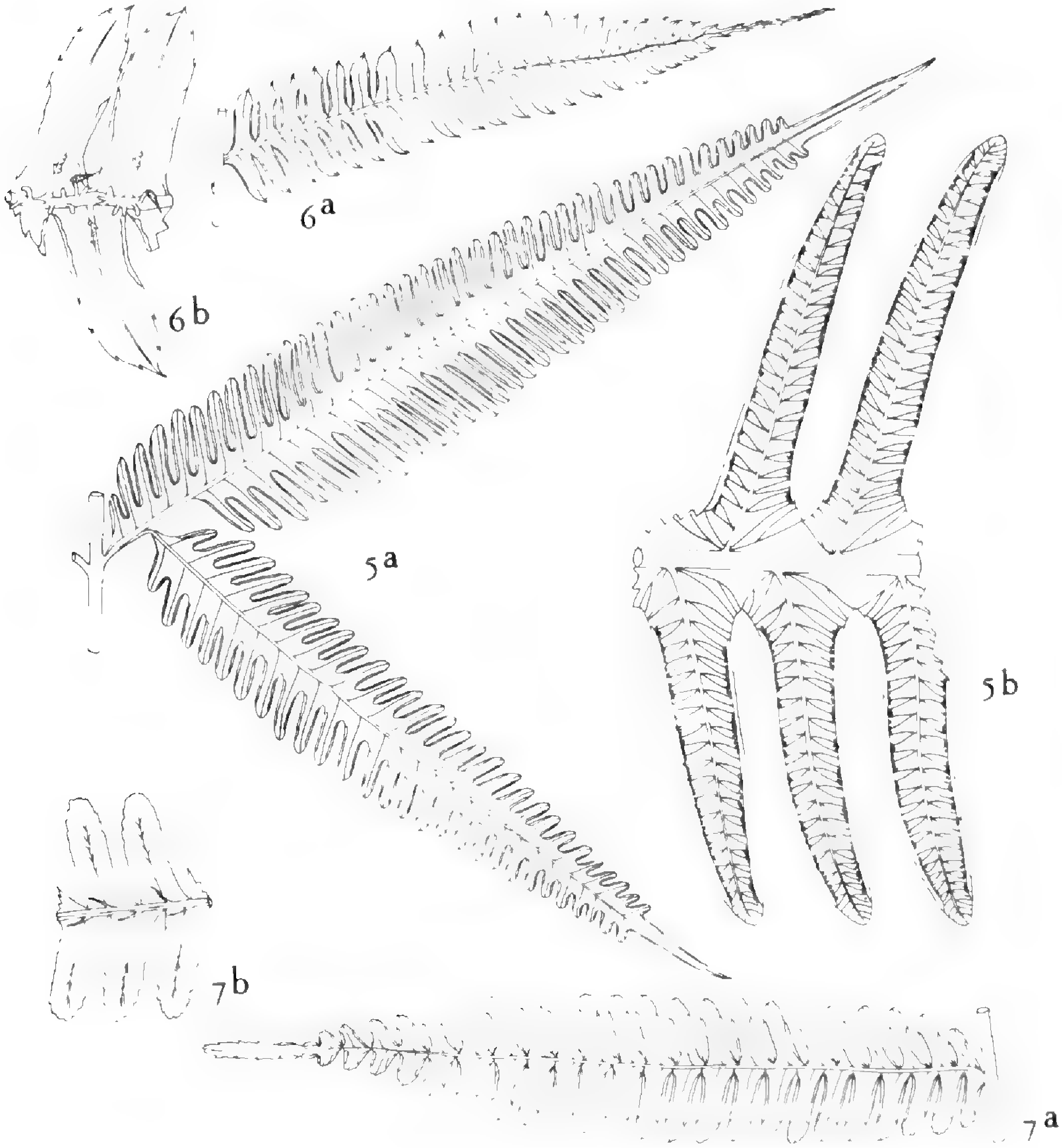

FIG. 5-7. Fig. 5. *P. quadriaurita*: 5a, a fertile basal pinna, × 1/2; 5b, portion of fertile pinna, × 1 1/2. Fig. 6. *P. muricata*: 6a, a fertile pinna, × 1/2; 6b, portion of a pinna with muricated points on costa beneath, × 2. Fig. 7. *P. muricella*: 7a, a fertile pinna, × 3/4; 7b, portion of a pinna with awns on costa above, × 1.

In ravines and damp forests in mountains from 900 to 2700 m.

Specimens seen: 1901-1905 *Wercklé* (US). Vara Blanca between Poás and Barba, *Scamman 7035* (GH); Along cart-road from Vara Blanca to La Concordia, *Maxon & Harvey 8482* (US). SAN JOSE: El Copey, *H. E. Stork 1549* (US); La Palma, *Brade 26* (US); San Jerónimo, *Wercklé 580* (US). CARTAGO: Santa Clara de Cartago, *Lankester 711* (GH, US); Forêts du Turrialba, *Pittier 849* (US); Forêts du Roble, Massif de l'Irazú, *Pittier 4179* (US).

11. PTERIS ALTISSIMA Poir. in Lam. Encycl. 5: 722. 1804

Pteris Kunzeana Ag. Rec. Spec. Gen. Pterid. 62. 1839.

This large fern, sometimes reaching a height of 2 m., is the most common and widely distributed Pteris in Costa Rica. The blade is deltoid-ovate, broad, to tripinnate at the base, the basal pinnae are much the largest. The straw-colored stipe rises from a short, erect rhizome with shiny castaneous scales with a lighter dentate margin. The leaf-tissue is firm-herbaceous to subcoriaceous.

The pinnae and pinnules vary greatly in shape and general aspect in different fronds, but the character which distinguishes this from other similar species of Pteris is the 2-3-arcuate basal veins.

Mexico to Panama, to Brazil and Bolivia; West Indies.

In ravines and on hillsides in wet forests from 250 to 2200 m., from all the provinces of Costa Rica.

Representative specimens: LIMON: Forêts de Tsâki, Talamanca, *Tonduz 9440* (US); Los Diamantes, *Holm & Iltis 369* (NY, US), Los Diamantes, *Scamman 7034* (GH). HEREDIA: Yerba Buena, northeast of San Isidro, *Stanley & Valerio 49235* (GH, US); La Concepción, Llanuras de Santa Clara, *J. D. Smith 6870* (GH, US); Vara Blanca de Sarapiquí, *Skutch 3578* (GH, NY, US), Vara Blanca between Poás and Barba, *Maxon & Harvey 8337* (US); Cinchona, *Scamman 7619* (GH); La Paz-Waterfall, *Scamman & Holdridge 7910* (GH). ALAJUELA: Region of Zarcero, *Austin Smith 383* (GH); Surubres près San Mateo, *Biolley 6* (US). SAN JOSE: Las Nubes, *Scamman & Holdridge 7908* (GH); La Palma, *Scamman 7618* (GH), *Maxon & Harvey 7999* (US); Cerro Turrubares, Orotina, *Jimenez 600* (US); Finca Ortuna, Desamparados, *Scamman & Holdridge 7909* (GH). CARTAGO: Estrella, *Cooper 6044* (GH, NY, US); Navarro Valley, *H. E. Stork 1405* (GH); San Juan del Norte, *Scamman 7620* (GH); Forêts de Juan Viñas, Jan. 25, 1890, *Pittier* (US), Juan Viñas, *Cook & Doyle 212* (US). GUANACASTE: Cafetales at Hacienda Granadilla, *Dodge & Thomas 6421* (GH); Upper

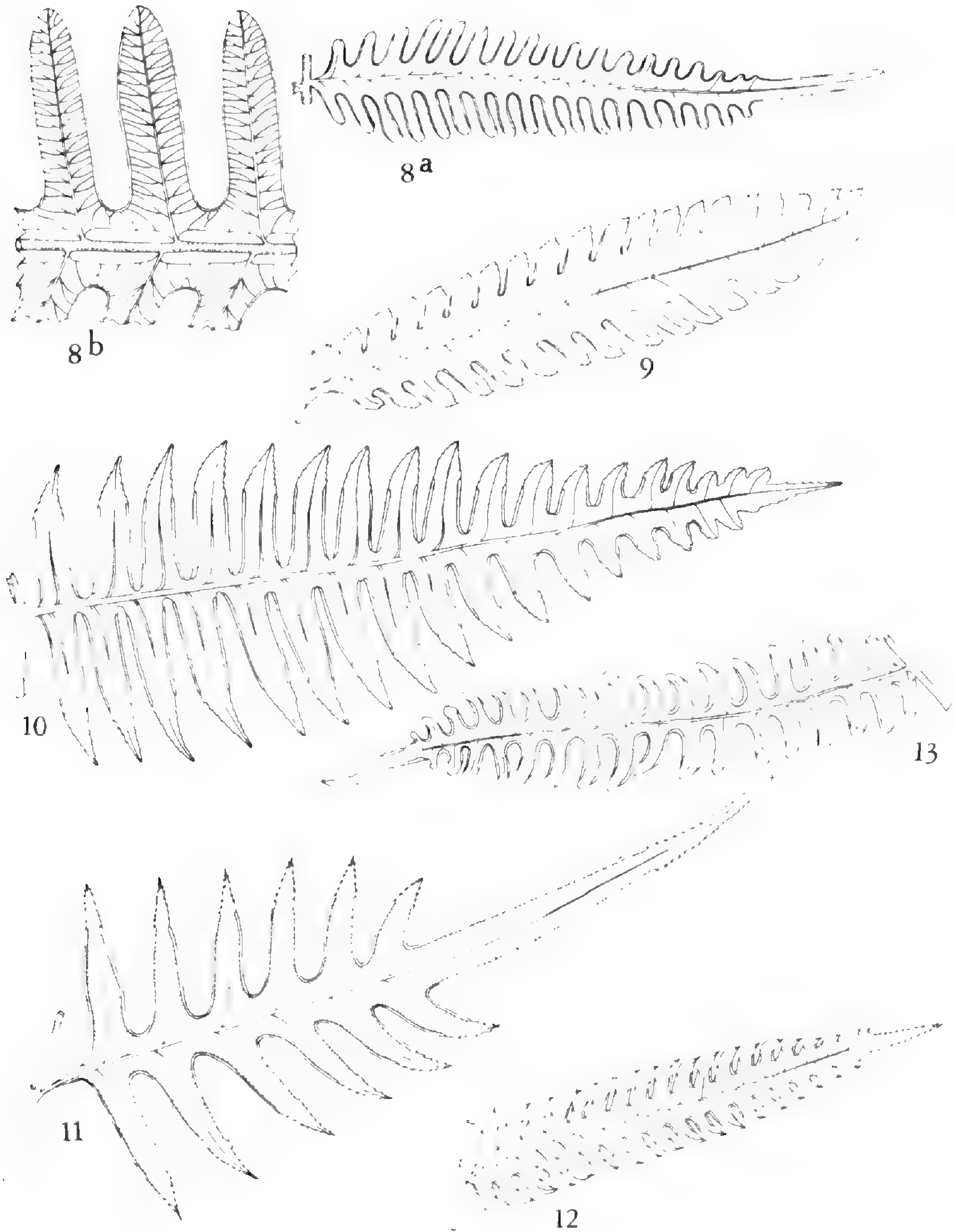

FIG. 8-13. Fig. 8. *P. biaurita*: 8a, a fertile pinna, × 1/2; 8b, portion of a fertile pinna, × 1 1/2. Fig. 9. *P. propinqua*: a fertile pinna, × 3/4. Fig. 10. *P. livida*: a fertile pinna, × 1/4. Fig. 11. *P. altissima*: a fertile pinna, × 1/2. Fig. 12. *P. podophylla*: a fertile pinna, × 1/2. Fig. 13. *P. tripartita*: a fertile pinna, × 1/2.

slopes of Cerro San José de Libano, *Dodge, Hanckel & Thomas 7878* (GH). PUNTARENAS: Between Golfo Dulce and Río Terruba, *Skutch 5412* (US).

12. PTERIS PODOPHYLLA Sw. Schrad. Journ. 1800.^{2} 67. 1801

A tall conspicuous fern often growing at the edge of a forest, in the mountains. The wide frond is ternately divided, the lateral divisions 3-4-partite, the central one pinnate-pinnatifid. The stipe is stout, thick and tawny, about 1 m. high, and somewhat muricated at the base. The linear-oblong falcate segments are regularly spaced on the costae with rounded sinuses, the sterile ones are finely spinulose-serrate as are the fertile near their tip. Texture is thick, coriaceous, and the basal veins are monoarcuate.

Mexico to Panama, to Peru and Bolivia; West Indies.

In partial shade at edges of forests and in clearings usually from 1000 to 2400 m.

Specimens seen: 1901-1905 *Wercklé* (US). HEREDIA: Confluence of Río Puerto Viejo and Sarapiquí, *Pittier 7491* (US); Cart road from Vara Blanca to La Concordia, *Maxon & Harvey 8475* (US). SAN JOSE: Santa María de Dota, *Standley 43335* (GH, US); Forêts du Copey, *Tonduz 11718* (US), El Copey, *Jimenez 1107* (GH, US); Dans les bois humides à la Palma, *Pittier 710* (US), Vicinity of La Palma, *Maxon & Harvey 8083* (US); Highway near La Chonta, *Scamman 5905* (GH); Rancho Redondo, on slope of Irazú, *Scamman & Holdridge 7621* (GH). CARTAGO: Forêts del Roble, Massif de l'Irazú, *Tonduz (Pittier) 4189, 4190* (NY, US); Forêts entre la Turrialba à la Río Birrio, *Pittier 845* (US); Finca Navarro, *Maxon 629* (NY, US).

13. PTERIS TRIPARTITA Sw. Schrad. Journ. 1800.^{2} 67. 1801

This fern has often been described as "gigantic" or giant bracken. The leaves reach 2 m. or more in height from a very stout rootstalk. Fronds are tripartite, the pinnatifid pinnae more or less sessile. The short ultimate segments are linear-oblong, falcate, obtuse or acute, crenulate only at the tip, and regularly spaced and evenly cut by obtuse sinuses usually at some distance from the costa.

A widely distributed fern, native to the Tropics of the Old World — Asia, Africa, Australia, Polynesia, etc. — but found as an escape occasionally in the New World, including cypress swamps and wet hammocks of Florida, and rarely in Central and South America.

Specimens seen: CARTAGO: Tapanti, in Valley of Río Reventazón, *Scamman & Holdridge 7913* (GH); Orosi, *Scamman & Holdridge 7914* (GH).

Other species of Pteris described from Costa Rica are the following. They are probably synonyms of some of the species mentioned here, but the types have not been seen.

P. longicaudadel Christ, in Pitt. Prim. Fl. Costar. 3: 21. 1901. Costa Rica, Forêts de Santo Domingo de Osa, Mars. 1896, *Tonduz 10071.* Cited as a synonym of *P. pungens* by Maxon, Sci. Sur. Porto Rico and V. I. **6**: 434.

P. macrodictya Christ, Bull. Herb. Boiss. II, **7**: 267. 1907. Costa Rica, 1904, *Wercklé.* Probably = *P. grandifolia.*

P. navarrensis Christ, Bull. Soc. Bot. Genève II, **1**: 227. 1909. Costa Rica, Valle del Río Navarro, 1400 m., *Wercklé 16761.* Probably = *P. podophylla.*

P. prolifera J. E. Bomm., Bull. Soc. Bot. Belg. 35: 189. 1896, in synonymy. Costa Rica, Juan Viñas, *Pittier 1841.* It is a proliferous phase of *P. quadriaurita* or perhaps of a species of another genus. — GRAY HERBARIUM, HARVARD UNIVERSITY.

OMISSIONS IN KEY TO XYRIS IN FLORIDA. — In Rhodora, Vol. 62, No. 743, 1960, two portions of the key to Florida Xyris were omitted from the manuscript, through an oversight. On page 300, there should be a second 3 just above the first 4 which should read "3. Plants tuberculate-roughened only on scape ridges and/or leaf margins." On page 301, the second "15" should end with 14. *X. smalliana.* — R. KRAL.

A SECOND STATION FOR STEWARTIA OVATA ON THE COASTAL PLAIN. — Grimes (1922) reported an extensive population of *Stewartia ovata* (Cav.) Weath. in James City County, Virginia, south of Williamsburg: *Grimes 3818* (NY), June 24, 1921. *Baldwin 14951* (GH) is from that same population, June 29, 1954; the label has the following notations: "Small trees to eighteen feet. Petals white. Filaments purple, rose, and yellow in various different plants." Coe (1959) mentions the variability of the plants at this station. The geographic range of *S. ovata* was mapped by Braun (1937): the Williamsburg station seems to have been the only one known for the Coastal Plain (Kobuski, 1951).

I recently found *S. ovata* in Lancaster County, Virginia, *Harley 2265* (GH), June 18, 1960, a small population on the east bank of John Creek, a short distance above its confluence with the Corrotoman River at Merry Point. Shrubs grew up to six feet in height. All the flowers observed were white with yellow stamens. A fruiting specimen was taken on Aug. 25th: *Harley 2272* (GH). Associated with *Stewartia* at this station are *Galax*, *Kalmia*, *Asarum virginicum*, etc. Several small colonies of *Epigaea* are near-by. — WINIFRED J. HARLEY, MERRY POINT, VIRGINIA.

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GRIMES, E. J. 1922. Some interesting plants of the Virginia Coastal Plain. Rhodora **24**: 148-152.

KOBUSKI, C. E. 1951. Studies in the Theaceae, XXI. The species of Theaceae indigenous to the United States. Journal of the Arnold Arboretum **32**: 123-138.

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VARIANCE IN HERBARIUM SPECIMEN IDENTIFICATION AND OTHER CONSIDERATIONS BASED UPON THE PREPARATION OF A LOCAL FLORA

ROBERT A. DAVIDSON AND PHYLLIS E. DAVIDSON

"A universal, to Aristotle, is any common noun, any name capable of universal application to the members of a class: so *animal, man, book, tree,* are universals. But these universals are subjective notions, not tangibly objective realities; they are *nomina* (names), not *res* (things); all that exists outside us is a world of individual and specific objects, not of generic and universal things; men exist, and trees, and animals; but man-in-general, or the universal man, does not exist, except in thought; he is a handy mental abstraction, not an external presence or re-ality" (Durant, 1953).

Some 2200 years after Aristotle, Gleason (1933) reflected: "It is now generally recognized that a species is an abstract mental concept. . . . To this concept is given a binominal name. . . . The assignment of the individual to a certain concept constitutes identification. . . . The name which appears on a herbarium sheet represents the opinion of some person." Gleason also has pointed out that specific concepts vary through accumulation of study material and through changed mental attitudes and emphasizes that, ". . . the probability that a specimen is correctly identified, that is, that it correctly illustrates a certain specific concept, depends largely on the person making the identification and on the date when it was made."

The foregoing comments are intended to serve as an initial warning that the data to follow, though objective in appearance, are at least partially quite subjective. Yet, since few would disagree that the boundaries of most present-day-recognized species are ". . . real, objective phenomena" (Stebbins, 1950), the data presented here may be of some interest.

In 1952 work was begun which culminated in a survey of the vascular flora of 16 counties of southeastern Iowa (Davidson, 1957). The field work done in this connection encompassed at least parts of four growing seasons during which some 15,000 miles were traveled, innumerable notes taken, and some 4,400 collections, totaling an estimated 9,000 individual specimens, made. In identifying these specimens[1] every effort was made to check as carefully as possible identifications of all specimens collected previously from southeast Iowa and deposited in the Herbarium of the State University of Iowa (IA). Eventually similar consideration was given to all southeast Iowa species included neither in the new collections not at IA but represented in the herbaria of Iowa State University, Parsons College, and Iowa Wesleyan College. A few critical specimens were examined at the Barnes' Herbarium of the Davenport Public Museum. For the most part, however, the data cited bear upon representatives of the flora of southeast Iowa on deposit at IA.

This herbarium houses some 125,000 vascular plants. Curated in the past by B. S. Shimek, L. M. Cavanaugh, W. A. Anderson, and currently by R. F. Thorne, the permanent collection at the time of the study was in good condition; nevertheless, special care was taken during the investigation to discard or ignore fragmentary material which *per se* would be subject to non-reliable identification. Student collections, other than those associated with formal graduate-level research, have not been incorporated into the permanent collection and almost without exception specimens and their identifications reflect the field work and opinions of experienced taxonomists.

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[1] Recent regional manuals (Fernald, 1950; Gleason, 1952), monographs and revisions, and other appropriate literature were consulted in identifying materials, in the application of names, and in the compilation of synonymy. In a few cases deviations from the literature were necessary to express other taxonomic opinions.

Reporting the data presented here is possible due to an earlier belief that differences in opinion regarding the correct identity of herbarium specimens might relate to certain evolutionary considerations. When idealized this reasoning would run something like this:

1. In a given area, species which are clearly defined and not associated with close relatives nor subject to introgression, etc., are subject to greater unanimity of opinion regarding their identity than are species for which there are close relatives or between which introgression, hybridization, intergradation, etc., occur.
2. "Misidentification"[2] thus is more closely associated with "critical" taxonomic groups than with "non-critical" groups.
3. Critical groups are more often closely associated with recent and current evolutionary flux than with old evolutionary stability.
4. Misidentification is thus related to evolution and perhaps to evolutionary stage.

The idealized "logical" conclusion follows that, *e. g.*, if we detected 20% misidentifications within the family Compositae amongst 50 genera including 200 species while we found only 5% misidentifications within the family Leguminosae amongst 50 genera and 200 species, we might assume that the Compositae is (at least as represented in a given area) in a stage of greater evolutionary flux than is the Leguminosae.

It seems apparent, however, that such a scheme would be feasible only if numerous qualifications were made and if large floristic segments were studied within the framework of a taxonomy much more refined than that with which we now work. In any event, rather vague thinking along the preceding lines caused accurate records to be kept on each herbarium specimen considered to be misidentified. These records may be summarized as follows:

A total of 1252 species, comprising 507 genera and 124 families, currently are known to occur in southeast Iowa.

Of these, 1148 were already represented in the herbaria consulted by the time the senior author's field work was initiated. Thus this more recent field work, resulting in the

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[2] "Misidentification" is used for simplicity throughout this paper to mean: "difference in opinion regarding the identity of. . ." Thus a misidentification was scored each time one of us (R.A.D.) disagreed with the label identification, or the latest annotation, of a herbarium specimen.

collection of 4435 numbers, increased the number of species comprising the flora of southeast Iowa previously uncollected in the area by 8.3%. One unrecorded species was collected for each 42.3 collection numbers. Said in another way, 2.3% of the new collections represented species previously unknown to the area.

Of the 3997 herbarium specimens examined, 184 (or 4.6%) were considered misidentified (this number does not include approximately 35 specimens considered to be putative hybrids). Upon correction these 184 specimens were included in the 507 specimens which represented the 139 species for which misidentified specimens were found. By relating the latter figure to the 1148 species represented in the herbaria we can calculate that 12.1% of all species was falsely represented by at least one herbarium specimen. This figure is of some importance inasmuch as the speed and clarity with which one arrives to a given species concept depends in large part upon the examination of a series of correctly identified specimens.

Before re-identification, the 184 misidentified specimens allegedly represented 60 species (synonymy taken into account here as elsewhere) not currently known to be present in southeast Iowa. Thus, for the segment studied, the herbarium was 4.8% richer in species than it should have been. It is suspected that this trend may reflect the taxonomists' "unconscious" desire to find rarities.

On the other hand, the 184 misidentified specimens when re-identified accounted for 21 species which are currently represented by one or more formerly misidentified specimens only. In other words, 21 species now considered validly present in the flora of southeast Iowa were neither represented in the herbarium before the present study nor collected during it. Thus some 1.7% of the total flora was hidden in the herbarium through misidentification.

Table 1 lists all families represented by 20 or more herbarium specimens, giving the included number of genera, species, specimens, misidentified specimens, and the percentage of misidentification. Few, if any, generalizations on the

TABLE 1. DATA ON PLANT FAMILIES REPRESENTED BY TWENTY OR MORE HERBARIUM SPECIMENS

Family	Number Genera	Number Species	Total Specimens	"Misidentified"	Percent "Misidentified"
Equisetaceae	1	4	24	0	0
Aspidiaceae	8	15	68	0	0
Potamogetonaceae	1	11	31	2	6.4
Gramineae	51	118	441	36	8.1
Cyperaceae	9	72	178	10	5.6
Araceae	3	4	22	0	0
Commelinaceae	2	4	23	0	0
Juncaceae	2	11	23	6	26.0
Liliaceae	10	22	62	0	0
Salicaceae	2	16	64	1	1.5
Betulaceae	4	4	36	1	2.7
Fagaceae	1	9	73	0	0
Polygonaceae	4	27	84	4	4.7
Chenopodiaceae	3	12	24	4	16.6
Amaranthaceae	3	10	36	1	2.7
Caryophyllaceae	8	16	45	0	0
Ranunculaceae	12	28	133	0	0
Papaveraceae	4	7	23	1	4.3
Cruciferae	16	32	62	8	12.9
Saxifragaceae	6	9	29	0	0
Rosaceae	4	41	143	15	10.4
Leguminosae	28	55	215	3	1.3
Rutaceae	2	2	22	0	0
Polygalaceae	1	5	24	0	0
Euphorbiaceae	3	19	57	0	0
Anacardiaceae	1	4	41	0	0
Vitaceae	3	6	25	1	4.0
Malvaceae	6	7	20	0	0
Guttiferae	1	9	28	3	10.7
Violaceae	1	16	58	17	29.3
Onagraceae	5	12	39	0	0
Umbelliferae	17	23	49	6	12.2
Primulaceae	3	8	29	1	3.4
Asclepiadaceae	2	12	21	0	0
Convolvulaceae	3	14	36	4	11.1
Boraginaceae	7	11	37	0	0
Verbenaceae	2	6	42	0	0
Labiatae	20	40	161	13	8.0
Solanaceae	5	12	40	2	5.0
Scrophulariaceae	19	39	162	0	0
Acanthaceae	2	3	21	0	0

Plantaginaceae	1	7	22	0	0
Rubiaceae	3	8	42	2	4.7
Caprifoliaceae	6	12	40	1	2.5
Campanulaceae	3	7	39	1	2.5
Compositae	52	153	509	32	6.2

cause of misidentification are discernable with any degree of certainty. The quality of misidentifications ranged from genera mistaken for other genera (e. g., *Anthemis* for *Matricaria*, *Crepis* for *Pyrrhopappus*, *Eragrostis* for *Leptoloma*, *Pontederia* for *Heteranthera*, *Thaspium* for *Pastinaca*, etc.) to "closely related species" being confused (e. g., *Mentha* spp., *Viola* spp., *Muhlenbergia* spp., etc.). The relative technicality of the taxonomy of a given group may or may not be important (at any rate, any attempt to isolate this as a single factor probably would be futile). The Euphorbiaceae, a rather technical group with few critical species (*Euphorbia heterophylla* L. and *E. dentata* Michx. being notable exceptions), was represented by 57 specimens all correctly identified. On the other hand approximately 12% of the 49 specimens representing the Umbelliferae, also technical but with few critical species noted, was misidentified. The Cyperaceae, at once quite technical and apparently including many taxonomic problems, was represented by 178 specimens of which only 5.6% was misidentified (the figure quite close to the 4.6% "Grand 'Misidentification' Average" for the entire herbarium segment studied). In the Gramineae, similarly technical and also with several critical species complexes, misidentifications were found in 8.1% of the 441 representative specimens. The Juncaceae, technical, but with few taxonomic problems encountered, was represented by 23 specimens of which 26% was misidentified. The taxonomy of the Chenopodiaceae and Amaranthaceae might be considered more or less equally technical, but of the two families species of the Amaranthaceae seem generally less well defined; yet of 24 chenopodiaceous specimens 16.6% was misidentified while of 36 amaranthaceous specimens only 2.7% was misidentified. Less technical, but with several outstandingly difficult genera, the Rosaceae bore a misidentification figure of 10.4%. The large misidentification percentage for the Violaceae (29.3% of 58 specimens) probably reflects the biological complexity (introgression, etc.) of *Viola* and concomitant difficulties in its taxonomic interpretation plus intensive recent work on the group.[3] The surprising low misidentification percentages given for the Salicaceae and Fagaceae, both apparently containing biologically complex entities, are probably best accounted for by the fact that many specimens considered uninterpretable were not included in the tally as neither were specimens considered putative hybrids.

The number of families (some, e. g., the Scrophulariaceae and Ranunculaceae, represented by relatively large numbers of specimens) for which no misidentifications were detected seems surprisingly large.

It should be re-emphasized that the "facts" and "figures" presented here are, actually, only quasi-facts and -figures. Without qualifications they are not strictly appropriate for mathematical manipulations; with the qualifications that are indicated they seem even less so. These qualifications are of a compounding nature with each seriously affecting the others. In the first place, are the species under consideration actually real with objective, definable limits? Probably most are while some are not — what is the percentage of each in the total flora? How much error is the result of carelessness? For those species that are real, how adequate has been their perception, and how adequately have these perceptions been set to the language of keys, descriptions, etc? How uniformly do various taxonomists interpret this language (which as Gleason, *op. cit.*, has pointed out changes with time) and how much more, or less, accurate are recent identifications than preceding ones? These are just a few of the questions that come to mind.

Probably very little of significance can be deduced from this minor side-study. However, an attempt has been made to indicate some of the effects of recent field work on the known flora of a given sector and to quantitate differences of opinion regarding the composition of this flora. — DEPT. OF BOTANY, UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN.

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[3] Specimens were examined and annotated by Dr. Norman H. Russell.

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A NEW ZEPHYRANTHES FROM SOUTHERN TEXAS

FRED B. JONES

Zephyranthes refugiensis *sp. nov.* Bulbus subglobosus 2-2.7 cm. diam.; folia linearia; ad basim 2-3 mm. lat., usque ad 25 cm. long.; pedunculus 15-23 cm. alt.; spatha 2.2-2.8 cm. long. integra, fenestrata aut bifida, dimidio inferiore tubulari; pedicellus 8-16 mm. long.; perianthus erectus, tubo 1.5-2.4 cm. long., viridi; segmenta perianthi oblanceolata ad lanceolata, flava; stylus erectus, antheras attingens; stigma album breviter trilobatum.

Bulb subglobose, 2-2.7 cm. wide x 1.7-2.3 cm. high, tunics dark brown; neck 4-5 cm. long; leaves linear, 2-3 mm. wide at base, to 25 cm. long, grayish green, channelled on upper side, convex on lower side, apex subacute to rounded; peduncle 15-23 cm. high, 3-4 mm. wide at base, 2-3 mm. wide at apex, round to slightly flattened, one-flowered; spathe membranous, 2.2-2.8 cm. long, entire, fenestrate or bifid, the lower half tubular, purplish; pedicel 8-16 mm. long; ovary 4-6 mm. long, 3-4 mm. wide; perianth erect, 3.4-4.5 cm. long, the limb funnelform; perianth tube 1.5-2.4 cm. long, 2-3 mm. wide at base, 3-4 mm. wide at apex, yellowish green; perianth segments oblanceolate to lanceolate, yellow (Wilson, 2-3), greenish at base, often flushed with red on outside; petaline segments 20-28 mm. long, 7-11 mm. wide; sepaline segments approximately as long but usually 1 mm. wider; filaments inserted at the throat of the perianth tube, suberect, somewhat flattened, light greenish yellow; sepaline filaments 7-10 mm. long, petaline filaments usually 1 mm. longer; anthers versatile, suberect, affixed much below the middle, 8-10 mm. long at anthesis, the pollen orange-yellow; style erect, greenish below, white in the upper part, reaching apexes of filaments or even of anthers; stigma shortly three-lobed, white; capsule deeply three-lobed; seeds D-shaped, 5-6 mm. long, black.

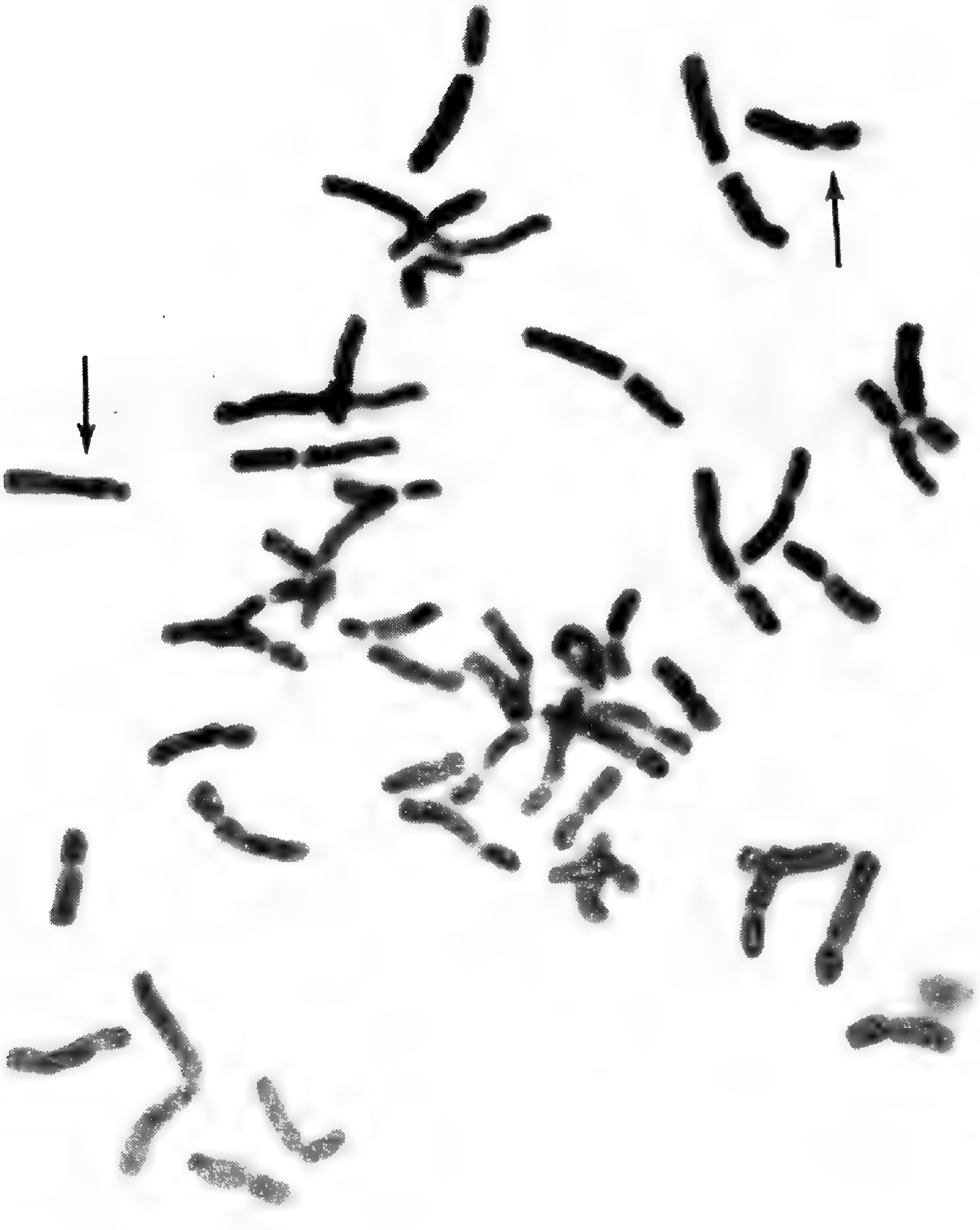

FIGURE I. Photomicrograph (X1500) of the somatic chromosome complement of *Zephyranthes refugiensis* ($2n = 48$) from a colchicine-treated root tip squashed in 2% acetic orcein. Arrows indicate two of the chromosome types readily distinguishing *Z. refugiensis* from *Z. pulchella*. (Courtesy of R. O. Flagg, The Blandy Experimental Farm, Boyce, Va.)

TYPE: 1½ miles east of Refugio, Refugio County, Texas, Fred B. Jones 4353, Oct. 26, 1960, Welder Wildlife Foundation Herbarium (isotypes to be distributed).

The usual habitat of *Z. refugiensis* is an open swale, either in a brushy pasture or on prairie. The soil preference appears to be a tight sandy loam. Flowering occurs five to ten days after a heavy shower, at which time water to a depth of several inches is likely to be standing over the bulbs. A flush of bloom follows each substantial rain from July to November. Other rain lilies which may be present in the swales and come into flower at the same time as *Z. refugiensis* are *Z. pulchella*, *Cooperia Drummondii*, *C. Jonesii*, *C. Traubii* and *Habranthus texanus*.

Z. refugiensis is readily distinguished from *Z. pulchella*, to which it seems to have a close affinity, by the longer perianth tube. The lighter yellow perianth and decided fragrance are also distinctive characteristics. Flagg (Fig. 1) reports that the plant differs cytologically from *Z. pulchella*.

As presently known, the species is limited to northern and eastern Refugio County and a small adjoining area in Goliad County.[1] — WELDER WILDLIFE FOUNDATION, SINTON, TEXAS.

MERGER OF THE NORTH AMERICAN HOUSTONIA AND OLDENLANDIA UNDER HEDYOTIS*

WALTER H. LEWIS

Principally on the basis of seed, and to a lesser extent floral and fruit characteristics, the genera *Houstonia* L. and *Oldenlandia* L. are distinguished. A comparative study of these features for the North American species and, where possible, for the African *Oldenlandia* is presented using the following outline.

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[1] For making available the collections of rain lilies on deposit in their respective herbaria, I am grateful to the following: Dr. B. L. Turner, Herbarium of the University of Texas; Dr. F. W. Gould, Tracy Herbarium of A. & M. College of Texas; Dr. Lloyd Shinners, Herbarium of Southern Methodist University.

Dr. Hanna Croasdale kindly prepared the Latin diagnosis.

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Subg. HOUSTONIA[2] — *seeds* few, large, dorsiventrally flattened, crater-form to concavo-convex, with or occasionally without hilar ridge, endosperm corneous; *capsules* one-fourth to three-fourths inferior; *flowers* often dimorphic, corolla elongate.

Subg. OLDENLANDIA — *seeds* numerous, minute, angled, rarely subglobose, endosperm fleshy; *capsules* wholly inferior; *flowers* usually monomorphic, corolla short.

These criteria are largely from the keys and descriptions of Gray (1860), Wernham (1916), Standley (1918), and Fernald (1950).

SEED. A majority of the subg. *Houstonia* species have averages of 10-15 seeds per capsule. However, Rose (1890) reported ca. 40 seeds for *H. brevipes* (Rose) W. H. Lewis, Terrell (1959) recorded up to 35 seeds in the *H. purpurea* (L.) T. & G. complex, and to these are added averages of 30 seeds for the capsules of *H. arenaria* (Rose) W. H. Lewis and 50-60 for those of *H. asperuloides* Benth. Most subg. *Oldenlandia* species average over 50 seeds per capsule, excepting *H. microtheca* (S. & C.) Steud. and *H. watsonii* W. H. Lewis from Mexico, with 20 and 30 seeds, respectively. The African *Oldenlandia* subg. *Orophilum* Brem. with 9 species and the questionable segregate *Lelya* Brem. are described as few-seeded (Bremekamp, 1952). These examples illustrate a continuous and often overlapping range for seed frequency in the two subgenera.

The typical seeds of 18 species of subg. *Houstonia* and subg. *Oldenlandia* are outlined in figures 1-18. The usual subg. *Oldenlandia* seed is small, e.g., *H. corymbosa* (L.) Lam. (fig. 12, 0.24 x 0.4 mm.), but this varies to the larger seeds of *H. greenei* (Gray) W. H. Lewis (fig. 17, 0.41 x 0.71 mm.) and *H. microtheca* (fig. 18, 0.65 x 0.90 mm.). These seeds are about the same size or even larger than those of *H.* (*Houstonia*) *asperuloides*, *H. saxatilis* W. H. Lewis, *H. peninsularis* (Brandg.) W. H. Lewis, *H. arenaria*, *H. gracilenta* (I. M. Johnst.) W. H. Lewis, *H. umbratilis* (Robins.) W. H.

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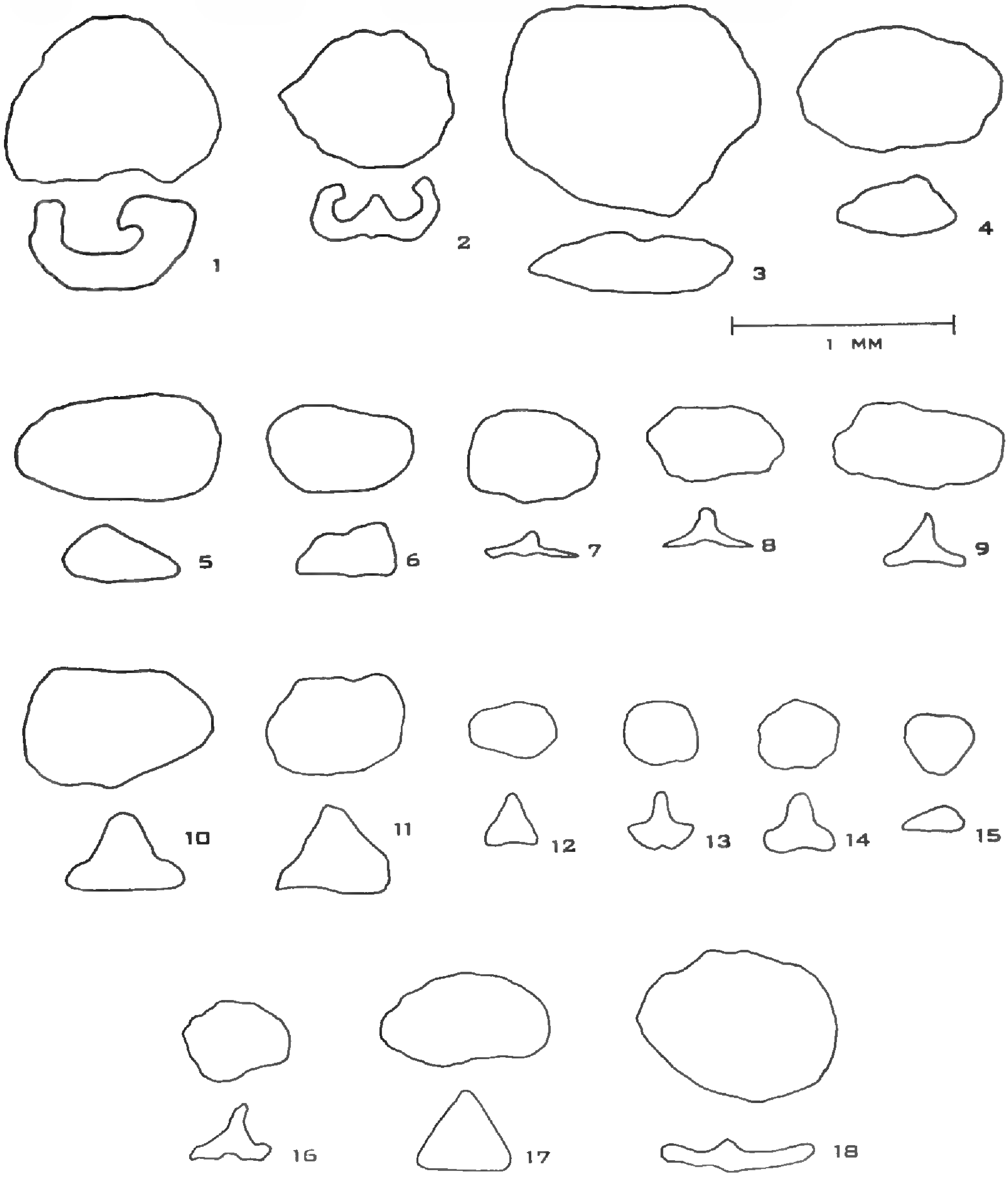
[2] The North American *Houstonia* and *Oldenlandia* are discussed at the rank of subgenus so that the accepted nomenclature for *Hedyotis* can be used. Only one of the Afro-Asian species used in evidence here has been transferred to *Hedyotis*. Because a detailed study of the more numerous Old World species was not attempted, a change in nomenclature at this time is premature and all species and the subg. *Orophilum* Brem. are retained under *Oldenlandia*.

Lewis (fig. 6-11), and several additional species not illustrated. Although the seeds of subg. *Houstonia* tend to be larger than those of subg. *Oldenlandia*, a discontinuity in size does not exist.

The species of subg. *Houstonia* are described as having dorsiventrally flattened seeds with distinct craters varying to concavo-convex and with hilar ridges on the ventral face. Near median sections of *H. crassifolia* Raf. and *H. wrightii* (Gray) Fosb. seeds are typical representatives (fig. 1-2). Those of subg. *Oldenlandia* do not have seeds dorsiventrally flattened, craterformed, concavo-convex, nor ventrally ridged, but rather they are angular or more rarely subglobose (fig. 12-14). These descriptions, however, are not always applicable. The seeds of *H.* (*Houstonia*) *mullerae* Fosb. (fig. 4), *H. brevipes* (fig. 5), and *H. asperuloides* (fig. 6) are not strongly dorsiventrally flattened, but are ± angular; those of *H. arenaria* (fig. 9), *H. gracilenta* (fig. 10), and *H. umbratilis* (fig. 11) are angular. None are craterform and all lack hilar ridges. An intermediate seed type with only a shallow ventral groove may be noted for *H. serpyllacea* Schl. (fig. 3). On the other hand, the ± dorsiventrally flattened seeds of *H.* (*Oldenlandia*) *callitrichoides* (Griseb.) W. H. Lewis (fig. 15) and the concavo-convex seeds of *H. microtheca* (fig. 18) with hilar ridges hardly match the characteristics of the subg. *Oldenlandia*. Such variability is not restricted to the American species, for the African *O. divaricata* Engl., *O. benguillensis* Hiern, *O. luzuloides* Schum., and *O. micrantha* Chiov., all possess dorsiventrally flattened seeds.

It is unfortunate that, in the Rubiaceae, there are a number of characters in general use which, for practical taxonomic purposes, are difficult to utilize (Verdcourt, 1958). Among these I include the endosperm of small seeds. Most species of subg. *Houstonia* have corneous endosperms, but among the exceptions are *H. arenaria*, *H. saxatilis*, and *H. brevipes*, whose endosperms are decidedly fleshy. Those of *H. (Houstonia) gracilenta* and *H. (Oldenlandia) callitrichoides* are intermediate in texture, while the seeds of *H. mi-*



Figs. 1-18. Outlines and near median sections of *Hedyotis* seeds, Figs. 1-11 subg. *Houstonia*, Figs. 12-18 subg. *Oldenlandia*. Fig. 1. *H. crassifolia* Raf.; fig. 2. *H. wrightii* (Gray) Fosb.; fig. 3. *H. serpyllacea* Schl.; fig. 4. *H. mullerae* Fosb.; fig. 5. *H. brevipes* (Rose) W. H. Lewis; fig. 6. *H. asperuloides* Benth.; fig. 7. *H. saxatilis* W. H. Lewis; fig. 8. *H. peninsularis* (Brandg.) W. H. Lewis; fig. 9. *H. arenaria* (Rose) W. H. Lewis; fig. 10. *H. gracilenta* (I. M. Johnst.) W. H. Lewis; fig. 11. *H. umbratilis* (Robins.) W. H. Lewis; fig. 12. *H. corymbosa* (L.) Lam.; fig. 13. *H. pringlei* (Robins.) W. H. Lewis; fig. 14. *H. herbacea* L.; fig. 15. *H. callitrichoides* (Griseb.) W. H. Lewis; fig. 16. *H. watsonii* W. H. Lewis; fig. 17. *H. greenei* (Gray) W. H. Lewis; fig. 18. *H. microtheca* (Schl. & Cham.) Steud. Drawn with the aid of a camera lucida at ×24 reduced by one-half in reproduction.

crotheca, *H. watsonii*, and *H. pringlei* (Robins.) W. H. Lewis are corneous, contrary to the typification of subg. *Oldenlandia*. This feature is at best a generalization with fleshy, intermediate, and corneous endosperms known to each subgenus.

FRUIT. The eastern North American species of subg. *Houstonia* often have capsules one-half or frequently less than one-half inferior. From these first described species, the taxon was sharply separated from its closest relatives and even removed from the Rubiaceae (to the Gentianaceae, DC. Prodr. 4: 622, 1830). The study of the southwestern species, in particular *H. arenaria*, *H. asperuloides*, *H. gracilenta*, *H. mucronata* Benth., *H. greenmanii* Fosb., *H. serpyllacea*, and *H. subviscosa* (Wright ex Gray) Shinners, has shown that the subg. *Houstonia* capsules may be entirely or almost entirely inferior, i.e., not more than one-sixth free. Although the subg. *Oldenlandia* capsules are rarely free, the American *H. microtheca* and *H. watsonii* and the African *O. juncoides* Schum. and *O. staelioides* Schum. are not wholly inferior and are indistinguishable from those of the subg. *Houstonia* species mentioned.

FLOWER. At least one American species, *H.* (*Oldenlandia*) *pringlei*, is dimorphic, as are the flowers of *O. affinis* (R. & S.) DC., *O. umbellata* L., *O. verticillata* Bullock ex Brem., *O. somala* Chiov., and *O. eludens* Brem. from Afro-Asia. Perhaps a greater per cent of species in the subg. *Houstonia* possess this characteristic than is known for subg. *Oldenlandia*, but such a tendency has little taxonomic value.

Many Mexican and eastern North American species under subg. *Houstonia* have rather elongate corollas, while the two widely distributed species of subg. *Oldenlandia* in North America, *H. boscii* DC. and *H. uniflora* (L.) Lam., have insignificant, minute corollas. The corollas of *H.* (*Houstonia*) *australis* Lewis & Moore, *H. croftiae* (Britt. & Rusby) Shinners, *H. intricata* Fosb., *H. greenmanii* Fosb., and *H. subviscosa*, however, rarely exceed 2 or 3 mm. in length and are about equal to those of the typical subg. *Oldenlandia* species. In contrast, *H. (Oldenlandia) pringlei* (5-8 mm.) and *H. xestosperma* (Robins. & Greenm.) W. H. Lewis (7-9 mm.)

from Mexico and *O. cryptocarpa* Chiov. (tube, 6 mm.), *O. hymenophylla* Brem. (tube, 7 mm.), and *O. sepaneoides* Schum. (tube, 7 mm.) from Africa have long corollas about equal to the longest in subg. *Houstonia.*

No character currently in use separates the *Houstonia* from the pantropical *Oldenlandia*, and at best only tendencies are expressed. In his revision of the African species, Bremekamp (1952) has chosen, usually with considerable hesitation, to establish genera for those species varying by one or more "key" characters. Although fewer taxa are indigenous to North America, at least 4 additional genera would be required to accommodate those species morphologically between the (artificial) limits established for typical *Houstonia* and the North American *Oldenlandia.* Since the major characteristics of several species exhibit continuous ranges, even this procedure would not place all taxa in definite niches, and for this reason alone, such a generic realignment would ultimately collapse.

On the basis of morphological and the supporting, though incomplete, cytological data (Lewis, 1959), the two genera are merged under *Hedyotis* following Torrey & Gray (1841), Fosberg (1941, 1954), and Shinners (1949). Most taxa have been transferred to *Hedyotis,* but a number of new combinations must be made to complete this transfer for the North American species.

HEDYOTIS subgenus HOUSTONIA (L.) Gray

HEDYOTIS ARENARIA (Rose) W. H. Lewis, comb. nov., based on *Houstonia arenaria* Rose, Contr. U. S. Nat. Herb. **1**: 70, 1890.

HEDYOTIS ASPERULOIDES Benth., f. BRANDEGEANA (Rose) W. H. Lewis, comb. nov., based on *Houstonia brandegeana* Rose, Contr. U. S. Nat. Herb. **1**: 70, 1890. Distinguished from the typical form by its fine, delicate stems and slightly smaller (1-2 mm.) capsules which are ± equal in width and length.

HEDYOTIS BREVIPES (Rose) W. H. Lewis, comb. nov., based on *Houstonia brevipes* Rose, Contr. U. S. Nat. Herb. **1**: 83, 1890.

HEDYOTIS DRYMARIOIDES (Standl.) W. H. Lewis, comb. nov. based on *Houstonia drymarioides* Standl., Jour. Wash. Acad. Sci. **18**: 162, 1928.

HEDYOTIS EXIGULA W. H. Lewis, nom. nov., based on *Houstonia gracilis* T. S. Brandg., Zoe **5**: 238, 1907. Not *Hedyotis gracilis* DC., Prodr. **4**: 419, 1830.

Hedyotis gracilenta (I. M. Johnst.) W. H. Lewis, comb. nov., based on *Houstonia gracilenta* I. M. Johnst., Proc. Calif. Acad. Sci. IV. **12**: 1174, 1924.

Hedyotis longipes (S. Wats.) W. H. Lewis, comb. nov., based on *Houstonia longipes* S. Wats., Proc. Amer. Acad. **18**: 97, 1883.

Hedyotis nigricans (Lam.) Fosberg, f. **salina** (Heller) W. H. Lewis, comb. nov., based on *Houstonia salina* Heller, Bot. Expl. S. Tex. (Contrib. Herb. Franklin & Marshall College 1): 96, 1895.

Hedyotis palmeri (Gray) W. H. Lewis, comb. nov., based on *Houstonia palmeri* Gray, Proc. Amer. Acad. **17**: 202, 1882.

Hedyotis peninsularis (T. S. Brandg.) W. H. Lewis, comb. nov., based on *Houstonia peninsularis* T. S. Brandg., Zoe **5**: 160, 1903.

Hedyotis saxatilis W. H. Lewis, nom. nov., based on *Houstonia australis* I. M. Johnst., Univ. Calif. Publ. Bot. **7**: 446, 1922. Not *Hedyotis australis* Lewis & Moore, Southwest. Nat. **3** (1958): 208, 1959.

Hedyotis sinaloae W. H. Lewis, nom. nov., based on *Houstonia parvula* T. S. Brandg., Zoe **5**: 221, 1905. Not *Hedyotis parvula* (Gray) Fosberg, Bull. Bishop Mus., Honolulu, no. **174**: 54, 1943.

Hedyotis umbratilis (Robins.) W. H. Lewis, comb. nov., based on *Houstonia umbratilis* Robins., Proc. Amer. Acad. **45**: 401, 1910.

Hedyotis vegrandis W. H. Lewis, nom. nov., based on *Houstonia prostrata* T. S. Brandg., Zoe **5**: 105, 1901. Not *Hedyotis prostrata* Korth., Nederl. Kruidk. Arch. II. **2**: 160, 1851.

HEDYOTIS subgenus OLDENLANDIA (L.) Fosberg

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Hedyotis capillipes (Griseb.) W. H. Lewis, comb. nov., based on *Oldenlandia capillipes* Griseb., Cat. Pl. Cub. 130, 1866. Not *Hedyotis capillipes* Schl. ex Hook. f., Fl. Brit. Ind. **3**: 73, 1880, pro syn.

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DRABA APRICA IN OKLAHOMA

Reed C. Rollins

It is often said among botanists that rare plants receive an unwarranted amount of attention and by and large this appears to be true. Some of the stimulus for this is to be associated with the attraction of novelty for its own sake but I am convinced that a real desire to make rarities more generally known or to clear up doubtful information is often basic to the attention given. A case in point as to the latter has to do with *Draba aprica* Beadle. This little annual crucifer was first discovered by Thomas Nuttall in Arkansas in 1819 and later published for Nuttall by Torrey and Gray (1838) as *Draba brachycarpa* Nutt. *β fastigiata* Nutt. The same plant was found on Kenesaw Mt., near Marietta, Georgia, and described for Beadle by Small (1913) as *D. aprica* without reference to the earlier varietal name of Nuttall.

When Fernald (1934) was working on *Draba* in the early 1930's, he stimulated L. M. Perry to search for this species on Kenesaw Mt., since it had not been recollected in the intervening years. The results were two collections by Perry and Myers in May, 1934. In his writeup of *D. aprica*, Fernald (l.c.) raised the question as to whether *D. brachycarpa* var. *fastigiata* and *D. aprica* were one and the same thing. The problem at that time also involved the question as to whether the material of Nuttall described as var. *fastigiata* really came for Arkansas or was an inadvertent mixture, on the same sheet at the New York Botanical Garden, of Georgia material from other collections. Fernald assumed that the specimen at New York is the type (holotype) of *D. brachycarpa* and that the type (holotype) of var. *fastigiata* is on the same sheet. Just to put the record straight in one respect, the holotype of *D. brachycarpa* is at the British Museum. A photograph of it and an isotype are in the Gray Herbarium. The holotype of *D. brachycarpa* var. *fastigiata* should also be at the British Museum but I was unable to find it there on one of my visits. Perhaps the New York specimens are, in fact, the holotype in the latter case. Although he was wrong about the actual location of the holotype of *D. brachycarpa*, Fernald did call attention to the need of a search for *D. aprica* (*D. brachycarpa* var. *fastigiata*) in Arkansas to clear up the confusion as to the area of origin of Nuttall's material.

Steyermark (1940) came through with the discovery of *Draba aprica* in the Ozarks of southeastern Missouri, demonstrating that the species still occurs in territory at least adjacent to that of Nuttall's travels. If any doubt remains that the plant might occur where Nuttall went on his famous excursion up the Arkansas River, it should be completely dispelled by a collection made by Kenton Chambers and me in 1957. We had stopped a few miles north of Broken Bow in extreme southeastern Oklahoma to try for cytological material of the then recently described *Streptanthus squamiformis* Goodman (1956). In the same area with the *Streptanthus* on an open knoll sparsely covered with dwarfed oaks and pines, we found more than a dozen plants of *Draba aprica*. In the collection (*Rollins and Chambers 5762*, 3.7 miles north of Broken Bow, McCurtain Co., Oklahoma, April 13, 1957; GH), we inadvertently included two plants of *D. brachycarpa.* Our collecting experience with these two species was similar to that of Nuttall, who one hundred and thirty-eight years earlier had mixed the two species in a collection that was primarily *D. brachycarpa,* with only a few plants of *D. aprica* included. Steyermark (l. c.) similarly found *D. brachycarpa* and *D. aprica* growing at the same site. Aside from showing that *D. aprica* is to be included in the Oklahoma flora, our collection is notable in that it is the only one since Nuttall's day from the area where he originally found it.

Hitchcock (1941) has suggested that *Draba aprica* is indeed only a variety of *D. brachycarpa,* as originally proposed by Nuttall and published by Torrey and Gray. However, I disagree with this conclusion. The larger and fewer seeds; the more elongate, densely pubescent instead of glabrous siliques; the characteristic shortened branches and condensed infructescences; and the dentritic instead of cruciform trichomes of the leaf-surfaces are all distinctive features of *D. aprica.* A further suggestion that *D. aprica* might be a polyploid form because of the larger fruits and seeds seems unwarranted in view of the fact that the trichomes are much smaller than in *D. brachycarpa* and might with the same justification be interpreted as evidence for the opposite viewpoint. — GRAY HERBARIUM OF HARVARD UNIVERSITY.

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GISEKIA PHARNACIOIDES, A NEW WEED

R. K. GODFREY[1]

The loose recently tilled sandy soils of a number of orange groves in Orange County, central peninsular Florida, are presently inhabited by large numbers of plants of *Gisekia pharnacioides* L. (Phytolaccaceae). This is an Old World annual plant much resembling *Mollugo verticillata* L. in habit and certain superficial characteristics. It has not been previously reported as a naturalized introduction to this continent and I have no information as to when it first appeared or by what means it was introduced. I first saw the plant in a single orange grove in the summer of 1958. Later in that year Professor Erdman West, University of Florida, Gainesville, told me that a plant of this species had recently been sent to him for identification from an orange grove in the vicinity of Lake Alfred, Polk County, Florida. Travelling through central Florida in the summer of 1961, I saw it in numerous orange groves in the general vicinity of my first collection, between Oakland in Orange County and the Oceola County line, but did not see it elsewhere.

Although this weed appears to flourish in cultivated, loose sands much as do *Mollugo verticillata*, *Diodia teres* Walt., and other annuals, it would not appear to be any more of a problem agriculturally than are other such ubiquitous weeds.

There are several species of *Gisekia* which occur in different parts of the Old World. Specimens of our plants were sent to Dr. Carroll E. Wood, Jr., Harvard University, who very kindly compared them with specimens at the Gray Herbarium. He said that ours best matched specimens of *Gisekia pharnacioides* from India.

Citations for my specimens are: Orange County, Florida: locally abundant in an orange grove, 5 miles south of Oakland, Aug. 8, 1958, *Godfrey 57373;* abundant, loose sandy soil, orange grove, 3 miles north of jct. Fla. Rt. 530 and 545, south of Oakland, *Godfrey and Reinert 61029.*

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Gisekia pharnacioides is a somewhat succulent, glabrous annual with several subequal prostrate principal branches spreading radially from the base. The leaves are opposite, the branching is opposite except as one of the two laterals may fail to develop. Leaves short-petioled, narrowly lanceolate, elliptic-lanceolate, or linear-oblong, entire; midvein prominent below, depressed above, lateral veins scarcely evident; upper leaf surface deep green, finely punctate, the lower pale green, somewhat roughly granular-punctate; lowermost margins of the blades with translucent band-like edges which are decurrent on the petiole thence across the

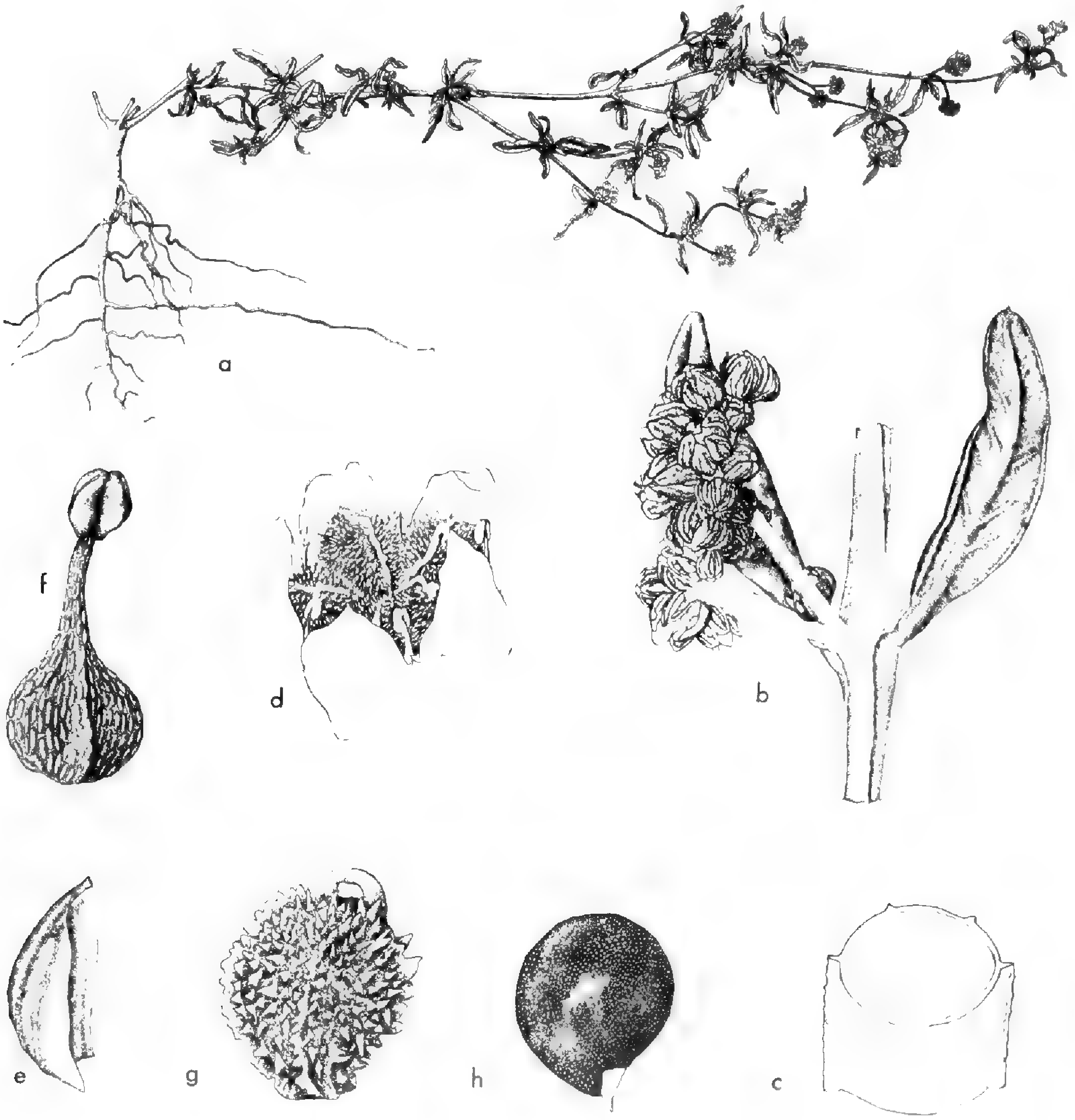

FIG. 1. *Gisekia pharnacioides.* a. Habit, all except one branch removed. b. Node with an axillary dichasium. c. Outline of cross-section of stem. d. Flower. e. Sepal. f. Stamen. g. Ovulary. h. Seed.

swollen nodes and finally decurrent along the stem as narrow pebbly ribs to the next node. The stem body is essentially terete aside from the four ribs which are more or less obscured in drying; between the ribs lesser striae are sometimes evident. The stems are reddish in color.

Inflorescences are axillary dichasia and are produced more or less throughout the branches, the terminus of each major branch ending in a dichasium. In a given axil, the dichasium consists of a solitary short-stalked central flower with two lateral compact, compound, stalked dichasia, the stalks up to 1-2 cm. long but frequently very unequal in length. Each of the laterals is subtended by a subulate bract.

Individual flowers are small, about 2 mm. long. The calyx is comprised of five boat-like sepals, white-hyaline along their lower margins, and pink-hyaline at their obtuse tips. No corolla is present. Stamens five, alternating with the sepals and about equalling them in length, the filaments translucent, much dilated at the base and abruptly narrowed upward, the anthers white. Carpels five, free, flattened, oblique relative to positions of attachment and of the stigma, but nearly circular in outline; carpel wall thin, translucent or almost transparent but densely clothed with white, thickish, spicule-like, but soft protuberances, somewhat erose-winged along the flattened margins. Style soft and flat, short, arising obliquely and incurving over the summit of the ovulary, stigmatic at the tip. Ovules one in each carpel. In fruit, the ovulary wall is thin and virtually transparent but the dried protuberances of its surface make it appear coarsely granular. The seed is oblique-lenticular, nearly circular in outline, very dark brown or black, its surface lustrous and finely punctate, so closely enveloped by the thin ovulary wall that it shows through.

Individual plants vary greatly in size as is characteristic of many kinds of annuals. Where they grow very thickly, individuals are small, the branches tending to be ascending. Isolated plants are in general much more vigorous, have branches 6-8 dm. long, perhaps more, and are definitely prostrate. — DEPARTMENT OF BIOLOGICAL SCIENCES, FLORIDA STATE UNIVERSITY, TALLAHASSEE.

HETEROSTYLY AND HOMOSTYLY IN LITHOSPERMUM CANESCENS (BORAGINACEAE)

H. G. BAKER

In the Boraginaceae, heterostyly of the distylous type was first investigated experimentally by Hildebrand (1864, 1865) and Darwin (1877) who both worked with species of *Pulmonaria*. Its occurrence in the family, however, had been noticed earlier by Torrey (1856), especially in *Amsinckia*, and Gray (1859) records it for *Lithospermum*. Much more recently, Johnston (1952), in his taxonomic survey of *Lithospermum*, took care to distinguish heterostylous from homostylous species and used the distinction in his key for their identification. However, no experimental work has been done on this genus so that our knowledge of the population biology of its species is still at a primitive level. Therefore, it is of interest that two works published by nineteenth century botanists dealing with heterostyly in *Lithospermum canescens* (Michx.) Lehm., one of the showy North American species, appear to have remained unknown to twentieth century writers on the genus even though they contain items of considerable moment.

The first of these neglected works is by Erwin Smith (1879). This is of more than merely historical interest because it also records the existence of homostylous plants of *L. canescens* amongst the plants which he collected in Michigan. In Johnston's recent treatment, *L. canescens* was considered to be exclusively heterostylous and, indeed, no other species of the genus has been recorded as containing indisputably heterostylous and homostylous plants. This need not be surprising for Baker (1960) has given reasons for believing that speciation is likely to follow quickly after a change in breeding system (and heterostyly promotes allogamy while derived homostyly is generally associated with a greatly increased proportion of autogamous seed-production).

Translating Smith's remarks on proportions into percentages, it would seem that roughly 59% of the plants which he saw were short-styled (with stamens inserted at the mouth of the corolla-tube) while only 39% were long-styled. In the long-styled plants the length of the style varied from being included within the corolla-tube to being conspicuously exserted, an appearance which could result from the sampling of flowers of different ages should there be a differential elongation of corolla-tube and style during maturation of the flower. The remaining 2% of plants would be classified nowadays as "short-homostyles". Even these showed some variability, the anthers standing either at the level of the stigmas or just above them. Particularly striking, however, was a tiny proportion of homostylous plants in which the stamens are inserted at two levels, two of them above the stigma and three on a level with it.

The accuracy of such an observation is testified to by the subsequent description of an unequal (or zonal) insertion of stamens by Johnston (1952) in *Lithospermum tournefortii* Johnston (heterostylous) and *L. decumbens* Vent. (probably homostylous), as well as in several other genera of the Boraginaceae. However, it is in the published accounts of the floral structure of *Amsinckia lunaris* Macbr. (Macbride, 1917; Suksdorf, 1931; Ray and Chisaki, 1957) that the closest parallel may be seen. Here, probably as in *Lithospermum canescens*, a heterostylous species has produced a homostylous variant in which the stamens are inserted at two levels, one of them corresponding with the height of the stigma and almost certainly leading to a high proportion of self-pollination. In *Amsinckia lunaris*, according to Ray and Chisaki, the pollen grains from the two lower anthers are smaller than those from the upper trio (which may function in cross-pollination). It would be most interesting to know if a similar situation obtains in the unusual plants of *Lithospermum canescens*.

In view of this report of homostylous plants of *L. canescens* from Michigan, a survey was made of the floral structure of specimens from a variety of States in the herbaria at the University of California, Berkeley, and at

Stanford University. Also Dr. Paul Grun and Dr. R. B. Channell kindly made observations on material at Pennsylvania State and Vanderbilt Universities, respectively. Unfortunately, no homostylous specimens were found. Overall, however, 39 short-styled plants were observed along with 24 long-styled. This preponderance of short-styled plants tallies with Smith's (1879) observation from Michigan. If field-studies should show this to be a regular feature of naturally occurring material, it might be interpreted most reasonably as indicating that some self-pollination occurs (otherwise the two forms might be expected to occur in roughly equal numbers). A preponderance of short-styled plants could be produced if this type is self-pollinated considerably more frequently than is the case with the long-styled form, through pollen falling down the corolla-tube. Another possible cause of such a disparity in numbers, although of lesser likelihood, would be that both forms are selfed with roughly equal frequency but that the allele producing the long-styled condition is the genetical dominant. On selfing the heterozygous form produces both kinds in its progeny while the homozygous recessive form produces all recessives, creating an excess of this form. However, in almost all cases where the genetics of a distylous system is known it is the short-styled form which is genetically dominant (cf. Lewis, 1954). Only in the Plumbaginaceae is there good reason to believe that the opposite is true (Baker, 1954 and unpub.), and preliminary results for the Boraginaceae from the genus *Amsinckia* (Ray and Chisaki, 1957), as well as a modern interpretation of Darwin's (1877) results with *Pulmonaria*, both suggest a contrary situation; that the short-styled condition is dominant.

Another, apparently unique, feature of heterostyly in *Lithospermum* in a difference in *shape* between the pollen of long-styled and short styled plants. To Johnston (1952), his discovery of this shape-difference correlated with heterostyly demonstrated "a type of pollen dimorphism previously unreported." However, in 1880, in the second of these neglected papers, C. E. Bessey described heterostyly in material of *L. canescens* from central Iowa and included not only statistics on the sizes of the pollen grains of the two kinds of plants but also these comments on their shapes, "pollen grains ovoidal, slightly constricted in the middle" (on short-styled plants) and "pollen grains oblong, much constricted in the middle" (on the long-styled plants). The descriptions accord quite well with Johnston's more detailed observations made three-quarters of a century later.

This overlooked, earlier description of pollen shape differences associated with heterostyly recalls that dimorphism in sculpturing of the grains was described as a part of flower dimorphism in the Plumbaginaceae by Macleod in 1887, but that this lay unused until Kulczyński (1932) applied it to the identification of fossil pollen. Actually, neither Bessey's nor Macleod's description of pollen dimorphism was the first report of such a phenomenon, for it had been seen in the Rubiaceae as early as 1868 by F. Müller (1869), the significance of this demonstration remaining unnoticed until recently (Baker, 1956).

In fact, Bessey's short paper was more concerned with a description of the variable relationship between stamen and style lengths in another species, *Lithospermum longiflorum* Pursh (which is now considered synonymous with *L. incisum* Lehm.). In this species, Bessey considered that heterostyly might be in process of development. However, in view of its production of cleistogamic flowers on a regular seasonal basis, it seems more likely that his alternative suggestion, that this is a species which has moved toward inbreeding rather than away from it, is the correct one.

However, had Bessey made his observations just a few years sooner, it is unlikely that they would have been relegated to the obscurity which has been their fate. On May 22, 1877, Asa Gray wrote to Charles Darwin saying, "I asked my good correspondent Prof. Bessey to see if *Lithospermum longiflorum (= angustifolium)* being cleistogamous later, is, like its relatives, also dimorphous. Here is his first reply just in season to send you by this post. I forgot to ask him to examine *pollen.* I will do so" (unpub. letter in Gray Herbarium, quoted from microfilm copies kindly lent by Dr. Hunter Dupree).

Darwin replied on June 4, 1877, in a letter which, because it does not mention the genus involved, has always been a mystery (cf. transcript in Holbrook, 1939). Now, we can see that it was to *Lithospermum incisum* that Darwin was referring when he wrote, "Prof. Bessey's case has come too late, as the sheets on this subject are printed .... The pollen grains and stigmas ought to be compared. The case seems to be well worth careful investigation and I would have given my eyes for seeds formerly; but now I have done with the subject." He went on to give instructions for Bessey on methods of observation and experimentation and point out that, "the case may be one merely of great variability or it may be one of incipient heterostylism." Bessey appears to have given some heed to the instructions because his paper did not appear till three years later. Meanwhile, Darwin (1877) had published the famous book to which he was making reference in his letter — "The Different Forms of Flowers on Plants of the Same Species."

Surprisingly, Asa Gray, himself, never made a clear statement on dimorphism in *L. canescens.* In the "Synoptical Flora of North America" (Gray, 1878, and subsequent editions) his sole comment reads, ". . . in one form style about the length of the tube and stamens, inserted below its middle." Even with the deletion of the comma, one is merely left to infer the existence and appearance of a second form.

Knuth (1899, page 120; in translation 1909, page 137) added to the camouflage of Bessey's discovery by giving an erroneous reference in the statement, "Darwin describes the flowers of this species [*L. canescens*] as either heterostylous or very variable in regard to the length of the style." Actually, Darwin never described the heterostylism of any species of *Lithospermum* and, in all probability, the statement should have referred to Bessey and to *L. incisum*! Similarly, Knuth credits Darwin with a description of cleistogamous flowers in *L. incisum* (Knuth, 1899, page 120, as *L. longiflorum* Pursh; in translation 1909, page 137, as *L. angustifolium* Michx.). Once again the credit should have been Bessey's. On another page, however, although rather inconspicuously, the same author does give Bessey credit for having seen heterostyly in *L. canescens* (Knuth, 1898, page 62; in translation 1906, page 50).

Thus, despite a history of confusion and neglect lasting for the larger part of a century, the reproductive biology of *Lithospermum canescens* is commended to the attention of field-botanists and experimentalists living within its geographical range in the eastern half of North America. This species promises to reward the student of natural populations through variations in the proportions of the various flower-forms and the genetical studies which these may make feasible. — BOTANY DEPARTMENT, UNIVERSITY OF CALIFORNIA, BERKELEY, CALIFORNIA.

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A NEW SPECIES OF PANICUM FROM NEW JERSEY

Jason R. Swallen

A specimen of *Panicum* was received recently for identification from Bayard Long of the Academy of Natural Sciences of Philadelphia, which has proven to be new. It was collected by Frank Hirst, an active amateur botanist in southern New Jersey, who recognized it as an unusual plant, and in whose honor the species is named. "It occurs dominantly in a small woodland pond in the pine barrens — growing in the water, much as Panicum spretum often does. This is a most interesting pond, the Panicum being associated with Lobelia boykinii, Paspalum dissectum, Coreopsis rosea, etc."

Panicum hirstii Swallen, sp. nov.

Culmi 55-80 cm. alti, ramosi, glabri; ligula brevis, ciliata; laminae acuminatae, adscendentes, usque ad 11 cm. longae, 3-5.5 mm. latae, glabrae; panicula angustissima, usque ad 9 cm. longa; spiculae 1.8-2.1 mm. longae, glabrae; gluma prima obtusa enervis.

Culms 55-80 cm. tall, erect or ascending, glabrous; sheaths mostly shorter than the internodes, glabrous or sparsely pilose on the margins near the summit, the uppermost usually elongate; ligule a dense line of hairs, 0.5 mm. long; blades stiffly erect or narrowly ascending, 4.5-11 cm. long, 3-5.5 mm. wide, flat, acuminate, glabrous, often tinged with purple; panicles 4.5-9 cm. long, about 5 mm. wide, the branches as much as 2.5 cm. long, appressed, smooth or scaberulous; spikelets 1.8-2.1 mm. long, glabrous, the pedicels appressed, usually a little shorter than the spikelets; first glume broadly obtuse, nerveless, 0.5-0.8 mm. long; second glume and sterile lemma with hyaline margins, the lemma cucculate, subacute, as long as the fruit, the glume broadly obtuse, a little shorter than the fruit; fruit subacute, obscurely roughened, pale or yellowish. Autumnal phase sparingly branching from most of the nodes, the leaves and panicles not much reduced.

Type in the U. S. National Herbarium No. 2,306,491, collected in Leipzig Ave. Pond, Germania, Atlantic Co., New Jersey, June 7, 1959, by Frank Hirst (No. 47).

Additional material examined: NEW JERSEY: In water of small woodland pond, pine barrens, in Galloway Township, southeast of Egg Harbor City (this is the same locality as the one where the type was collected, fide Bayard Long), August 11, 1959, *Bayard Long 85320.* GEORGIA: Margin of pine-barren pond, Sumter County, August 23, 1900, *Roland M. Harper 458;* Cypress swamp, 1 mile north of Leary, Calhoun County, May 31, 1947, *Robert H. Thorne 4313.*

Harper 458 was doubtfully referred to *Panicum roanokense* Ashe by Hitchcock and Chase in their revision of *Panicum* (Contr. U. S. Nat. Herb.15: 197. 1910). *P. hirstii* is readily distinguished from *P. roanokense*, however, by the very narrow panicles with relatively short-pedicelled spikelets, the shorter second glume, and the sparingly branching culms, the autumnal blades and panicles scarcely reduced. — DEPARTMENT OF BOTANY, U. S. NATIONAL MUSEUM, SMITHSONIAN INSTITUTION, WASHINGTON, D. C.

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EVIDENCE FOR THE HYBRID ORIGIN OF SCIRPUS PECKII

ALFRED E. SCHUYLER

On the basis of current morphological, cytological, and ecological studies by the author, the sedge *Scirpus peckii* Britt. appears very likely to be a hybrid between *Scirpus atrovirens* Willd. of section Taphrogeton, and either *Scirpus atrocinctus* Fern. or *Scirpus pedicellatus* Fern. of section Trichophorum. Although *S. peckii* has had a rather complicated history according to the taxonomic literature (Brainerd, 1901), there has been little question in the past about regarding it as a distinctive species. Fernald stated (1900) that, "It is a very handsome and unique plant, not closely related to any described species." It is paradoxical that he also described one of the probable parents of *S. peckii* in the same paper. Fernald (1950) considered *S. peckii* to belong to still another section than those already mentioned, section Androcoma, while admitting (1900) that it had some characteristics of section Trichophorum.

MORPHOLOGICAL EVIDENCE

In order to discuss these plants in detail, I prefer to use comparative descriptive terms rather than quantitative terms. It should be borne in mind that these comparative terms only apply to *S. atrovirens*, *S. atrocinctus*, *S. pedicellatus*, and *S. peckii*.

Scirpus atrovirens, one of the putative parents, produces culms from an underground rhizome with relatively long internodes (Plowman, 1906). The leaves, involucral bracts, and scales have a comparatively low length/width ratio. The values for the bracts are expressed as quotients in table I. The scales have a conspicuous mucronate tip and are arranged in a steep spiral on the spikelet axis. The lateral rays of the inflorescence branch at relatively divergent, sometimes obtuse angles from the main rays. Bulblets often occur where the rays branch. The spikelets are arranged in compact glomerules, and all the flowers of the spikelet mature at about the same time. After the flowers mature, the spikelet ceases to grow. Hence, flowering and spikelet growth occur during a relatively short span of time. The flowers in the lower part of the spikelet generally have two stamens, although sometimes there are three. Toward the top of the spikelet, the flowers lack stamens. The perianth bristles are short and inconspicuous, and have downward protrusions called barbs.

Scirpus atrocinctus and *S. pedicellatus,* the other probable parents of *S. peckii,* are members of the *Scirpus cyperinus* (L.) Kunth complex. The plants of this complex, along with *Scirpus longii* Fern., are commonly called woolgrasses. Except for *S. longii,* I think it is better to regard these woolgrass types as conspecific and only varietally distinct. However I will treat them in the traditional manner for convenience in this paper. In New York and Vermont, *S. atrocinctus* usually occurs in the uplands, while *S. pedicellatus* usually occurs in stream and river valleys. Morphologically the two types are very similar; they differ mainly in color and size, *S. atrocinctus* is a slender plant with black scales, and *S. pedicellatus* is a robust plant with brown scales. Both types flower approximately at the same time as *S. atrovirens,* while *S. cyperinus (sensu stricto)* flowers later in the summer.

These two woolgrass types have underground rhizomes with short internodes (Plowman, 1906) and form large tussocks. The leaves, involucral bracts, and scales have a comparatively high length/width ratio. Unlike *S. atrovirens,* the scales do not have a conspicuous mucronate tip and they are arranged in a shallow spiral on the spikelet axis. The lateral rays branch at acute angles from the main rays and only rarely do bulblets occur where the rays branch. The spikelets are solitary and the flowers mature gradually from the base to the tip of the spikelet. The tip continues to grow over a relatively long span of time. The flowers in the lower part of the spikelet generally have 1 or 2 stamens, but higher in the spikelet, most flowers lack stamens. However, in contrast to S. *atrovirens*, there are a few bisexual flowers scattered throughout the upper part of the spikelet. The perianth bristles are long, conspicuous, and without barbs.

The suggested hybrid, S. *peckii*, produces culms in tussocks similar to S. *atrocinctus* and S. *pedicellatus*. The leaves, involucral bracts, and scales have a length/width ratio which is intermediate between S. *atrovirens* and the woolgrasses. The scales do not have a conspicuous mucronate tip, and are arranged in a spiral which is intermediate between the steep spiral of S. *atrovirens* and the shallow spiral of the woolgrasses. The lateral rays branch at angles which are intermediate between those of the probable parents. As in S. *atrovirens*, bulblets often occur where the rays branch. The spikelets may be solitary or may occur in small glomerules. At first, the spikelet appears to mature in the same manner as S. *atrovirens*, when about 25 flowers mature at about the same time. However, in contrast to S. *atrovirens*, the tip of the spikelet does not cease to grow, but continues

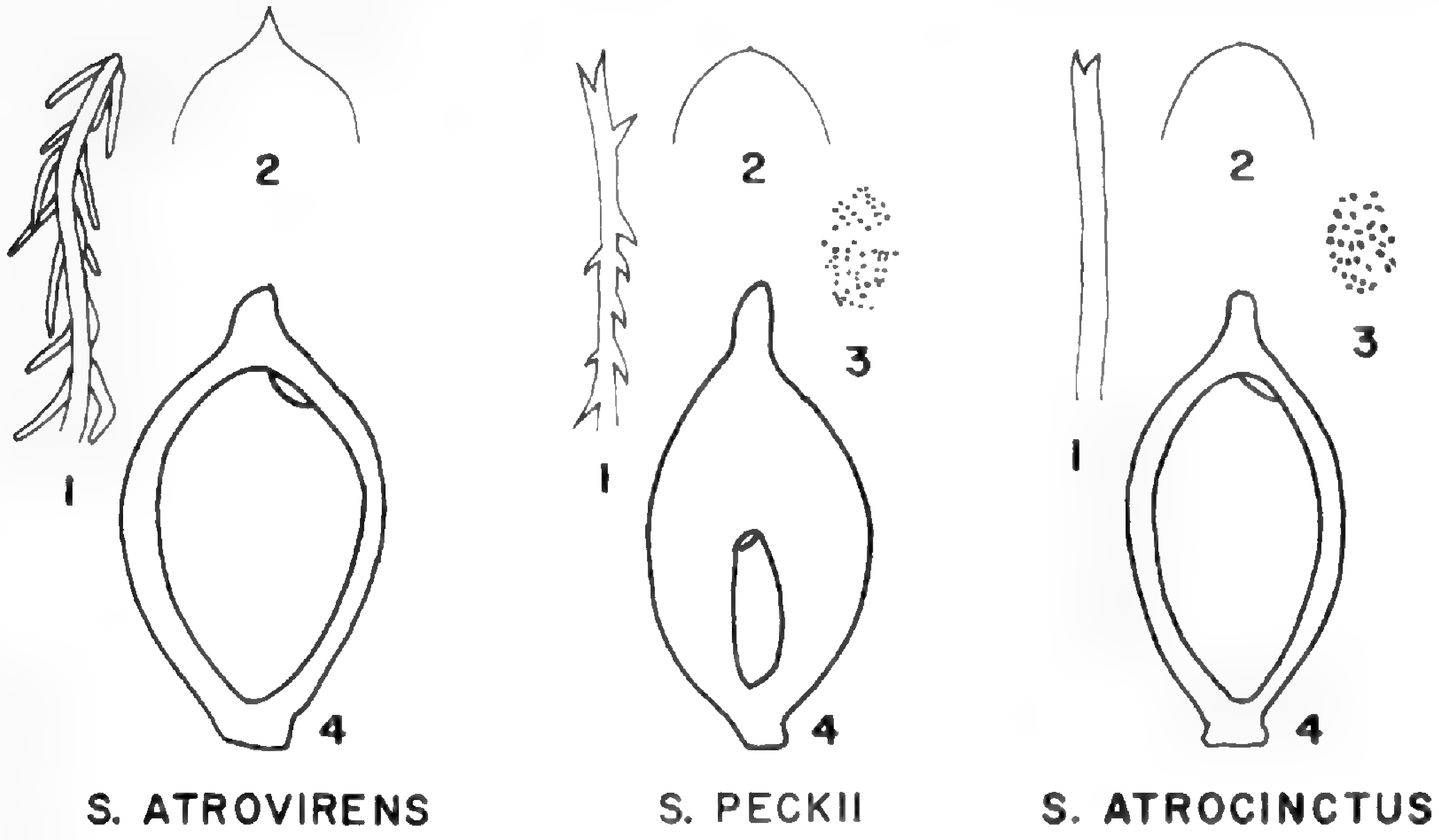

FIG. I. 1. Perianth bristles, x 47 2. Scale tips, x 12 3. Meiotic chromosomes, polar views, metaphase I, x 455 4. Fruits and inclosed seeds, x 34.5.

on to form another tier of flowers. The flowers in the lower part of each tier have two, or occasionally three stamens, and toward the top of each tier, the flowers lack stamens. In this respect, each tier shows a close resemblance to the entire spikelet of *S. atrovirens.* The perianth bristles are about twice as long as those of *S. atrovirens.* Like *S. atrovirens*, the bristles bear barbs, but they are not as long nor are they always protruding downward.

Scirpus peckii also appears to be intermediate between *S. atrovirens* and the woolgrasses on the basis of anther length, style length, and fruit length. However, the differences are minute, and my initial measurements are not complete enough to demonstrate this convincingly.

ECOLOGICAL EVIDENCE

From my observations of *S. peckii* in eleven localities in

TABLE I. A comparison of some characteristics of *Scirpus atrovirens, S. peckii, S. atrocinctus,* and *S. pedicellatus.*[1]

Character	*S. atrovirens*	*S. peckii*	*S. atrocinctus* *S. pedicellatus*
Growth form	Cespitose, but not tussock-forming	Tussocks	Tussocks
Color at base of lowest involucral bract	Green	Black or brown	Black or brown
Length divided by the width of the lowest involucral bract	16-30	32-53	43-87
Scale length	1.3-1.7 mm.	1.3-1.7 mm.	1.5-2.0 mm.
Scale tip	Mucronate	Mucronulate	Mucronulate
Spikelet arrangement	Glomerate	Solitary to sub-glomerate	Solitary
Flower maturation throughout the spikelet	Almost simultaneously	Gradually in tiers	Gradually
Bristle length	0.7-1.1 mm.	1.6-2.0 mm.	4.5-6.0 mm.
Bristle margin	Strongly barbed	Moderately barbed	Not barbed
Stamen number/ flower*	0, 2, (1), (3)	2, 0, 1, (3)	0, 1, 2

*arranged in order of their frequency of occurrence; parentheses indicate that the number is rarely observed.

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[1] The measurements included in this table came from 10 plants of *S. atrovirens*, 15 plants of *S. peckii*, and 15 woolgrass plants.

Vermont and New York, the following pattern appeared: *S. peckii* is widely distributed in these states, but rarely forms large populations; often only 1 to 5 tussocks are found in a particular locality. Further evidence pertaining to this distribution pattern has been provided by Ezra Brainerd (1901). He stated in regard to *S. peckii*, "In a drive of over seventy miles I found single plants of two or three culms each in six stations miles apart." Such an occurrence is unique among the leafy species of *Scirpus* which usually form sizeable populations. In the localities where I observed *S. peckii*, it was always associated with *S. atrocinctus* or *S. pedicellatus*, and, in all but two localities, *S. atrovirens* was also present. Furthermore, there was a morphological correlation between *S. peckii* and the woolgrass type in each locality. In localities where *S. atrocinctus* was the only woolgrass type, plants of *S. peckii* were slender, while in localities where *S. pedicellatus* was the woolgrass type, plants of *S. peckii* were more robust. In one locality, where both woolgrass types were present, both forms of *S. peckii*, the slender and the robust, were present. I think that the unique distribution pattern, and the morphological correlation of *S. peckii* with the associated members of the woolgrass group, give strong additional support for the hybrid origin of this species.

INDICATORS OF HYBRID STERILITY

Further evidence of the hybrid nature of *S. peckii* is provided by its pollen grains, chromosomes, and fruits. Almost all the pollen grains of *S. peckii* which I have observed, have highly distorted walls and their contents do not stain with aceto-carmine. They are in striking contrast to those observed from woolgrasses, which usually have undistorted walls and their contents readily stain with aceto-carmine. I have only been able to make an approximate determination of the chromosome number of *S. peckii*. There appear to be about 60 chromosomes in pollen mother cells undergoing meiosis. This number is approximately the sum of the hypothetical parents. *S. atrocinctus* has a haploid number of 34 and *S. atrovirens* has a haploid number of 25-30 (Hicks, 1928). The chromosome number of *S. pedicellatus* has not yet been determined. Also the units at meiotic metaphase in

S. peckii are smaller in size than those of *S. atrocinctus*. Because of their higher number and smaller size, I am inclined to regard the chromosomes of *S. peckii* as univalents. This condition would not be unusual in a hybrid between two fairly unrelated parents. All the fruits of *S. peckii* which I have observed, have lacked mature seeds. These abortive seeds lack mature embryos and an endosperm. Taxonomists have indirectly made use of these seedless fruits as a taxonomic character. Fernald (1950) mentions that the achenes are soft and whitish, and Gleason (1952) mentions that they are very pale. These characteristics are due to the lack of the yellow-brown seed which colors and fills the fruits in other leafy species of *Scirpus*.

CONCLUSIONS

In view of the evidence presented here, I am certain that this widespread northeastern species is really not so "unique" as it first appears. On the contrary, it appears to have achieved its unusual morphological characteristics by combining the characteristics of two well-known and distinctive species. It is very likely a sterile hybrid which arose, and probably is still arising, over the wide geographical area in which the common parents co-exist.

I am somewhat surprised that it has not previously been suggested that *S. peckii* is a hybrid. I think that the reason for this is due to the technical difficulties that we encounter while identifying many species-groups in the Cyperaceae. The search for differentiating characters has to be a critical one in order to make proper species identifications. However, a critical search for similarities has little value for identification purposes. Hence, we naturally tend to overemphasize differences and tend to ignore similarities which may have taxonomic significance. — UNIVERSITY OF MICHIGAN, ANN ARBOR.

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ENVIRONMENTAL VARIATION IN HETEROTHECA SUBAXILLARIS

C. John Burk

A weedy composite, *Heterotheca subaxillaris*, is a prominent member of the dune-grass community on Bogue Barrier, the most southern island of the North Carolina Outer Banks. The plant occurs not only on the open dunes, but also along roadsides and pathways through the shrub zone and into the pine-oak-hickory forest which covers those portions of the island which are most protected from salt spray. The plants on the dunes are low-growing, nearly prostrate forms. The plants in the pine-oak-hickory forest grow erect and to a height of a meter or slightly more. The plants occurring in the shrub zone are intermediate in size between these two extremes.

While most of these plants flower in late summer and early fall, one population (which occurred on both sides of the road adjacent to the bridge which connects the north end of the island with the mainland) was observed in flower all the year-round, some eighty plants being in full bloom on January 19, 1960. Most of the other *Heterotheca* plants on the island were in winter-rosette form at that time. The winter-flowering specimens resembled a plant described by Benke (1928) as *H. subaxillaris* var. *petiolaris*. They were shorter than typical *H. subaxillaris* and more densely pubescent. While a few of the flowering heads were aborted and deformed, most of the capitula were larger (more than a centimeter in diameter) than those of typical *H. subaxillaris*. They flowered on short branches sent up from a persistent rosette, and, as Benke had noted, were very similar in appearance to plants of the closely allied genus *Chrysopsis*.

Stem cuttings were made from portions of the basal rosettes of a number of these plants, and clonal pairs of cuttings were placed, one on short day (9 AM to 5 PM) and the other on long day (dawn to 11 PM) in the greenhouse at the University of North Carolina. Winter rosettes of typical *H. subaxillaris* had been brought into the greenhouse and placed on long and short days on December 9, 1959.

The winter rosette specimens flowered within two months on long day (2 plants); they did not flower at all on short day but remained in vegetative condition until early May of 1960 when the experiment was concluded. The clone-cuttings of the winter-flowering plants which had been placed on long day rooted quickly and began to flower within a month. The ones on short day rooted rather tardily. Many of the latter plants died. One of them flowered on April 26, 1959, and on May 2, two more plants were in bud out of a total of eight surviving cuttings. Of the long-day members, eight had flowered out of fifteen which had survived.

It would appear from these preliminary experiments that typical *H. subaxillaris* requires long days to flower whereas Benke's variety *petiolaris* will flower on long or short day-lengths. It might be noted that the portion of the Outer Banks from Bogue Barrier north past Cape Hatteras is an "island" of localized mild climate along a coastline which, northward and southward, is more rigorous. The ability to flower all the year-round might well be a selective advantage under these conditions.

In March and April of 1960, while these experiments were in progress, a revision of *Heterotheca*, Section *Heterotheca*, was published (Wagenknecht, 1960). In this work *H. subaxillaris* var. *procumbens* was described. The description of this variety coincided exactly with that of the plants in the dune-grass community on Bogue Barrier, and it was suspected that *H. subaxillaris* var. *procumbens* might be an ecotypic derivative of typical *H. subaxillaris*.

Thirty established plants of the beach variety and 30 established plants from the populations of tall-growing *H. subaxillaris* from the pine-oak-hickory forest were transplanted from Bogue Barrier to alternating rows in the Botanical Gardens of the University of North Carolina in early June of 1960. At the time of transplanting, the plants from the pine-oak-hickory forest had begun to bolt whereas those from the dunes had not. The transplants were watered only at the time of transplanting. After that, they were exposed to normal meteorological conditions. They were grown on a poor clay soil to which no fertilizers had been added. Nevertheless, both sets of plants grew very well in Chapel Hill and, under the virtually uniform conditions provided in the Botanical Garden plots, developed into virtually identical sets of plants. The heights of the transplants and the length of the longest stem of each are given in Table 1. The ratio of the height to the length may be considered a general measure of the degree of procumbence. Included in Table 1 are the heights and lengths of 20 specimens taken from each of the two populations on the island from which the transplants had been removed in June. These two latter sets of plants were collected on October 13, 1960; the transplants were uprooted and measured on October 18.

TABLE 1. Height, length, and height/length ratio of *H. subaxillaris* from dune and pine-oak-hickory populations contrasted with height, length, and height/length ratio of plants from the same populations grown in a uniform environment. 20 plants from each population were measured in centimeters and the longest stem of each plant was used for length measurement.

	Dune-grass ecads	Forest types	Dune-grass transplants	Forest transplants
height range	17-35	55-100	104-148	94-157
average height	27	81	124	121
length range	21-48	68-103	106-154	94-160
average length	33	86	129	124
height/length	.82	.94	.96	.97

It would appear from the data that the Bogue Barrier plants referable to *H. subaxillaris* var. *procumbens* reflect the response of a common genotype to more rigorous environmental conditions. The other characters separating the variety from the species (degree of serration of the leaves, prominence of lateral veins) are subjective at best and were quite useless in separating the two sets of plants grown in the uniform environment from one another.

The recent revision placed *H. subaxillaris* var. *petiolaris* in synonymy with *H. latifolia* Buckley. While the probable photoperiodic nature of the variations in Benke's plant was recognized (it had been collected in March), it was considered to be a deviant of the western species *H. latifolia* on the basis of its heavy pubescence. Examination of the sites upon which the photoperiodic variant occurs revealed no specimens referable to *H. latifolia*, as described in the revision, although numerous plants of typical *H. subaxillaris* were encountered. It would seem more likely that the day-neutral plants on Bogue Barrier were variants of the species already abundant on the island than that they were plants of a separate introduced species.

One of the principal characters used to distinguish *H. latifolia* from *H. subaxillaris* is the tendency of *H. latifolia* to grow as much as two meters in height while *H. subaxillaris* does not exceed one meter. An examination of Table 1 shows that this criterion is not valid. It should be mentioned that a specimen of *H. subaxillaris* from Bogue Barrier was cited in the revision as a representative specimen. The heavier pubescence attributed to *H. latifolia* and encountered in the winter-flowering plants on Bogue Barrier likewise does not appear to be a valid criterion for distinguishing two taxa since clonal plants of typical *H. subaxillaris* also developed the heavy pubescence when grown in the greenhouse over winter, regardless of the daylength to which they were exposed, "losing" the heavy pubescence when grown in the Botanical Gardens over the summer.

Thus it would seem preferable, for the time being, to retain the former concept of *H. subaxillaris* as a single, highly variable species until a more extensive study of the effects of different environments upon its forms is made.

Specimens representing all environmental variants cited, both naturally occurring and experimentally induced, have been deposited in the herbarium of the University of North Carolina. — DEPT. OF BOTANY, SMITH COLLEGE, NORTHAMPTON, MASS.

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OBSERVATIONS ON THE SAGITTARIA SUBULATA COMPLEX[1]

PRESTON ADAMS AND R. K. GODFREY

The *Sagittaria subulata* complex has been variously interpreted by recent authors. Small (1933) recognized four species, *S. subulata* (L.) Buch., *S. stagnorum* Small, *S. lorata* (Chapm.) Small, and *S. filiformis* J. G. Smith. Seven years later Fernald (1940) interpreted the group as a single species, *S. subulata,* with four "fairly marked varieties," var. *natans* (Michx.) J. G. Smith, var. *gracillima* (Wats.) J. G. Smith, var. *lorata* (Chapm.) Fernald, and var. *typica.* The following year Clausen (1941) concurred with Fernald that *S. subulata, S. natans,* and *S. lorata* were conspecific. Clausen, however, considered Fernald's varieties *natans* and *lorata* to be phases of a single subspecies, ssp. *lorata* (Chapm.) Clausen. The variety *gracillima* was thought by Clausen to be a deep water phase of the tidal mud flat plant, then known as *S. subulata* ssp. *typica.* In a recent revision of the genus Bogin (1955) recognized a single species with three varieties. He noted that this species, *S. subulata,* is "exceedingly plastic" in its vegetative body. His varieties were proposed "only hesitantly" since they "are all similar florally, and merge into one another vegetatively without sharp demarcation in structure or distribution." Bogin's conception of var. *subulata* included Fernald's varieties *natans, lorata,* and *typica* as well as Small's *S. stagnorum* and part of Smith's *S. filiformis.* In his circumscription of a second taxon, var. *gracillima,* Bogin included a portion of Small's *S. lorata* and part of *S. filiformis* J. G. Smith. Bogin's third variety included only the Florida plants named as *S. kurziana* by Glück in 1927.

It is apparent from the foregoing brief resume that the *Sagittaria subulata* complex is not well understood if one may presume that about the same kind of sample was available to each of the investigators. Much of the variance in interpretation is undoubtedly due to the exceedingly great plasticity which these plants, as well as other species in the

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[1] This investigation was supported (in part) by a research grant, RG-6305, to the junior author from the Division of General Medical Sciences, Public Health Service.

genus, show in their vegetative responses to different environments and/or environmental fluctuations.

The junior author commenced to observe the *Sagittaria subulata* complex in the field several years ago while conducting general collecting in the northern Florida region. During the summer of 1959 numerous observations were made by Dr. Norlan C. Henderson[2] and the senior author. Since that time the present authors have continued to study these plants and all of our collective experience includes a not inconsiderable amount of observation in nature where forms that appear to represent the extremes occur, and where certain differing kinds of habitat fluctuations were evident. In addition it includes some greenhouse culture experiments. It is our intent here to report upon this work only insofar as it leads us to offer some hypotheses as to the taxonomy of the complex and to suggest procedures for further intensive investigation to test these ideas.

Throughout most of these investigations the authors have entertained the notion that at least three biological entities were involved. One of these, the largest and most conspicuous, was thought to be referable to *Sagittaria kurziana* Glück. Plants of this type are very abundant in the St. Marks and Wakulla river channels (Wakulla County, south of Tallahassee, Florida) as well as in several of the large springs and spring-fed streams in central Florida. A second kind of *Sagittaria*, considerably smaller in size, was observed on the tidal mud flats and banks along the lower portions of these two rivers. This plant was considered to be the same as the *S. subulata* of the tidal flats around Chesapeake Bay and northward. A third aspect with floating dilated leaf blades was also recognizable and referred to Small's *S. stagnorum* (= *S. natans* Michx., not Pallas). However, recent observations of the complex, especially at the Wakulla-St. Marks stations, have demonstrated that this idea must be revised.

It will be helpful in the following discussion to consider first the kind and nature of the three principal phases ob-

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[2] Then a graduate student and an N.S.F. Research Participant, now at McMurray College, Abilene, Texas.

servable within the *Sagittaria subulata* complex. We think that an analysis of the morphology of the recognizable extremes and the habitats in which they grow will provide a framework around which our other observations can be organized.

THE SAGITTARIA KURZIANA PHASE

Plants of this type were first brought to the attention of botanists by Hugo Glück (1927) who had been guided to the type locality by Dr. Herman Kurz, then Professor of Botany at Florida State College for Women (now Florida State University) at Tallahassee. Glück and Kurz observed and collected the plant in the Wakulla and St. Marks rivers in 1926. The tremendous size of the phyllodes and scapes greatly impressed Glück who remarked enthusiastically that, to the best of his knowledge, it is the "largest *Sagittaria* of the whole world!" He noted phyllodes as long as 3.3 meters but the present authors have not encountered any longer than about 2.5 meters.[3]

The "*Sagittaria kurziana*" plants are characterized by the great length of their strap-like phyllodial leaves, several of which issue from a very short stem (Fig. 1). Each phyllode tends to be broadest above the middle, tapering gradually toward the apex, and is more or less flattened with the veins usually evident as several prominent ridges on the lower surface (Fig. 2). When viewed from underwater these leaves are seen to cover the spring or stream bottom, a scene which brings to mind Agnes Arber's vivid description of the deep water phase of *S. sagittifolia*, a European species. Mrs. Arber wrote (1920, p. 12) that "the ribbon-leaves of *Sagittaria* . . . have a singular beauty when seen forming, as it were, a meadow beneath the surface of the water, moving in the current in a way that recalls a field of wheat swayed by the wind." The inflorescence scapes of the "*S. kurziana*" type of plant also become very long, often reaching 15-25 dm.

This distinctive *Sagittaria* seems to be much at home in the clear running water of the Wakulla and St. Marks rivers (and a few of their small tributaries). It is very abundant

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[3] The notation on *Griscom 21059a* (GH) that the leaves reach a length of fifty feet needs verification before being accepted.

in the Wakulla River all the way to its source at the large fresh-water Wakulla Spring. The plant also grows in great abundance in at least ten other comparable springs and spring-fed streams of northern and central Florida. These aquatic habitats are unique, having been produced by a combination of climatic and geological forces (Whitford, 1956). A tremendous volume of water issues forth from

FIG. 1-5. FIG. 1. "*S. kurziana*," habit. Note young plantlet from rhizome. FIG. 2. Phyllode of "*S. kurziana*," cross-section, lower surface in face view. FIG. 3. "*S. kurziana*," plant uprooted and floating. Compare the much elongate original phyllodia with those formed while floating (see text). FIG. 4. "*S. subulata*," habit. Note young plantlet from rhizome. FIG. 5. Phyllode of "*S. subulata*," cross-section, lower surface in face view.

these giant springs, many having a flow of over three cubic meters per second. Around the springheads are often large open pools, and the water forms deep runs or streams which may be several miles long. Very little surface water enters and the chemical and thermal conditions are relatively stable, the light being the only important environmental variable (Whitford, 1956). The waters are hard in most of these springs, with large amounts of calcium, sodium, potassium and chlorides often present. The temperature is remarkably constant, varying less than 1° C. annually in many of the spring pools (slightly more down stream, of course). Wakulla Spring has a temperature of about 24° C. while several of those further south are a few degrees warmer.

In the St. Marks and Wakulla rivers the plants of the "*Sagittaria kurziana*" type grow in water from about one to at least three meters deep (completely submersed where the waters are affected by the tide) forming broad zones. In McBride's Slough, a spring and its stream that flows into the Wakulla River, the plants often grow throughout the width of the stream, especially near the springhead. Besides the *Sagittaria* other species of vascular plants are often present, including *Najas guadalupensis*, *Vallisneria* sp., and *Potamogeton illinoensis*. Dense beds of *Chara*, a large green alga, are also common. The leaves of these plants are coated with dense growths of algae, especially diatoms, filamentous greens, and blue-greens (Whitford, 1956). This investigator found that the algae form recognizable communities, well-developed on the *Sagittaria* leaves, depending upon the mineral content of the springs.

The importance of these large springs and spring-fed streams in Florida as natural laboratories ready-made for ecological studies under controlled conditions has been shown by Odum (1957). From intensive investigations of community metabolism and productivity in one such spring, the famous Silver Springs near Ocala, Marion County, Florida, Odum found that a remarkable steady state is present and appears to have existed for a very long time. Under these optimum conditions Odum discovered that the *Sagittaria* plants are responsible for one-third of the primary production of organic matter in the spring community. The *Sagittaria* no doubt plays a similar important role in the ecology of the other springs where it occurs.

THE SAGITTARIA SUBULATA PHASE

This distinctive *Sagittaria* of tidal mud flats and tidal shores was first collected by John Clayton sometime during the early seventeenth century. Clayton lived for many years in Gloucester County, Virginia (Stearn, 1957). While he visited and collected in other parts of Virginia, Clayton could have gotten his specimens of "*S. subulata*" near his home, since Gloucester County is bounded on the east by Chesapeake Bay and on the west by the York River.

The "*S. subulata*" phase is a small plant, commonly with short phyllodia (Fig. 4) not unlike those of *Lilaeopsis chinenses* (with which we have known it to be intermixed) and which by means of subterranean runners forms dense mats. In size, the shoots grade from the tiny *Lilaeopsis*-like ones on the upper tidal shores to a condition where there are rosettes of ascending wider leaves reaching a length of 1.5-3 dm. or more on lower shores (Fig. 10 a-i), submersed even at mean low tide. "Grassy" mats are formed on the bottom which very much resemble those formed by *Thalassia* in purely saline situations. The phyllodia tend to be more or less lenticular in cross-section, especially in the lower half, and, when fresh, as much as two-thirds to three-fourths as thick as they are wide (Fig. 5). Generally the veins are inconspicuous, not forming the prominent ridges as in the "*S. kurziana*" form. A tendency for the phyllodia to be broadened near their apices, producing a narrow but definite blade, is often present in plants of "*S. subulata*" from New York to North Carolina (Figs. 7, 8, 9).

The best development of the "*Sagittaria subulata*" form occurs on the tidal flats and along river shores which come under the influence of the tides. A few plants have been seen growing completely out of the water but they are probably covered during times of particularly high tide. For several hours each day (during the retreat and advance of the tide) most of the plants are exposed to the drying action of the sun and the air with little, if any, adverse effects. Near the junction of the Wakulla and St. Marks rivers the "*S. subulata*" form is very abundant on the mud flats, often being virtually the only plant in a zone as wide as 30 meters. Seaward from this point even wider expanses of

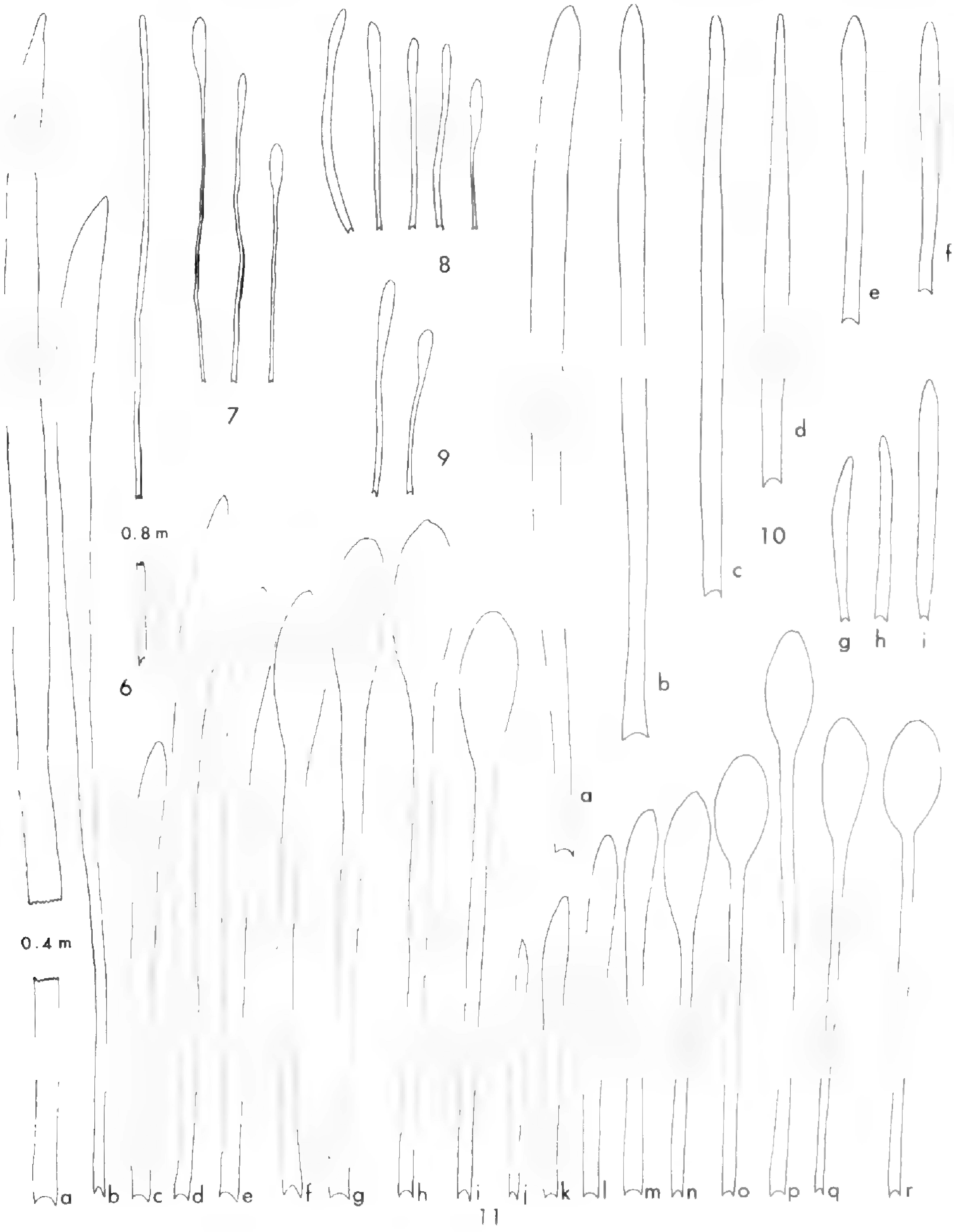

Fig. 6-11. Fig. 6. "*S. subulata* var *gracillima*" from Collins, Rhode Island (GH). Fig. 7. "*S. subulata*" from House 25070, Ulster Co., N. Y. (GH). Note widened lamina. Fig. 8. "*S. subulata*" from Steele Aug. 28, 1896, District of Columbia (US). Fig. 9. "*S. subulata*" from Steele Sept. 1, 1900, District of Columbia (US). Fig. 10 a-i. "*S. subulata*" from *Adams 728A*, Wakulla Co., Fla. (FSU). Fig. 11 a-r. "*S. kurziana,*" population G, Wakulla Co., Fla. (See text).

the tidal flats are thickly carpeted with this plant. Upstream, further away from the tidal influence, the colonies diminish in extent, until only a few scattered individuals are present, as in the case at the U. S. Rt. 98 highway bridge over the Wakulla River (about seven miles from the Gulf of Mexico).

THE SAGITTARIA STAGNORUM PHASE

Plants of this taxon were first described by the elder Michaux in his "Flora Boreali-Americana" (1803) under the name of *S. natans* (an epithet unfortunately predated by *S. natans* Pallas, a European plant). Typically, many of the phyllodia are dilated near the apex, producing linear-ovate to ovate or even slightly sagittate blades which float upon the surface of the water (Figs. 12, 13). During the winter, the floating leaves disappear, presumably being killed by a thin film of ice which occasionally forms in this region. This medium-sized, very distinctive plant reaches its most typical development in the quiet, relatively shallow waters of sinkhole ponds and pools, lake margins, and swamps and roadside ditches in which water stands for several months. In the small sinkhole ponds which are a characteristic feature of the landscape in northern Florida the "*S. stagnorum*" phase often forms a zone or ring of considerable width around the margins. When the plants are in flower an unusual aspect suggesting confetti on the water surface is presented.

ADDITIONAL FIELD AND GREENHOUSE OBSERVATIONS

Having described in a general way the three main phases detectable within the *Sagittaria subulata* complex, we now turn our attention to the variations from these principal forms. Lest we be accused of so-called "typological thinking" may we hasten to assure the reader that this manner of organizing our observations is purely arbitrary. Due to the unusual nature of the problem this particular manner of presentation appears to us to be the best method. We are fully cognizant of the elementary biological principle that populations, subspecies, species — taxa if you please — vary in differing degrees. If the reader so wishes, he may regard each "phase" as representing the midpoint on a variation curve; in a sense they can be called by the old-fashioned word "extremes."

Population[3] *A:* Marion Co., Fla., near Silver Springs, east of Ocala.

In a small drainage ditch which flows into an artificial boat basin near the Silver River (the stream from Silver Springs) *Sagittaria* plants with a most variable array of phyllodial shapes occur (*Henderson and Adams 2016* July 8, 1959, FSU, 8 sheets). All intermediate forms from strap-like phyllodia to leaves with fairly definite petioles and blades were observed, even on the same plant. The dilated leaf tips extended nearly vertically above the water surface with little or no tendency to become floating. Amidst the *Sagittaria* were numerous other kinds of vascular plants, resulting in the ditch being fairly choked with vegetation. The water depth in the middle of the ditch was about 70 cm. On the other side of a small footbridge, at the junction of the drainage ditch and the boat basin, were many *Sagittaria* plants with only long, strap-shaped phyllodia. Here the water was much deeper, the current fairly swift, and very few other plants were present. Since the *Sagittaria* in the nearby Silver River and Silver Springs had the "*S. kurziana*" appearance, this population was interpreted as being a deviation from the typical form of "*S. kurziana.*" More recently, study of similar populations in other areas has strongly suggested that a re-interpretation is necessary (see below).

Population B. Taylor Co., Fla.

A colony similar in several features to population A was discovered growing in a "black" water, swift-flowing stream out of a *Nyssa* swamp (8 miles south of Perry, *Godfrey and Houk 60460,* Oct. 21, 1960, FSU, 13 sheets). Many of the phyllodia were elongate and ribbonlike but all transitions to leaves with broadly dilated blades (Fig. 14 g-p) were present, even on the same individuals. The leaves on several

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[3] The presence of extensive vegetative reproduction by means of rhizomes and corms renders the collection of true population samples most difficult. Therefore, we have had to be satisfied with taking specimens along transits or by merely walking (or rather wading) about over the stand and picking up plants at irregular intervals (see fuller discussion of this phenomenon below).

plants were cut off about 8-12 cm. above the base and the rootstocks were planted in wet soil contained in aquaria. The tanks were filled with 12-15 cm. of tap water. Within a few days after transplanting, new leaves were being produced (*Godfrey 60460A*, March 1961, FSU, 8 sheets). These, as well as subsequent ones, tended to have a widened floating blade with slender "petiole" (Fig. 14 a-f). Such plants have the typical vegetative form characteristic of "*S. stagnorum*".

FIG. 12-13. "*Sagittaria stagnorum*," habit. Note the sagittate leaves.

Population C: Levy Co., Fla.

A population comparable to the Taylor County area (see B above) was found growing amidst a thick mat of the aquatic grass *Hydrochloa caroliniensis* in a drainage ditch bordering a cypress swamp (ca. 5.5 miles west of Bronson, *Godfrey 60559*, March 2, 1961, FSU, 4 sheets). In nature, these plants possessed phyllodia which exhibited much the same gamut of variations in shape as the Taylor County population except that the "petiole" of the leaves with blades were very much shorter and stouter. Within less than two weeks after being transferred to aquaria in the greenhouse, broad, floating leaf blades on narrow petiolar structures were being produced in abundance (the original leaves were not removed in this sample; they soon rotted away in the aquaria). In this example, also, the aquarium grown plants assumed the aspect typical of the "*S. stagnorum*" phase (*Godfrey 60559A*, April 17, 1961, FSU, 3 sheets).

Population D: Leon Co., Fla.

For more than a year the senior author has continually observed a colony of *Sagittaria* growing in the "black" water of a *Nyssa-Taxodium* swamp. During a period of heavy rains and consequent high water level the plants were in about 0.5 to 1.2 meters deep. Many of the phyllodia were elongate and strap-like but, especially in the shallower water, various forms of widened leaf tips were produced (15 miles north of Tallahassee, *Adams 431*, April 19, 1960, FSU, 12

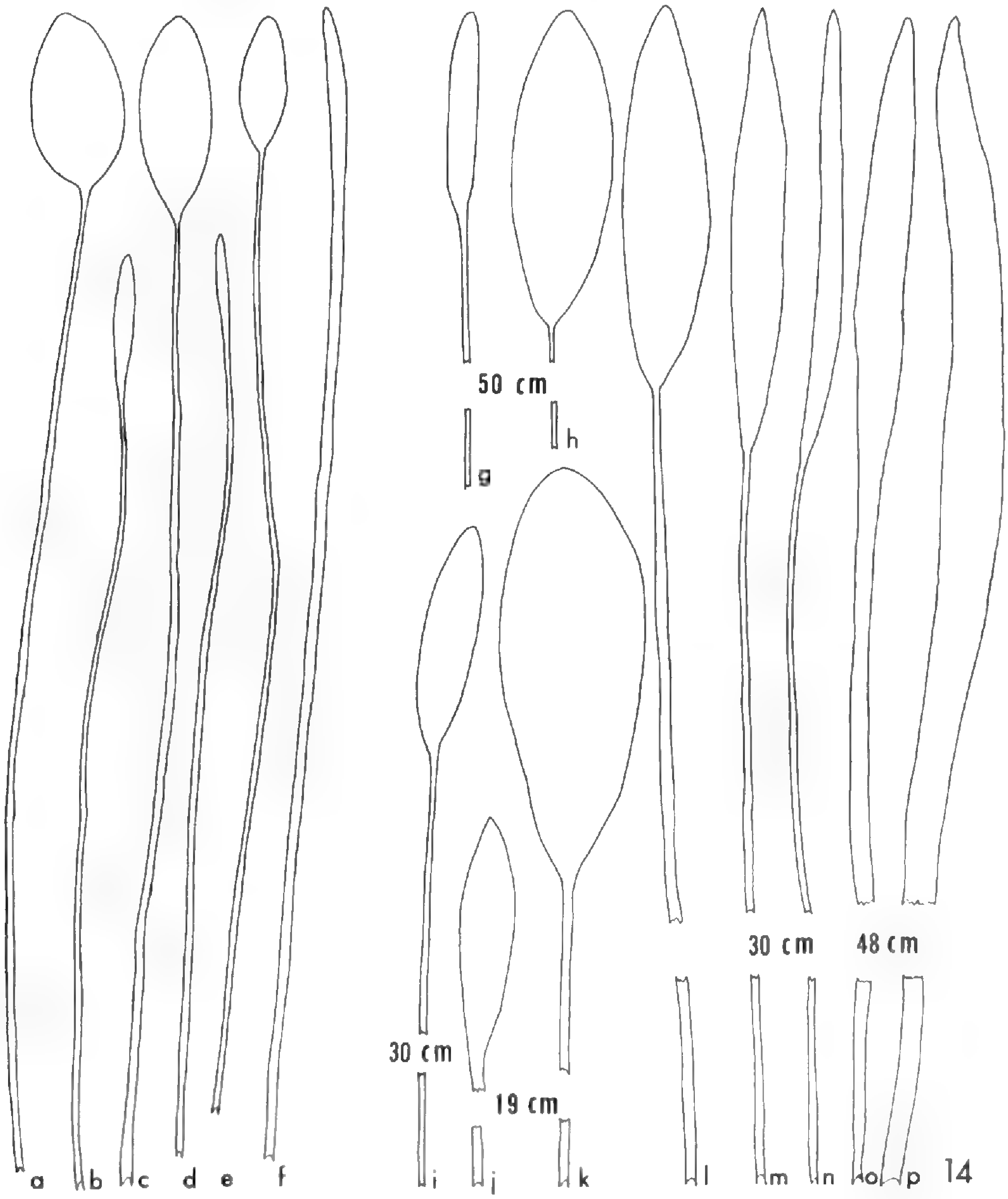


FIG. 14. "*S. stagnorum,*" phyllodia: population B, Taylor Co., Fla.; a-f, plants grown in aquaria; g-p, plants in nature. (See text).

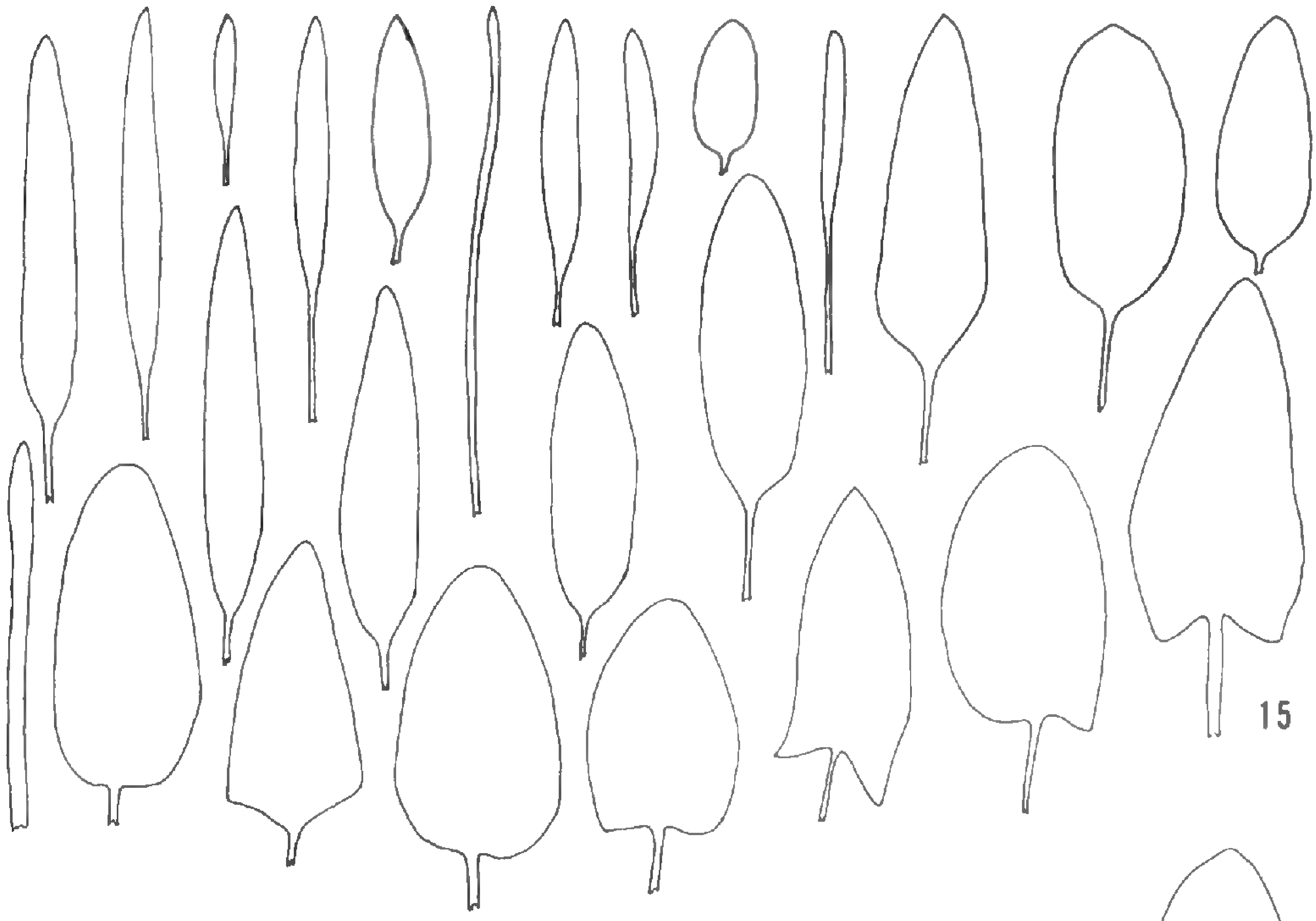
sheets). About five weeks later, the water level had dropped considerably and the plants presented a much changed appearance (*Adams 474*, May 21, 1960, FSU, 33 sheets). In the mud along the swamp margin were plants completely exposed to the air. Their leaves were very short, semi-erect, and with wide blades. Underground runners from these terrestial plants were traced out into the swamp bottom for distances of one-half to a meter or more. At intervals in the water new shoots were produced from these runners. The phyllodia were elongate and ribbon-like as well as with dilated, floating tips. Several rootstocks of the submerged individuals were transferred to aquaria and, within two weeks, most of the new leaves were of the floating type (*Adams 752*, March 30, 1961, FSU, 3 sheets).

Population E: Leon Co., Fla.

Tremendous variation in the shape of the floating leaf blades is present in many populations referable to the "*Sagittaria stagnorum*" phase. The plants of one such colony in and on the exposed shores of a small pond had leaves showing all imaginable transitions from the ribbon-like phyllode to one with a dilated floating blade having a truncate or even somewhat sagittate base (Fig. 15) (1 mile north of Woodville, *Henderson 2003*, June 18, 1959, FSU, 5 sheets). A collection from the same pond (*Godfrey 57484*, Aug. 15, 1958, FSU, 27 sheets) made the previous summer is revealing since much more variability in leaf blade shape and size is present (Fig. 16). In general, the widened lamina were longer than in the Henderson collection while their bases tended to be more sagittate. Such annual changes in a population are of great interest and need to be investigated further. The tendency for production of sagittate leaves is evidently a widespread phenomenon, judging from the available herbarium material.

Population F: Wakulla Co., Fla.

Valuable information concerning the apparent effects of the local environmental conditions upon the vegetative bodies of the "*Sagittaria stagnorum*" form has been obtained by transect studies. One colony growing in a wide ditch adjacent to a *Nyssa* swamp was sampled by collecting the plants at intervals along a transect reaching from the muddy bank out into the ever-deepening water (6 miles south of Crawfordville, *Adams 263*, Aug. 15, 1959, FSU, 8 sheets). Plants on the wet soil were dwarfed, their phyllodia rather short and with semi-erect dilated tips (Fig. 17a). Further out in the water (about 5-10 cm. depth) the typical floating blades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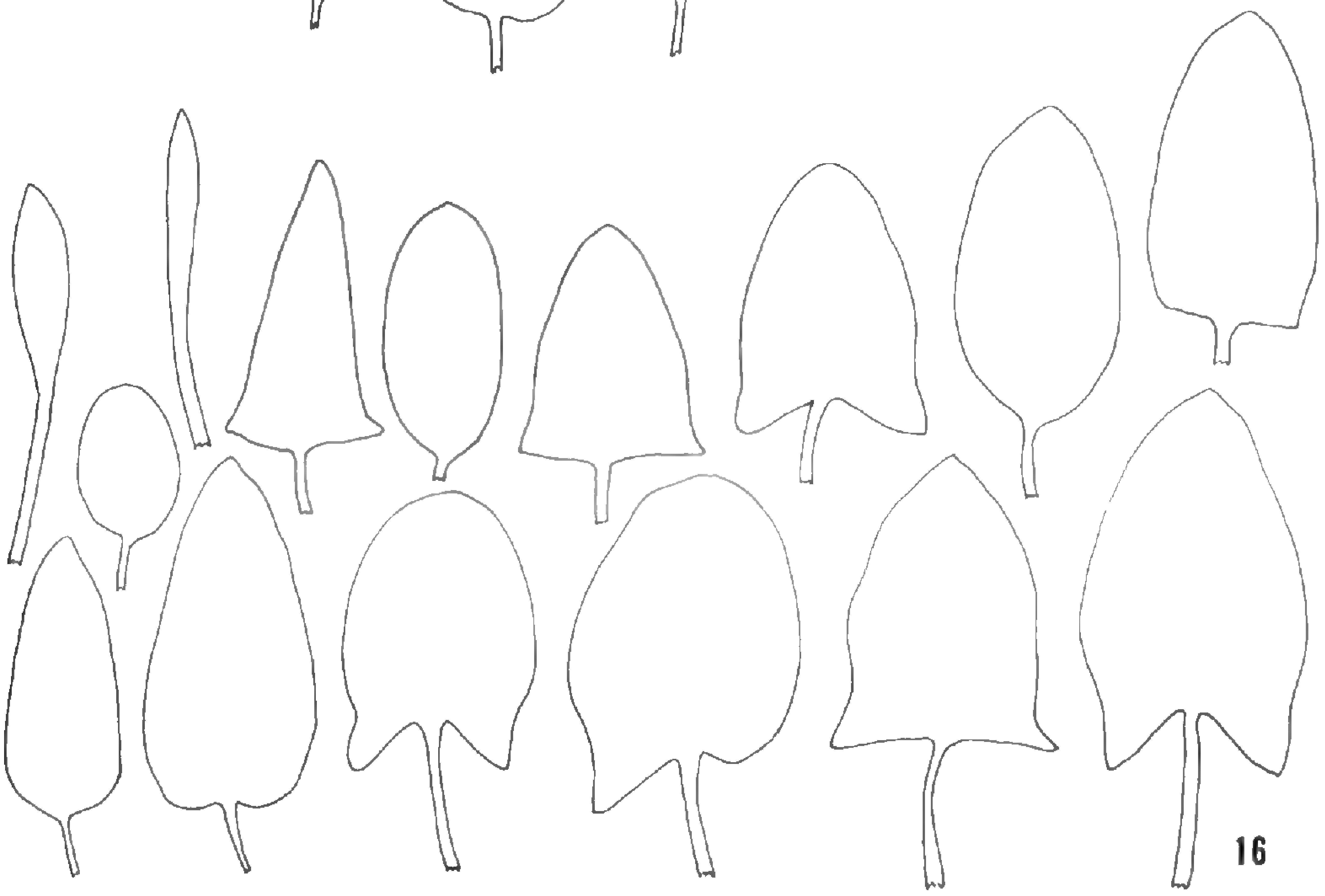
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Fig. 15-16. "Leaf" variation of "*S. stagnorum*," population E, Leon Co., Fla. Note transition from narrow straplike phyllodia to blades with sagittate bases.

(Fig. 17 b-e) were found along with some ribbon-like phyllodia. With increase in water depth the phyllodia become much more elongate (Fig. 17 f-i) while the floating leaves virtually ceased to be produced (at about 1 meter deep). The length of the scapes varied directly with the water depth, also. Similar observations have been recorded by the authors at numerous other stations.

Population G: Wakulla Co., Fla.

In McBride's Slough, a medium-sized spring-fed stream flowing into the Wakulla River, a *Sagittaria* not unlike the "*S. kurziana*" phase is extremely abundant (*Adams and Mitchell 754*, April 21, 1961, FSU, 18 sheets). In the fairly swift current of the deeper portions of the stream these plants have elongate, ribbon-like phyllodia (Fig. 11a, b) and correspondingly long inflorescence scapes. However, in the shallower water near the banks many plants with much

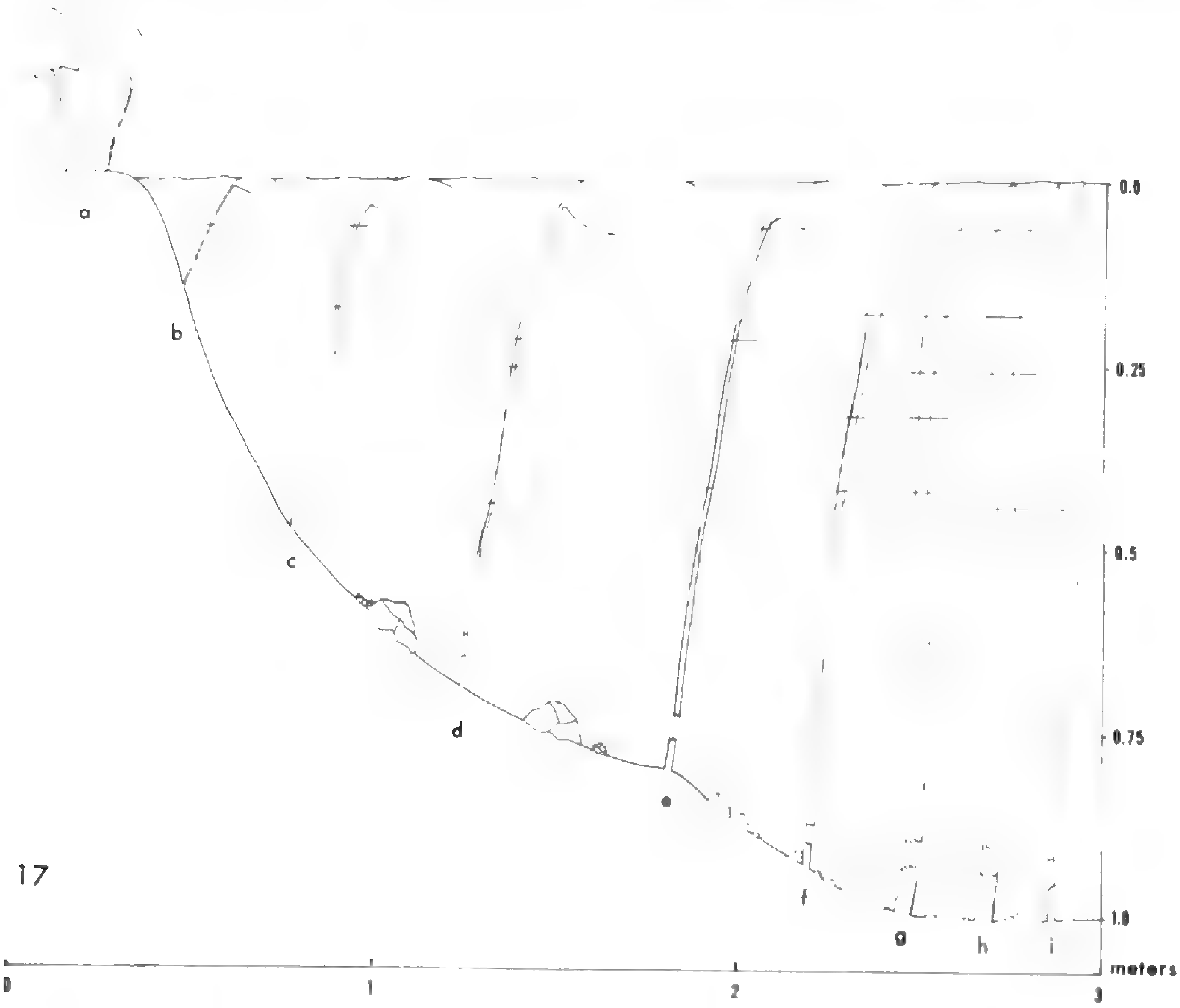

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Fig. 17. Phyllode variation in "*Sagittaria stagnorum.*" Diagrammatic representation of a transect from the shore out into the water of a drainage ditch. Water depth indicated by the ordinate. Transect distance by the abscissa. Phyllode length not to scale.

shortened phyllodia exhibiting various degrees of widening at the tips occur (Fig. 11 c-i). At the spring itself, the "*S. kurziana*" aspect is present in the deeper water but a gradual decrease in the size of the plants occurs toward the periphery of the springhead pool. On the soft mud at the edge of the pool, the leaves on individual plants show a gradual increase in dilation of the apex, not infrequently even producing a floating blade (Fig. 11 j-r).

Population H: Wakulla Co., Fla.

Approximately a mile north of the village of Newport is a sulfur spring which forms a small stream emptying into the St. Marks River. In the swift current of this rivulet there occurs a *Sagittaria* with elongate strap-like phyllodia hardly distinguishable (if at all) from the "*S. kurziana*" phase so abundant in the nearby river (see Fig. 1). Along the muddy banks and in quiet backwaters created by large masses of *Cicuta* (and other vegetation) plants whose phyllodia are variously dilated are frequently encountered. Occasionally some of these individuals produce phyllodia with widened, floating blades not unlike those characteristic of the "*S. stagnorum*" phase (Fig. 13). On the muddy banks along the lower portion of this stream (near its junction with the river) are plants which are very difficult to distinguish from the "*S. subulata*" form (similar to Figs. 4, 10 a-i) so very abundant further downriver where tidal fluctuation occurs (*Adams and Mitchell 755,* April 21, 1961, FSU).

OBSERVATION ON METHODS OF REPRODUCTION

Extensive vegetative reproduction via underground runners and corm-like structures is present in the *Sagittaria subulata* complex. The runners extend from the base of a plant and, after becoming several centimeters long, produce small white swellings similar to a corm or tuber (Figs. 1, 4, 12). From each such structure a new plantlet will arise. Not long afterwards, a new runner may form from the base of the young plant, a process often resulting in several to as many as fifty plants linked together (Wakulla Co., Fla., St. Marks River, 2 miles north of St. Marks, *Henderson 2021,* July 21, 1959, FSU, 3 sheets). Such a phenomenon is responsible for the formation of vast mats or beds containing practically nothing but *Sagittaria.* In the Wakulla and St. Marks rivers large clumps of the "*S. subulata*" form often become detached from the tidal mud, float about on the surface, and are carried along by the current. Frequently the plants in these floating mats remain alive long enough to flower and produce mature fruits. Individual plants of the "*S. kurziana*" aspect are occasionally torn loose from their anchorage in the river bottom. If they happen to become caught-up in debris along the shore, or in quiet backwaters, very short phyllodia with dilated tips may be produced (Fig. 3). Flowers on greatly shortened inflorescence stalks are often formed, even remaining long enough to mature the achenes. Young plantlets may often form at the lowest node of the inflorescence. Several instances of this phenomenon have been seen on plants in McBride's Slough (*Adams 754A*, April 21, 1961, FSU).

Vegetative reproduction appears to be of paramount importance in the maintenance and local spread of plants of the *Sagittaria subulata* complex. The massive beds such as those formed in the Wakulla and St. Marks rivers replenish their numbers simply by the new plants which form from the corms produced on the subterranean runners. It would appear that, in these dense "carpets and meadows" of *Sagittaria,* seedlings would have little chance of becoming established, presumably being hindered by competition with existing plants which originated from the runners.

Reproduction by seeds no doubt occurs but probably plays a secondary role in the life cycle of these plants, at least once a colony becomes established. Re-establishment of the "*S. stagnorum*" phase following severe drouth resulting in drastic and often lengthy desiccation of the habitats is probably due to seeds. The junior author has observed situations where, after a severe drouth cycle of several years, no *Sagittaria* plants could be found in the dried-up ponds, ditches, and swamps. The drought was broken by much autumn rain following which these habitats rapidly became filled with water — and in the following very early spring the "*S. stagnorum*" form was found to be extremely abundant in the very same places were none was present earlier. This observation implies that such rapid re-colonization may have been due to seeds since the underground runners would most likely have been killed by the several years of drouth. Abundant seeds are matured by the plants of the *S. subulata* complex.

The pedicels of the carpellate flowers become reflexed after pollination (Figs. 1, 3, 4, 12) and the fruits reach maturity underwater. The fruit, a distinctive achene with variously developed wings, becomes detached from the receptacle and floats to the water surface. We have not been able to follow the subsequent events leading to germination of the seeds.

NOTES ON FLOWERING

Plants of the "*Sagittaria kurziana*" phase flower throughout the year. The other phases of the *S. subulata* complex apparently cease flowering in the winter. Beginning in March and April in the Tallahassee region blooming resumes and continues until about November. In Massachusetts *S. subulata* var. *gracillima* (= *S. stagnorum* Small?, see below) begins to flower about the middle of June and continues until the end of July (note attached to C. E. Faxon's specimens in the Gray Herbarium).

Usually the pedicillated flowers are held a centimeter or two above the water surface during anthesis, the pollination appearing to be due to small flies. In the tidal flats where the "*Sagittaria subulata*" phase occurs the flowers open when the tide is low, thus permitting them to be pollinated. On the deep water side of the mud flats we have seen partially-opened flowers and these appear not ever to have become emersed. Although in all the phases the staminate flowers usually are emersed at anthesis, there is as yet considerable question as to whether many female flowers (which ultimately produce achenes) are ever emersed.

OBSERVATIONS ON THE INFLORESCENCE BRACTS

Each whorl of branches in the inflorescence of *Sagittaria* was described by Bogin (1955) as being "almost always subtended by a ring of 3 bracts." In the *S. subulata* complex these "bracts" were said to be "typically connate at the base, sheathing, . . . and occasionally spathe-like." Our observations on living plants show that these so-called bracts are actually the split and withering portions of a floral envelope which completely encloses the young inflorescence and flower buds. As these organs develop, the floral envelope is split down one side nearly to the base, producing a spathe-like appearance. Frequently, similar tears occur in the other sides, often producing a 3-parted "bract" structure like that illustrated by Bogin. Shortly afterwards, the envelope begins to wither and die, usually breaking away, leaving a narrow "ring" of chlorophyllous tissue at the node. The floral envelope may reach a length of 2-3 cm. in plants of the "*S. kurziana*" phase, especially at the lowermost whorl of the inflorescence. A similar envelope covers the corms, and is split by the growth of the young shoot.

CHROMOSOME COUNTS

Several mitotic chromosome counts on plants identified as members of the *Sagittaria subulata* complex have been published. Brown (1946) reported the diploid number of 22 chromosomes for "*S. stagnorum* Small", "*S. Kurziana* Glück", and a putative hybrid between plants of these two taxa. A diploid count of 22 chromosomes in plants of the tidal "*S. subulata*" was published by Baldwin and Speese (1955). Brown (1946) also found 22 chromosomes in somatic tissue of plants which he identified as "var. gracillima." No mention of this report was made by Bogin (1955) who claimed to have discovered "ca. 44" chromosomes in root tips of "var. *gracillima.*"

REMARKS ON THE STATUS OF S. SUBULATA VAR. GRACILLIMA

Since being described by Sereno Watson (1890), this *Sagittaria* with very narrow elongate phyllodia has been subjected to a variety of opinion concerning its biological distinctness and its taxonomic standing. Most authors have recognized its close affinity with the *S. subulata* complex but their interpretations of its alliance within the group have varied considerably. Watson considered the plant to be a variety of *S. natans* Michx. (*S. stagnorum* Small) while Smith (1895) treated it as a variety of *S. subulata* (L.) Buch. Many years later Fernald (1940) concurred with

Smith's opinion but the following year Clausen (1941) regarded var. *gracillima* as a deep water phase of the tidal flat plant *S. subulata*. Recently, Bogin (1955) and Beal (1960) have maintained *gracillima* as a variety of *S. subulata.*

Exception to the prevailing opinion concerning the relationship of var. *gracillima* was made by Pierce (in Gleason, 1952). This author concluded that the plant was more properly interpreted as a "deep water form" of *Sagittaria graminea* Michx.

Our observations of the *Sagittaria subulata* complex strongly suggest that var. *gracillima* may represent merely the deep water aspect of "*S. stagnorum.*" We have seen many plants of the "*S. stagnorum*" phase in Florida and Georgia, both living and on herbarium sheets (Figs. 14d, 17i), which are hardly distinguishable from New England specimens (Fig. 6) traditionally classified as this variety. As discussed above, plants of "*S. stagnorum*" growing in water about a meter or more deep possess very elongate narrow phyllodia (Figs. 14 A, 17 i). The production of dilated leaf blades by plants of var. *gracillima* from Massachusetts similar to *House 25070* (Fig. 7) further suggests its close affinity with the "*S. stagnorum*" phase of the *S. subulata* complex.

CONCLUDING REMARKS

Despite the not inconsiderable amount of observation detailed in the foregoing discussion, we still do not feel justified in assigning taxonomic status to the three relatively distinguishable phases (Figs. 1, 4, 12, 13) in this complex. We believe that their biological discreteness, or lack of it, must be investigated more thoroughly, probably entailing the following: a more intensive and extensive analysis of populations or stands in relation to variable and fluctuating environments; reciprocal transplants; experimental culture; more exact and more extensive cytological study; and, if possible, crossing experiments. The universal occurrence of vegetative reproduction and the consequent impossibility of discerning individual plants in this complex certainly require that population analysis be handled differently from that in groups whose populations are comprised of manifest--ly discrete individuals. Possibly plants can be grown satisfactorily from seed thus yielding information not otherwise available. — DEPARTMENT OF BOTANY AND BACTERIOLOGY, DEPAUW UNIVERSITY AND DEPARTMENT OF BIOLOGICAL SCIENCES, FLORIDA STATE UNIVERSITY.

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THE CHROMOSOMES OF PODOPHYLLUM PELTATUM

GABRIELE N. MÜHLING AND G. B. WILSON[1]

Podophyllum peltatum L., commonly known as May Apple, Mandrake or Pomme de Mai, represents one of the best sources of cytological material for class purposes. It is found in eastern North America, east from a line drawn from Minnesota to Texas, including southern Ontario and Quebec. Representatives of the genus also occur in eastern Asia (Fernald, 1950). Large amounts can be collected easily and the sporogenous material is normally found to be in meiosis for about a two week period. Good cytological preparations can be made by simple techniques. The early stages of meiosis especially pachytene can be fixed and stained giving a clarity that equals maize. The chromosomes are large and few in number.

The advantages of the material do not seem to be recognized very generally probably because the cytology has not been described in any detail since 1926 when Kaufmann published his general description of the karyotype and meiosis. It therefore seemed worthwhile reporting and illustrating the work from our own collections of this material.

MATERIALS AND METHODS

Flower buds of *Podophyllum peltatum* L. were collected in the Oakland and Ingham Counties of Michigan. Collections

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The authors wish to thank Mr. P. G. Coleman for his preparations of the illustrations.

of anthers from these areas have been made yearly for the past six years. The most extensive collections were made in 1954 and 1959 and the main part of the data for this paper were obtained from these. Buds from the former year were fixed in the field in 3 parts absolute ethyl alcohol and 1 part glacial acetic acid and from the latter year in a 6:3:2 mixture of absolute methanol, chloroform and propionic acid (Piennar, 1955) and then placed under vacuum as soon as possible. Microspore mother cells of anthers were prepared for analysis mostly by staining by the Feulgen technique after a 9-10 minute hydrolysis in 1 N HCl at 60° C. Each anther was carefully squashed on a slide to separate the sporogenous tissue from the tapetum. Slide preparations were dehydrated in a 9:1 mixture of tertiary butyl alcohol and absolute ethyl alcohol overnight and then mounted in diaphane. Some material was stained with aceto-carmine. Fixed anthers were macerated in 1 N HCl at 60° C for 5 minutes prior to staining. Before dehydration, excess carmine was removed from preparations by running a drop of 45% acetic acid under the cover slip. If this is not done the cytoplasm becomes dark, often obscuring the division figures.

DISCUSSION

1. *Karyotype:* Our observations of a haploid number of six chromosomes in *P. peltatum* are in agreement with those earlier reported by Litardière (1921) and Kaufmann (1926). The kinetochores are found in three positions — each type appearing twice in the karyotype. In two chromosomes the kinetochores are in a near-median position; in two, in a submedian position and in two, in a subterminal position. The relative lengths of the arms of the chromosomes measured at anaphase II in the above order are: approximately 1:1; 1:2; and 1:18. For convenience the three types shall be called A, B, and C respectively. One chromosome of each of the three types has a satellite. It appears on the long arm in types B and C (Plate 1262, fig. 7, 8 and 9). It is not possible to determine which arm contains the satellite in type A because of their near identical length and the lack of any other morphologically distinguishing characteristic

(Plate 1262, fig. 9). In some details this description of the satellites does not agree with that of Kaufmann (1926) which may be because of the difficulty in detecting them or because a different population was sampled. A number of

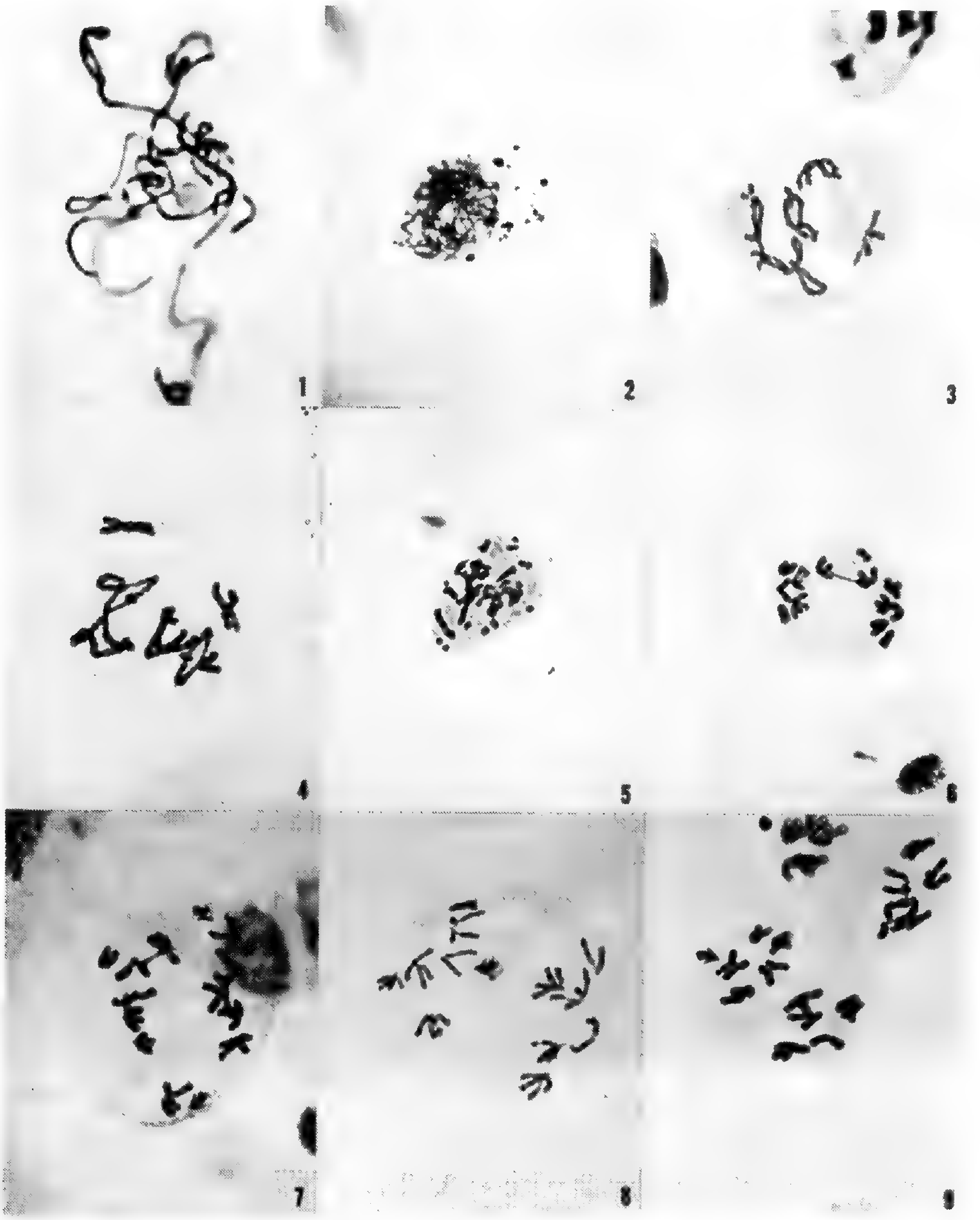

Plate 1262. Fig. 1. Pachytene showing nucleolar attachment. Fig. 2. Zygotene with DNA blobs. Fig. 3. Diakinesis and faint outline of nucleolus. Fig. 4. Interlocking chromosomes. Fig. 5. Probably a metaphase I with numerous fragments. Fig. 6. First anaphase bridge and fragment. Fig. 7-9. Anaphase I. Arrows point to chromosomes with satellites.

peculiarities are noted in the occurrence of these satellites. First of all we did not observe them in somatic anaphases when they generally do appear in material which has them. Furthermore frequently a satellite is only visible in one chromatid of a first division anaphase chromosome, its partner having no indication of this structure whatsoever (Plate 1262, fig. 9).

The total length of the complement of six chromosomes of this species is about 60 microns. The lengths of each of the chromosomes expressed in terms of the total length of the complement is approximately as follows: the median attached chromosome, 20% ; submedian 17% ; and subterminal, 13%.

2. *General description of meiosis:* The key stages are shown in the figures in Plate 1263. They are consistent with the generalized textbook descriptions. Pachytenes are particularly good. In cells where they are sufficiently spread out, it is possible to count the number of chromomeres in a chromosome. The interkinesis between the two meiotic divisions is well marked, sometimes being so complete that nucleoli appear although this seems to be somewhat unusual. Cytokinesis does not occur until the end of second division so that diads are sometimes confused with binucleate tapetal cells since they are somewhat similar in size and shape.

A number of special features of the material deserve some comment:

a. The nucleolus: In somatic tissue the number of nucleoli appears to vary from one to three. So far we have failed to determine with which chromosomes they are associated. In meiosis there is consistently a single nucleolus, which is associated with one of the two subterminally attached chromosomes. Although the satellite can not be seen all of the time, it is assumed that the nucleolar association is with the chromosome possessing the secondary constriction. The nucleolar organizer region appears to be in the proximal third of the long arm and is not associated with any obvious secondary constriction. In any case, the three secondary constrictions noted do not seem to be concerned with nucleolar formation. In some plants such as maize (McClintock, 1934) the nucleolus develops from a definite organizing region in the area of the secondary constriction.

b. Some microsporocytes that appear to be between zygotene and pachytene frequently show a large number of Feulgen positive bodies (Plate 1262, fig. 2). Similar observa-

PLATE 1263. Stages of meiosis in *Podophyllum peltatum*. Fig. 1. Zygotene; 2. Pachytene; 3, Diplotene; 4, Diakinesis; 5, Metaphase I; 6, Anaphase I; 7, Telophase I; 8, Prophase II; 9, Metaphase II; 10, Anaphase II; 11, Late anaphase II; 12, Telophase II.

tions have been made in *Trillium* (Sparrow & Hammond, 1947) and *Lilium* (Cooper, 1952 and Takats, 1959). Sparrow and Hammond (1947) suggest that this represents a transfer of nuclear DNA to the cytoplasm. Similarly Cooper suggests that this represents movement of DNA from the tapetum to the locules and ultimately into the nuclei of the microsporocytes. After an extensive examination of this phenomenon, Takats (1959) concludes that there is no evidence for transfer of DNA to the microsporocytes from the tapetum during this stage in meiosis. He suggests that the extrusion may be caused by such factors as injury to the anthers at time of harvest and type of fixative used. We are inclined to take the view that they represent an abnormality of some sort and doubt that such cells proceed through meiosis. Occasionally observations such as the configuration shown in Plate 1262, fig. 5 in which there is very considerable fragmentation suggests the possibility of a relationship between the abnormal zygotenes and pachytenes and the cells showing the chromatin pieces. Similar extreme fragmentation beginning at first metaphase is reported by Gentcheff and Gustafsson (1940) in an apomict, *Hieracium robustum*.

c. Populations examined so far quite consistently have revealed a first anaphase bridge and fragment suggesting heterozygosity for an inversion in what appears to be the median attached chromosome (Plate 1262, fig. 6).

d. Chromosome interlocking as illustrated in Plate 1262, fig. 4 also occurs occasionally.

3. *Chiasma frequency:* Counts of the chiasma frequency at diakinesis were made in samples of both the 1954 and 1959 material. The average of the former year is 10.9 ± .83 and the latter year 11.6 ∓ .86, the difference not being significant. Some terminalization takes place between early diakinesis and first metaphase but the number of chiasmata is not notably decreased till the beginning of first anaphase.

4. *Tapetal cells:* It is quite common for the tapetal cells in plants to show considerable aberration with reference both to mitosis and number of chromosomes (D'Amato,

1952). *P. peltatum* is particularly good material for illustrating aberrations. Some of the more striking ones are shown in Plate 1264. The tapetal cells begin division concurrent with the onset of meiosis and these first divisions are generally normal. By diplotene, tapetal divisions begin to show abnormalities in the form of scattered metaphase configurations and the frequency of divisions is on the increase. Between first metaphase and second prophase, the rate of mitosis in the tapetum seems to reach its peak and also the degree of aberration has increased considerably. Polyploidy is very common now, often to the octoploid level and in a few cases probably much higher. In some apparent-

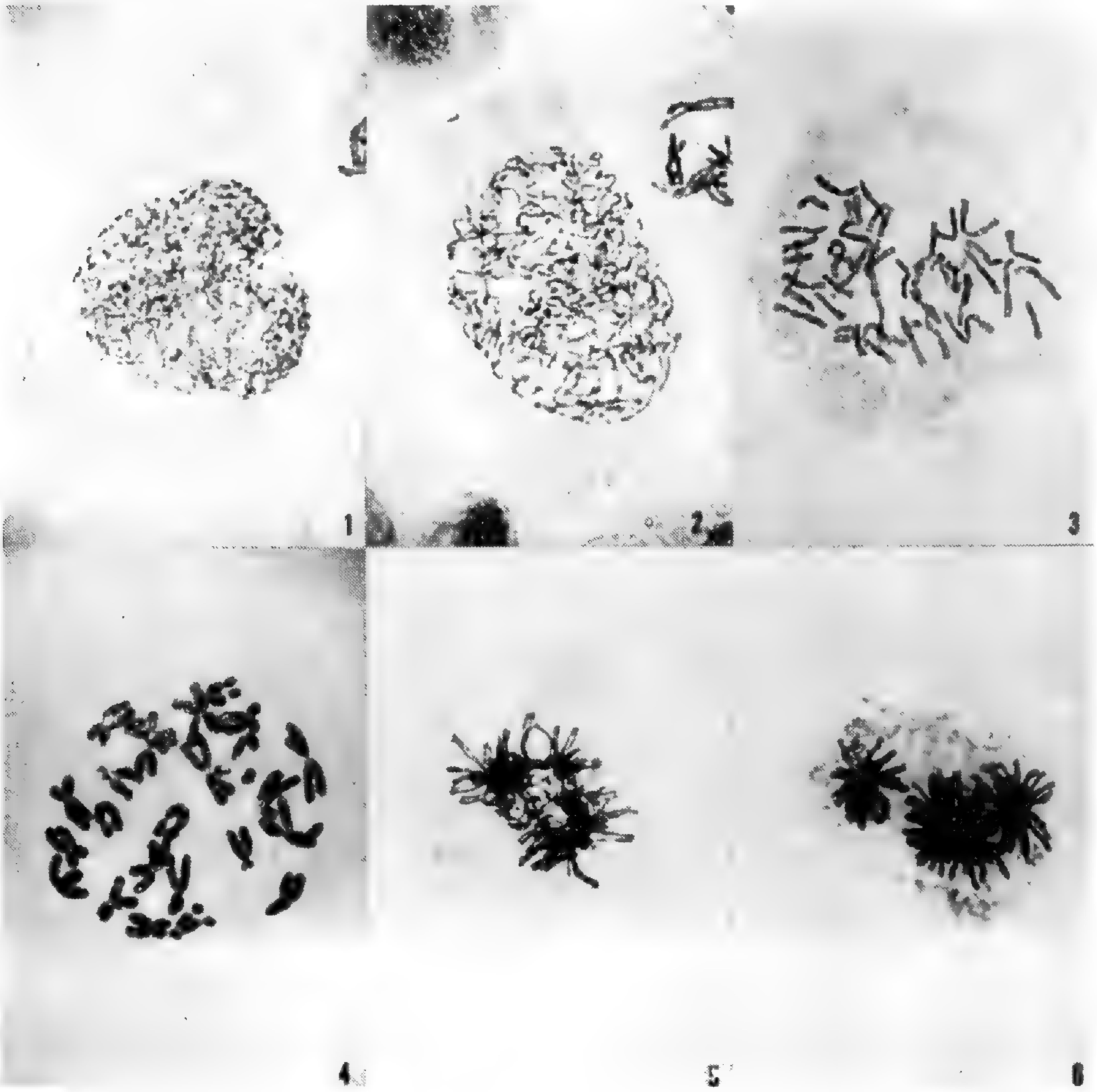

Plate 1264. Abnormal stages in mitosis of the tapetum. Fig. 1-2. Polyploid prophase. Fig. 3. Polyploid metaphase. Fig. 4. "Scattered" metaphase. Fig. 5. Metaphase. Fig. 6. Tri-polar anaphase.

ly clear cases the number is not an exact multiple of the basic number but one or more chromosomes is missing. Other characteristics are multinucleate cells with varying numbers of chromosomes in the different nuclei, star metaphases, star anaphases with three or more centers of aggregation. By the time tetrads are formed there is a definite decrease in the tapetal divisions and an over-all multinucleate condition exists in the interphases of this tissue. Indeed almost all of the mitotic aberrations which have been associated with chemical treatments or described for cancer cells are characteristically found in the tapetal cells of this plant.

The question may be asked whether the abnormalities of the tapetum arise as a result of its function. In her studies on *Solanum tuberosum* Avanzi (1950) suggests that the tapetum definitely has a nutritive function and that the abnormalities especially in chromosome number, occur at the time when the sporogenous tissue needs its greatest food supply. Taylor (1959) working on *Lilium longiflorum* came to the conclusion that the primary function of the tapetal layer is to secrete material for wall formation of the microspores. Further work needs to be done on this intriguing phenomenon in the tapetum to determine its cause.

SUMMARY

The above account describes microsporogenesis in anthers of *Podophyllum peltatum* L. and the concurrent mitotic activity of the tapetum. Some peculiarities related to these events are also mentioned.

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A LIST OF ALGAE FROM SELECTED AREAS IN MASSACHUSETTS[1]

EDGAR E. WEBBER

For the past thirty years, work on the flora of Worcester County has been centered upon vascular plants. Numerous references may be found elsewhere. Recently, attention has been directed to other forms of plant life (1, 3). However, little is known concerning the algae of the county. In 1899 Stone (6) included a list of algae found in Lake Quinsigamond as part of a floristic study of that area. Auyang (2) has recently completed a survey of the algae in Lake Quinsigamond. These two works appear to be the only ones to date dealing with the algal flora of the county, but they both are restricted to only one location.

The writer (7) has just completed an ecological study of the algal populations in eleven selected stations in Worcester

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[1] The taxonomic list, slightly modified, from a thesis, "The Ecology of Some Attached Algae in Worcester County, Massachusetts," presented to the Faculty of the Graduate School of Cornell University in partial fulfillment of the requirements for the degree of Master of Science.

County. No attempt will be made here at ecologically characterizing these stations; a listing of them will suffice.

STATION	NAME AND LOCATION
1	Eames Pond, Oxford, Mass.
2	Eddy Pond, Auburn, Mass.
3	The Cataracts, Worcester, Mass.
4	Silver Spring Brook, Paxton, Mass.
5	The Quag, Sterling, Mass.
6	Chaffin Pond, Holden, Mass.
7	Brook near Reservoir no. 4., Paxton, Mass.
8	Stream near Reservoir no. 2., Leicester, Mass.
9	Indian Lake, Worcester, Mass.
10	A tire depression, temporary habitat, near station 9.
11	Sargent Pond, Leicester, Mass.

Following is a list of algal species collected in Worcester County during the course of the ecological study mentioned above (7). The collecting station appears in parentheses after each species. The taxonomic scheme is that used by Prescott (4); the desmids and diatoms, since they are not included in Prescott (4), are classified following Smith (5).

CHLOROPHYTA

CHLAMYDOMONADACEAE: Chlamydomonas sp. (6).

VOLVOCACEAE: Pandorina morum (Muell.) Bory (2-b, 5-a, 5-b); Gonium sociale (Duj.) Warming (10).

HAEMATOCOCCACEAE: Haematococcus sp. (5; isolated pockets along shore).

ULOTRICHACEAE: Ulothrix subconstricta G. S. West (11-b); U. tenerrima Kuetz. (3, 7-a); U. variabilis Kuetz. (6, 7-a, 11-b); U. sp. (? cylindricum) Prescott (7-a); Binuclearia tatrana Wittr. (11-a).

MICROSPORACEAE: Microspora tumidula Hazen (7-a); M. sp. (4).

CYLINDROCAPSACEAE: Cylindrocapsa geminella var. minor Hansg. (5-a).

CHAETOPHORACEAE: Stigeoglonium aestivale (Hazen) Collins (1-b); S. lubricum (Dillw.) Kuetz. (2-a, 7-b); S. tenue (Ag.) Kuetz. (8-c); S. sp. (? glomeratum (Hazen) Collins or subsecundum Kuetz.) (7-b).

COLEOCHAETACEAE: Coleochaete scutata Breb. (5-a); Chaetosphaeridium globosum Klebahn (6); Draparnaldia glomerata (Vauch.) C.A. Ag. (8-a); Aphanochaete repens A. Br. (11-a).

CLADOPHORACEAE: Rhizoclonium hieroglyphicum (Ag.) Kuetz. (2-a).

OEDOGONIACEAE: Bulbochaete scrobiculata Tiff.) Tiffany (11-a); B. sp. (? elatior) Prings. (11-a); B. sp. (? mirabilis) Wittr. (11-a); B. sp. (? setigra (Roth) C.A. Ag. or insignis Prings.) (11-a); Oedogonium boscii (LeCl.) Wittr. (3); O. gracilius (Wittr.) Tiff. (6); O. reinschii Roy (6); O. subsexangulare Tiff. (11-a); O. sp. (? hystricinum Trans. & Tiff.) (11-b); O. sp. (1-a, 1-b, 2-a, 2-b, 5-b).

CHLOROCOCCACEAE: Golenkinia paucipina West & West (2-b).

CHARIACEAE: Characium ambiguum Herm. (1-a, 2-a, 7-a, 7-b); C. naegelii A. Br. (7-b, 8-b); C. stipitatum (Bachm.) Wille (11-a); C. sp. (? pringsheimii) A. Br. (6).

HYDRODICTYACEAE: Pediastrum araneosum var. rugulosum (G. S. West) G. M. Smith (6); P. biradiatum Meyen (2-b); P. boryanum (Turp.) Meneg. (1-a, 2-a, 2-b, 5-a, 6, 11-a); P. boryanum var. longicorne Raciborski (5-a); P. boryanum var. undulatum Wille (1-a); P. duplex Meyen (1-a, 6); P. duplex var. clathratum (A. Br.) Lag. (1-a, 2-a); P. duplex var. cohaerens Bohl. (6); P. duplex var. gracillimum West & West (11-b); P. obtusum Lucks (6, 11-b); P. sculptatum G. M. Smith (5-a); P. tetras (Ehr.) Ralfs (1-a, 2-a, 2-b, 5-a, 5-b, 6, 11-a); P. tetras var. tetraodon (Corda) Rab. (1-c, 5-a, 5-b, 6, 11-a, 11-b); Sorastrum americanum (Bohl.) Schmidle (6); S. americanum var. undulatum G. M. Smith (6, 11-b); S. spinulosum Naeg. (6).

COELASTRACEAE: Coelastrum cambricum Arch. (2-a, 11-b); C. microporum Naeg. (2-a, 5-a, 6, 8-a, 11-a, 11-b); C. sphaericum Naeg. (1-c, 2-a, 2-b).

OOCYSTACEAE: Dictyosphaerium pulchellum Wood (2-a); Trochiscia obtusa (Reins.) Hansg. (6); T. reticularis (Reins.) Hansg. (6, 8-b); T. sp. (1-b, 4, 5-b); Eremosphaeria viridis DBy. (6); Oocystis crassa Wittr. (6); O. elliptica W. West (6); O. solitaria Wittr. (6); Nephrocytium agardhianum Naeg. (5-a, 6, 11-b); N. obesum West & West (6); Dimorphococcus lunatus A. Br. (6); Ankistrodesmus convolutus Corda (2-a); A. falcatus (Corda) Ralfs (1-c, 6, 11-a); A. falcatus var. acicularis (A. Br.) G. S. West (11-a); A. falcatus var. mirabilis (West & West); G. S. West (2-a); A. spiralis (Turner) Lem. (6, 8-a); Selenastrum minutum (Naeg.) Collins (5-a, 11-a); S. sp. (6); Kirchneriella lunaris (Kirch.) Moebius (6); K. obesa var. major (Barnard) G. M. Smith (2-a, 6); K. subsolitaria Schmidle (2-a, 6); Quadrigula lacustris (Chod.) G. M. Smith (6, 11-b); Tetraedron caudatum (Corda) Hansg. (6, 11-b); T. minimum (A. Br.) Hansg. (2-a, 2-b, 11-a, 11-b); T. obesum (West & West) Wille (6); T. trigonum (Naeg.) Hansg. (6); T. tumidulum (Reins.) Hansg. (11-b).

SCENEDESMACEAE: Scenedesmus abundans (Kirch.) Chod. (2-a, 2-b); S. acuminatus (Lag.) Chod. (8-a); S. acutiformis Schroeder (1-a, 2-a, 2-b, 6, 11-b); S. arcuatus Lem. (2-a, 6); S. arcuatus var. capitatus G. M. Smith (2-b); S. arcuatus var. platydisca G. M. Smith (2-a, 6, 11-a, 11-b); S. armatus (Chod.) G. M. Smith (6); S. bijuga (Turp.) Lag. (1-a, 2-a, 2-b, 5-a, 5-b, 6, 8-a, 8-b, 11-a); S. bijuga var. alternans (Reins.) Hansg. (6); S. brasiliensis Bohlin (1-c, 2-b, 8-b, 11-b); S. carinatus (Lom.) Chod. (1-a); S. caudatus Corda (1-c, 2-a); S. caudatus var. typicus Kirch. (1-c); S. denticulatus Lag. (2-a, 2-b, 6, 8-a);

S. dimorphus (Turp.) Kuetz. (1-a, 2-a, 2-b, 6, 8-b); S. incrassatulus Bohlin (1-a); S. longus Meyen (5-b); S. obliquus (Turp.) Kuetz. (2-a, 2-b, 5-a, 6, 8-a); S. opoliensis P. Richter (2-b); S. quadricaudata (Turp.) Breb. (1-a, 1-c, 2-a, 2-b, 5-a, 5-b, 6, 8-a, 11-b); S. quadricaudata var. parvus G.M.Smith (1-a); S. quadricaudata var. quadrispina (Chod.) G. M. Smith (5-b); S. quadricaudata var. westii G. M. Smith (2-a, 5-b); Actinastrum sp. (? hantzchii) Lag. (2-a); Tetradesmus wisconsinense G. M. Smith (6).

ZYGNEMATACEAE: Mougeotia scalaris Hass. (8-b); M. sp. (1-a, 1-b, 1-c, 2-b, 5-a, 6, 7-a, 7-b, 8-a, 8-b, 8-c, 11-b); Spirogyra hyalina Cleve (6); S. rivularis Rab. (2-b); S. sp. (1-a, 1-b, 2-a, 2-b, 2-c, 5-a, 5-b, 6, 7-b, 8-b, 11-b); Zygnema sp. (1-a, 1-b, 5-a, 5-b, 6, 8-a, 8-b, 11-b); Zygnemopsis desmidioides (West & West) Transeau (5-a).

MESOTENIACEAE: Gonatozygon aculeatum Hastings (6); G. brebissonii Meneg. (11-a); Cylindrocystis americana West (8-c); C. brebissonii Meneg. (11-a); Netrium digitus (Ehr.) Itz. & Rothe (1-c, 5-a, 5-b, 6, 8-c); N. digitus var. constrictum West & West (6); N. naegelii (Breb.) West & West (6, 8-b); N. sp. (? oblongum) (DBy) Luet. (8-b); Spirotaenia condensata Breb. (1-a).

DESMIDIACEAE: Closterium abruptum West (6); C. acerosum (Schrank) Ehr. (6); C. acuminatum Ralfs (1-c, 3, 4); C. cornu Ehr. (11-a); C. ehrenbergii Meneg. (5-a); C. jenneri Ralfs (1-c, 2-a, 2-b, 4); C. juncidum Ralfs (6); C. lanceolatum Kuetz. (6); C. leibleinii Kuetz. (1-a, 5-b, 6, 7-a); C. libellula Focke (1-a, 5-b); C. libellula var. intermedium Roy & Bis. (6); C. moniliferum Ehr. (4, 6, 8-b, 8-c); C. parvulum Naeg. (1-c, 3, 5-a, 5-b, 6, 8-b, 8-c, 11-a); C. regulare Breb. (6); C. rostratum Ehr. (1-a, 4, 5-a); C. setaceum Ehr. (6, 11-b); C. strigosum Ehr. (6); C. subtruncatum West & West (6); C. venus Kuetz. (1-a, 3, 6, 8-b); Penium navicula Breb. (6); P. sp. (? closteroides) Ralfs (1-b); P. sp. (6); Pleurotaenium coronatum (Breb.) Rab. (6); P. maximum (Reins.) Lund (11-a); P. trabecula (Ehr.) Naeg. (5-a, 5-b, 6); Triploceras gracile Bail. (6); Euastrum abruptum Nord. (1-c, 6); E. abruptum forma minus West & West (11-a, 11-b); E. bidentatum Naeg. (6); E. binale (Turp.) Ehr. (6); E. binale forma minor G. S. West (11-a); E. elegans Kuetz. (3, 5-a, 11-a); E. evolutum West & West (6); E. evolutum var. integrius West & West (6); E. gemmatum Breb. (6); E. insulare (Wittr.) Roy (3, 6, 11-b); E. pictum Borg. (1-a); E. pulchellum Breb. (6, 11-a, 11-b); E. sinuosum var. reductum West & West (11-a, 11-b); Cosmarium amoenum Breb. (5-b, 6); C. amoenum var. tumidum Wolle (6); C. bioculatum Breb. (11-a, 11-b); C. boeckii Wille (3, 6, 11-a, 11-b); C. botrytis Meneg. (2-a); C. broomei Thwaites (1-a); C. circulare Reins. (1-c, 6, 8-c); C. coelatum Ralfs (3); C. connatum Breb. (6); C. contractum Kirch. (2-a, 6); C. excavatum Nord. (6); C. galeritum Nord. (2-a); G. globosum Bulnh. (5-a, 6); C. impressulum Elfv. (6); C. intermedium Delp. (5-a, 5-b); C. margaritatum (Lund) Roy & Bis. (5-a, 6); C. moniliforme (Turp.)

Ralfs (1-a); C. meneghinii Breb. (5-a, 6); C. naeglianum Breb. (6); C. nitidulum DeNot. (5-a); C. orbiculare Ralfs (5-b, 6); C. ornatum Ralfs (2-a); C. ornatum var. protractum Wolle (1-a); C. pachydermum Lund (6); C. portianum Arch. (1-a, 6, 11-b); C. punctulatum Breb. (6); C. pyramidatum Breb. (6); C. quadrum Lund (6); C. regnelii Wille (11-b); C. regnesii Reins. (6, 11-b); C. renniforme (Ralfs) Arch. (11-a); C. repandum forma minor West & West (6); C. speciosum Lund (2-a); C. sublobatum Arch. (6); C. tumidum Lund (6); C. undulatum Corda (1-a, 1-c, 2-a, 3, 5-a, 5-b, 6, 8-c, 11-a, 11-b); C. undulatum var. minutum Wittr. (5-a); C. undulatum (? var. wollei) West (5-b, 11-a); C. viride (Corda) Josh. (5-a, 6); C. sp. (? gonatum) Breb. (2-a); C. sp. (? pseudoconnatum) Nord. (8-c); Micrasterias americana (Ehr.) Ralfs (1-c); M. laticeps Nord. (6); M. mahabuleswarensis Hobson (5-a); M. pinnatifida (Kuetz.) Ralfs (6); M. radiata Hass. (5-b, 6); M. sol (Ehr.). Kuetz. (6); M. truncata (Corda) Breb. (5-a, 5-b); Xanthidium antilopaeum (Breb.) Kuetz. (1-b, 6); X. antilopaeum var. minneapoliense Wolle (6); X. antilopaeum var. polymazum Nord. (5-a, 6); Staurastrum alternans Breb. (3); S. arctison var. glabrum West & West (5-b); S. aspinosum Wolle (6); S. bienianum var. ellipticum Wolle (5-b); S. brebissonii Arch. (6); S. brevispinum Breb. (5-a, 11-a); S. crenulatum (Naeg.) Delp. (6); S. dejectum Breb. (5-a); S. dickiei Ralfs (5-b); S. dilatatum Ehr. (2-a, 5-a, 5-b); S. gracile Ralfs (2-a, 5-a, 5-b, 6); S. granulosum (Ehr.) Ralfs (11-b); S. leptocladum Nord. (1-a, 5-a, 5-b, 6, 11-b); S. leptocladum var. divergens Nord. (1-c, 6); S. margaritaceum (Ehr.) Meneg. (5-a); S. megacanthum Lund (6, 11-a); S. odontatum Wolle (6); S. paradoxum Meyen (11-a); S. pilosum Arch. (3); S. tetracerum Ralfs (6); Arthrodesmus convergens Ehr. (6); A. incus (Breb.) Hass. (1-c, 11-a); A. incus var. extensus Anderson (11-b); A. octocornis Ehr. (11-a, 11-b); A. triangularis Lag. (11-a, 11-b); Spondylosium papillosum West & West (11-a, 11-b); S. planum (Wolle) West & West (6, 11-a, 11-b); S. pulchellum Arch. (11-a, 11-b); S. pulchrum (Bail.) Arch. (6); Hyalotheca dissiliens (Smith) Breb. (5-a, 6, 8-c); H. undulata Nord. (6); Onychonema filiforme (Erh.) Roy & Bis. (6); Sphaerozosma excavatum Ralfs (6); S. filiforme Rab. (6); S. granulatum Roy & Bis. (6, 11-a); Desmidium aptogonum Breb. (6); D. baileyi (Ralfs) Wolle (6); D. grevelii (Kuetz.) DBy. (6); D. longatum Wolle (6); D. swartzii Ag. (6); Gymnozyga moniliformis Ehr. (6); G. moniliformis var. gracilescens Nord. (6).

CHRYSOPHYTA

CHLOROTHECIACEAE: Ophyiocytium capitatum Wolle (11-a, 11-b); O. parvulum (Perty) A.Br. (6, 11-a, 11-b); O. sp. (1-c, 2-a).

TRIBONEMATACEAE: Tribonema bombycinum (C.A. Ag.) Derbes & Solier (6, 7-a, 8-a); T. minus (Wolle) Hazen (2-a, 5-a, 7-b, 8-b).

VAUCHERIACEAE: Vaucheria sp. (1-b, 3, 6, 8-c).

OCHROMONADACEAE: Dinobryon sp. (6).

RHIZOCHRYSIDACEAE: Lagynion sp. (? ampullaceum) (Stokes) Pascher (6).

COSINODISCACEAE: Melosira sculpta Kuetz. (8-b, 8-c); M. varians C. A. Ag. (2-b); Stephanodiscus sp. (8-a).

TABELLARIACEAE: Tabellaria fenestrata (Lyngb.) Kuetz. (1-a, 1-c, 2-b, 3, 7-a, 8-a, 11-a); T. fenestrata (? var. asterionelloides) Grun. (1-c); T. flocculosa (Rothe) Kuetz. (1-a, 1-c, 3, 4, 5-a, 7-a, 8-a, 11-a).

MERIDIONACEAE: Meridion circulare (Grev.) Ag. (1-c, 2-a, 3, 4, 7-a); M. intermedium H. L. Smith (1-c, 3, 7-a).

DIATOMACEAE: Diatoma anceps (Ehr.) Kirch. (4).

FRAGILARIACEAE: Fragilaria sp. (? capucina) Desmaz. (1-a, 1-c, 2-a, 3, 4, 5-a, 7-a, 8-a, 11-a); Synedra acuta Ehr. (1-c, 3, 4, 8-a); S. radians Kuetz. (2-a, 8-e, 11-a); S. ulna (Nitzsch) Erh. (3); S. ulna var. biceps (Kuetz.) Schoen. (8-a); S. ulna var. danica (Kuetz.) Grun. (4, 8-a, 8-b, 8-c).

EUNOTIACEAE: Eunotia robusta var. diadema (Ehr.) Ralfs (11-a); E. robusta var. tetrodon Ralfs (3).

NAVICULACEAE: Navicula diaphala (Ehr.) W. Smith (5-a); N. sp. (1-a, 3, 4, 5-a, 7-a, 7-b, 8-b, 8-c, 10); Stauroneis inflata Kuetz. (8-c); S. sp. (3).

GOMPHONEMATACEAE: Gomphonema acuminatum var. coronatum (Ehr.) Ralfs (11-a, 11-b); G. constrictum Ehr. (2-a, 11-a); G. dichotomum Kuetz. (7-b, 8-b); G. geminatum (Lyngb.) C.A. Ag. (7-a, 11-a); G. sp. (1-a, 1-b, 8-b).

CYMBELLACEAE: Cymbella sp. (3, 4, 5-a); Epithemia sp. (5-b).

SURIRELLACEAE: Surirella sp. (4).

EUGLENOPHYTA

EUGLENACEAE: Euglena polymorpha Dangeard (6, 10); E. sp. (3, 5-a, 5-b, 6, 10); Phacus sp. (3, 5-a); Trachelomonas hispida (Perty) Stein (6).

PYRRHOPHYTA

PERIDINIACEAE: Peridinium cinctum (Muell.) Ehr. (6).

CYANOPHYTA

CHROOCOCCACEAE: Microcystis aeruginosa Kuetz. (2-a, 2-b, 2-c, 9, 11-a); M. incerta Lem. (9); Merismopedia glauca (Ehr.) Naeg. (5-a, 5-b); M. tenuissima Lem. (6); Aphanothece castagnei (Breb.) Rab. (6); Coelosphaerium collinsii Drouet & Daily (11-a); Marssoniella elegans Lem. (6); Glaucocystis nostochinearum (Itz.) Rab. (6, 11-a); G. oocystiformis Prescott (6).

OSCILLATORIACEAE: Spirulina laxa G. M. Smith (6); S. sp. (5-a); Trichodesmium lacustre Kleb. (3); Oscillatoria agardhii Gomont (11-b); O. amphibia C.A. Ag. (11-a); O. articulata Gardner (1-a, 11-b); O. curviceps C.A. Ag. (6); O. lacustris (Kleb.) Geitler (3); O. sancta (Kuetz.) Gomont (6); O. subtilissima Kuetz. (6); O. tenuis C.A. Ag. (1-c, 8-a, 8-c, 10); O. sp. (? angusta) Koppe (8-b); Phormidium inundatum Kuetz. (1-b, 2-a, 4, 11-b); P. retzii (C.A. Ag.) Gomont (4, 8-b, 11-b); Lyngbya aerugineo-coerulea (Kuetz.) Gomont (3).

NOSTOCACEAE: Anabaena affinis Lem. (2-a, 2-b, 2-c, 5-a); A. flos-aquae (Lyngb.) Breb. (11-a); A. oscillarioides Bory (8-c); A. spiroides Kleb. (9).

SCYTONEMATACEAE: Hapalosiphon hibernicus West & West (6); Stigonema mamillosum (Lyngb.) C.A. Ag. (11-a).

RIVULARIACEAE: Gloeotrichia echinulata (J.E. Smith) P. Richter (6); Calothrix epiphytica West & West (5-b).

RHODOPHYTA

CHANTRANSIACEAE: Audouinella sp. (4).

BATRACHOSPERMACEAE: Batrachospermum vagum (Roth) C.A. Ag. (4). — DEPT. OF BOTANY, CORNELL UNIVERSITY, ITHACA, N. Y.

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FURTHER NOTES ON CHAMAECYPARIS THYOIDES IN NEW HAMPSHIRE

Henry I. Baldwin

H. K. Svenson (Rhodora 31: 96-98, 1929) describes his three visits to the towns of Bradford, Windsor and Washington, N. H. when he located *Chamaecyparis thyoides* (L.) BSP., in Bradford near the Washington line, presumably along the highway from East Washington to Bradford Center, and at Black Pond and Bagley's Pond in Windsor. He failed to find any stations for this species in the town of Washington, although he and Prof. Fernald made a considerable search for it. Recently, in connection with explorations made for the purpose of acquiring an area where this species might be preserved, the following observations were made. As mentioned by Svenson, this tree is continually being cut for posts and poles, and is fast disappearing. Flooding by beaver dams as well as man-made dams has also taken its toll.

1. *Bradford swamp* adjoining Bradford Mineral Springs is one of the most extensive habitats. It extends from the highway between East Washington and Bradford Center, south to the Bradford-Hillsboro town line and farther along the brook into Hillsboro a considerable distance, where cedar is found today as widely separated single specimens. Along the western side of the swamp near the Bradford-Washington line there still remain clumps of larger trees up to 10″ in diameter, with scattered smaller trees on the fringes of areas clear-cut in 1958. No trees have been found in Washington; it seems probable that collections labelled "East of East Washington Village" were actually made in Bradford. The eastern side of the swamp also contains at least one untouched stand on the fringe of an open black spruce bog. Some cedar is to be found north of the highway near the northern margin of the swamp.

2. *Mud Pond* (also known as Ayers or Nichols Pond) elevation 900′ (area 4.6 acres of which 3 are in Hillsboro) through which the Bradford-Hillsboro town line passes, has long been known to the writer as a station for cedar. When visited over 20 years ago the impression was gained that an extensive stand of fairly large trees surrounded the pond. Possibly these have since been cut. When visited in March 1961 the following observations were made: A small clump of cedar is situated on the southwest border of the pond. The trees are small — mostly 1″ to 4″ in diameter. There is also one small tree on the southeast shore, and one 5″ tree on the east shore. All these are in the town of Hillsboro. There are also four trees along the northeast shore lying in Bradford. Carter Pond at the same elevation, and ringed by black spruce bog, apparently an identical habitat, was searched but no cedar found.

3. *Bagley's Pond,* mentioned by Svenson as a station, lies partly in Windsor and partly in Hillsboro at an elevation of 1,146′. It is 40 acres in extent, of which only three acres are in Hillsboro near the outlet. This was visited on March 26, 1961 and as in the case of the other areas, explored on skis on a hard crust. It was easy to cover all the shore line and the swampy areas at the inlet and outlet. No trace of cedar was found. The water level appeared to have been raised about two feet by a beaver dam at the outlet at some time in recent years and pine, spruce, hemlock and some hardwoods killed, especially in the swamp around the inlet at the west end. A thorough search of this area failed to disclose any dead cedar or stumps. Since Svenson mentioned finding cedar in Bagley's Pond in Windsor, it was presumably in this area where the trees occurred.

4. *Black Pond* in Windsor, elevation 1058′ (area 39 acres) has two main inlets on the south and west bordered by extensive swamps. The water level was raised many years ago for a mill at the outlet, the present site of Windsor Mt. Camps. The dam has been repaired and maintained by the camp. The shores are rather steep in the main part of the pond and no cedar is encountered until one passes the principal island. Part of swamps around the inlets are occupied by cedar of small size, mostly 1″ to 4″ in diameter, growing in thick clumps, usually associated with old stumps of the original cedar that was cut many years ago. The living trees are not over 10 feet in height. Mingled with these are numerous dead cedars of larger size (5″-6″ diameter and 20′ high) that may have been left in the original cutting and killed when the dam was built. All the presently living trees are in water, but the level must drop sufficiently in summer to permit them to survive. Some of the older stumps are one to two feet in diameter. Sections cut from these showed that growth had been extremely slow. One large stump had grown 0.3 inches during the last 10 years; 0.45 inches between 10 and 20 years, and 0.6 inches from the 20th to 30th year, counting back from the bark. Allowing for more rapid growth in youth this would still make it over

100 years old. A 6″ standing dead cedar averaged about 20 rings per inch. Nearby White Pond in Windsor and Stoddard was explored but no cedar found.

5. *Swamp NW of Loverens Mill* on Route 9, Antrim, N. H., elevation 1,036′. This extends for one mile north to the Windsor town line, and is separated from the Black Pond bog by a low height-of-land. Cedar is abundant in the poorly drained portions, disappearing wherever water movement becomes pronounced. It grows in mixture with black spruce *Picea mariana*, red maple and occasional white pine. There is no evidence of cutting in the southern portion, the only part visited. The largest cedars are 6″ to 8″ d.b.h. and younger, smaller trees are scarce due to the dense stand. The extent of the cedar area was not determined.

6. *Robb Reservoir* in Stoddard, elevation 1,275′. Cedar may be seen along the highway from Route 123, about 1 mile south of South Stoddard. This is a swamp at the south end of the Reservoir. Again the cedar occurs in mixture with black spruce and shrubs. (No cedar was found at the outlet or along the shores of Rye Pond in Nelsona short distance to the SE.) Cedar at the Stoddard site was commonly infected with *Gymnosporangium biseptatum.*

Apparently *Chamaecyparis* has not been previously reported from Antrim, Hillsboro or Stoddard, N. H. Hodgdon & Steele[1] do not list these towns. Specimens from these areas have been deposited in the herbaria of the N. E. Botanical Club and the University of New Hampshire.

This tree was found only in wet bogs or swamps with standing water the year round, and with imperfect drainage. Where water movement was evident no cedar was found. Common associated species were black spruce, *Picea mariana* (Mill.) BSP., tamarack, *Larix laricina* (Du Roi) K. Koch, red maple, *Acer rubrum* L., mountain holly, *Nemopanthus mucronata* (L.) Trel., highbush blueberry, *Vaccinium corymbosum* L. and cassandra, *Chamaedaphne calyculata* (L.) Moench. all growing in sphagnum. While cedar was found under these conditions, and in association with these

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[1] Hodgdon, Albion R. and Frederic L. Steele, 1958. The Woody Plants of New Hampshire, Bull. 447, N. H. Agr. Exp. Sta.

species, the converse was not true. There are numerous other sites with apparently identical habitat conditions where cedar has not been found. It may very likely occur in other places not yet examined. Certainly it is not possible to state that *Chamaecyparis* does *not* occur in a township without a very detailed survey.

This brief survey of *Chamaecyparis* at its known northwestern limit in New Hampshire serves to indicate the precarious status of plants that cannot maintain themselves when the environment is altered. Reproduction is scanty, growth is slow and is inadequate to restore stocking when cutting and flooding destroy the seed bearing trees. Unless some areas are placed under protection it will be only a matter of time before all *Chamaecyparis* disappears from this region, as it apparently already has from Bagley's Pond.
— FOX RESEARCH FOREST, HILLSBORO, NEW HAMPSHIRE.

WHICH SIDE IS UP? A LOOK AT THE LEAVES OF ORYZOPSIS

EDWARD G. VOSS

It was no less noted a critic than M. L. Fernald who asserted: "errors once born never die but, on the contrary, by others not situated to know the facts are continually mistaken for the truth and consequently perpetuated." (Rhodora 44: 246. 1942.) After examination of a long series of Michigan specimens of a grass common in dryish woods throughout the state, *Oryzopsis asperifolia* Michx., I was not a little surprised to read in Fernald's 8th edition of Gray's Manual (1950) that the leaves of this species have a "*glaucous lower surface*" (italics are the original emphasis).

Professor Fernald is in good, if not accurate, company. The first edition of Gray's Manual (1848) described the leaves as "pale underneath," and they have been similarly described in all subsequent editions. Torrey's great Flora of New York (1843) — a source in which I often find accurate bits of description omitted by other authors — considers the leaves "glaucous underneath." The official verdict of the Manual of Grasses (1935 & 1951 editions) is "glaucous beneath." Gleason's New Illustrated Flora (1952) says "pale . . . beneath." Harrington (Man. Pl. Colo., 1954) uses the phrase "rather glaucous below."

The embarrassing fact is that it is the *upper* (adaxial) surface of the leaf blades (a conspicuous 4-10 mm wide) which is glaucous. The truth is readily determined by following a blade as it extends from the sheath. In his original description, Michaux said nothing about glaucousness, and I do not know who started the error; possibly it was Torrey. Many authors, whether intentionally or not, have kept their records clean by declining to report on this point: Pursh, Bigelow, Eaton, Wood, Britton & Brown, etc.

The typically careful Deam (Grasses Ind., 1929) does not mention glaucousness, but does describe the blades as involute at the base, thus revealing his correct observation of the orientation of the leaf. (Descriptions of the margins as "revolute" show the same lack of understanding of which side is up.) Jennings (Wild Fl. West. Pa. & Upper Ohio Basin, 1953) merely describes the leaves as "glaucous," not committing himself as to surface. In a cursory examination of literature, I have found no one who actually describes the upper surface as glaucous.

Species possessing leaves with revolute margins and a glaucous under surface are not unusual. Involute margins and a glaucous upper surface would ordinarily, to be sure, be unexpected, although the leaves of *Oryzopsis pungens* (Spreng.) Hitchc. are almost universally described as very narrow and involute and one might therefore expect that in *O. asperifolia* they are simply wide and involute. Assuming that some, if not all, authors have based their mention of a glaucous surface on an examination of plants and not on second-hand information, apparently the examination was not extended to checking just which side of the leaf was being observed. This is one case in which herbarium specimens are more easily interpreted than plants growing in the field. For in the latter, the leaves (essentially basal) spread out loosely over the ground, with the glaucous upper surface usually appearing falsely to be the lower one, as the tough evergreen blades turn on their very narrow, involute, nearly terete, and evidently weak bases. However, one may easily trace the adaxial surface with the naked eye from the inside of the sheath, past the tiny ligule, through the groove in the slender base of the blade, to the broad glaucous surface with usually involute margins.

The leaves of *Oryzopsis racemosa* (Sm.) Hitchc., being cauline rather than basal, and even more conspicuous, have fared a little better in manuals and the score is nearly even. The Manual of Grasses says "pubescent beneath," and Gleason uses the identical phrase. Torrey (under the synonym *O. melanocarpa*) again disappoints us, with "pubescent underneath." Deam, however, says "pubescent above," as does Fernald in the 8th edition of Gray's Manual, and as did the 7th edition (earlier ones omitting the point). Jones (Fl. Ill., 1950) says "the upper surface pubescent." On all specimens which I have examined, the leaf blades are characteristically short-pilose *above*, although there is sometimes a little pilosity below in addition.

If a moral is to be drawn from these simple observations, it is that those who write local floras have no basis for an accurate product other than painstaking examination of "nature, not books." — HERBARIUM, UNIVERSITY OF MICHIGAN, ANN ARBOR.

A CHECK LIST OF WALTER DEANE'S SEEDLING COLLECTION

RICHARD J. EATON

The extensive and beautifully prepared herbarium of Walter Deane came to the New England Botanical Club by bequest in 1931. It included a bundle which he had designated as his "Seedling Collection" made in 1895 or thereabouts. It consists of meticulously prepared and well-mounted specimens representing fifty-two species in forty-three genera. For each species there are from one to five or more sheets with the specimens arranged in sequence according to age from cotyledon stage onwards. In many cases a fruiting specimen from the putative parent plant is exhibited as a voucher; in others, a specimen in similar condition collected from the immediate vicinity. In every instance mature identifiable material accompanies the seedlings. Mr. Deane's label data and supplementary field notes are convincing: one is persuaded to accept the identifications without skepticism.

It has been decided to insert this collection, appropriately segregated in separate species covers, in the organized herbarium of the Club. Before doing this, the appended check list was prepared, the nomenclature being revised to conform to that of Gray's Manual, 8th Edition. Without such a list the collection would be effectively lost among the eleven thousand or more species covers which enfold the two hundred thirty thousand mounted sheets in the Club herbarium. Actually, I think that a portion of the original collection, or perhaps a supplement to it, has been "lost" in this manner, because I have encountered from time to time an occasional sheet of seedlings labeled in Mr. Deane's well-known handwriting. From now on a record of such encounters should be kept so as to build up as complete a check list of the Deane seedlings as possible.

1. Abies balsamea
2. Picea mariana
3. Pinus Strobus
4. Alisma triviale
5. Betula lutea
6. Ulmus americana
7. Polygonum aviculare
8. P. Persicaria
9. P. orientale
10. P. Convolvulus
11. P. scandens
12. Chenopodium album
13. Atriplex patula var hastata
14. Salicornia europaea
15. Salsola kali
16. Amaranthus retroflexus
17. Portulaca oleracea
18. Spergularia marina
19. Stellaria media
20. Silene Cucubalus
21. Adlumia fungosa
22. Cakile edentula
23. Sisymbrium officinale var. leiocarpum
24. Tiarella cordifolia
25. Hamamelis virginiana
26. Geum urbanum
27. Prunus serotina
28. Trifolium repens
29. Lathyrus japonicus var. glaber
30. Oxalis montana
31. O. corniculata
32. Acalypha virginica
33. Euphorbia polygonifolia
34. Acer pensylvanicum
35. A. rubrum
36. A. spicatum

37. Impatiens capensis
38. Malva rotundifolia
39. Circaea alpina
40. Fraxinus americana
41. F. nigra
42. Lamium amplexicaule
43. Lycopus americanus
44. Campsis radicans
45. Plantago rugelii
46. Galium triflorum
47. Solidago sempervirens
48. Ambrosia artemesiifolia var. elatior
49. Bidens connata var. gracilipes
50. B. frondosa
51. Arctium tomentosum
52. Taraxacum officinale

THE BULBIFEROUS RANUNCULUS FICARIA. — Recent examination of this European species in two localities in the Boston area has shown that in both cases it is represented only by the bulbiferous variety, *Ranunculus ficaria* L. var. *bulbifera* Marsden-Jones. Cytotaxonomic studies carried out in Britain have shown that *Ranunculus ficaria* exists in at least two cytodemes, the diploid *R. ficaria* var. *ficaria* (*R. ficaria* var. *fertilis* Clapham) ($2n = 16$) and the tetraploid *R. ficaria* var. *bulbifera* ($2n = 32$). They are separable on a number of minor morphological and ecological features (see Marsden-Jones in Jour. Linn. Soc. Lond. Bot. **50**: 39. 1935 or D. E. Allen in Proc. Bot. Soc. Brit. Is. **3**: 45. 1958, or even van Tieghem in Ann. Sci. Nat. sér. 5, 5:88. 1866 who was naturally unaware of the cytological significance of his observations.) but most significant and noticeable of all is the fact that the tetraploid bears bulbils in the leaf axils and has a very reduced seed fertility whereas the diploid is quite fertile and does not produce bulbils. These bulbils do not become apparent until after the plant has been in flower for a few days when they rapidly enlarge to about the size of a grain of wheat.

The two populations examined this spring, one in the garden of 383 South Street, Jamaica Plain and the other in the Case Estates at Weston, both show the production of abundant bulbils. Cytological examination of both populations was made using acetocarmine squashes of the developing bulbils. This proved to be very favorable material, particularly during early stages of development, at which time a mass of cells near the apex of the bulbil is dividing quite rapidly. The chromosomes are rather long, however, and better preparations were obtained when the material was pre-treated for three hours in colchicine to shorten the chromosomes, fixed in Carnoy's solution, and softened for 10-15 minutes in 10% HCl.

In both populations examined the bulbils were found to be composed primarily of tetraploid cells ($2n = 32$). However, occasional triploid cells were observed in several bulbils from both populations. A few cells seemed to have a chromosome number intermediate between triploid and tetraploid, but in all cells that could be counted with certainty the somatic number was either 24 or 32. Possibly the cytological situation here is comparable to that observed in tissue cultures in which there is considerable variation in chromosome number. (See Torrey, J. G. in 7th Symposium of Society for the Study of Development and Growth, 189-222. 1959.)

Examination of the pollen revealed that less than 20% of the grains were either abortive or failed to stain normally. The remaining grains stained densely with acetocarmine and appeared normal, except for the fact that the size variation was rather high. It seems unlikely that the plants could be triploid and produce pollen that is over 80% fertile. Triploids have been reported in *Ranunculus ficaria* from areas in which the diploid and tetraploid varieties overlap, but these triploids are characterized by a high percentage of abortive pollen (Neves in Bol. Soc. Brot. ser. 2, **16**: 169. 1942, see also 46th (1955), Ann. Rept. John Innes Hort. Inst. 20-21. 1956). The plants in the above populations produced no fertile achenes this spring, but in view of the reasonably high pollen fertility observed it is possible that these plants are outbreeders and appear sterile due to the lack of pollen from a different individual. The populations examined were small and probably consist of a single vegetative clone. It is hoped that cross pollinations and a study of meiotic material next spring will clarify this point.

The specimens of *Ranunculus ficaria* in the Gray Herbarium and the New England Botanical Club Herbarium were next examined and it is significant that whereas several specimens show distinct axillary bulbils, none of the others may be identified with certainty as var. *ficaria*. Those where bulbils were not apparent were all collected early in the flowering season before the end of April when the bulbils would not be seen even on var. *bulbifera*. Every one of the specimens gathered after the beginning of May shows the presence of bulbils.

The examination of other herbaria would no doubt reveal other records and a tour of New England reveal other populations, but the main object of this note is to draw the attention of botanists in N. E. America to the existence of this polyploid and bulbiferous variety. It would also be most interesting to know whether it is only this variety that has been introduced from Europe.

The following are the herbarium records we have seen of var. *bulbifera*. CANADA. QUEBEC: comté de Jacques-Cartier, ville-Lasalle, dans les bruissons le long d'une clôture, 23 May, 1932. *Marie-Victorin & Rolland-Germain 46, 833* (GH). UNITED STATES. MASSACHUSETTS: Middlesex Co., Cambridge, spreading in William Brewster's garden, 8 May 1914, *Walter Deane* (NEBC); Norfolk Co., Milton, wild weed of my garden, 23 June 1923, *N. T. Kidder* (NEBC); Plymouth Co., South Hingham, May 1891, *H. W. Cushing* (GH) and moist soil in garden, transplanted from original locale, 10 May 1947, *C. H. Knowlton* (NEBC); Worcester Co., Lancaster, wild garden of Mrs. N. Thayer, never seen there before, June 1924, *Mrs. J. E. Thayer* (NEBC). PENNSYLVANIA: Philadelphia, "Nurseries", Fairmont Park, 7 May 1910, *H. St. John 111* (GH). (Herbarium specimens of plants that were examined cytologically in this investigation have been deposited in the Gray Herbarium). — PETER S. GREEN AND JOAB L. THOMAS, ARNOLD ARBORETUM, HARVARD UNIVERSITY.

A USEFUL MULTILINGUAL BOTANICAL DICTIONARY.[1] — In recent years more and more scientists in the New World have taken up the study of Russian in order to benefit more directly from the flood of Russian scientific books and papers now available to them through various channels. For most of them this pays, instead of waiting an inordinately long

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[1] N.N. Davidov and F. Kh. Bakhteyeva, 1960: Botanical Dictionary, Russian-English-German-French-Latin. — Glavnaya Redaktsiya Inostrannykh Nauchno-Teknicheskikh Slovarey Fizmatgiza, Leninsky Prospekt 15, Moskow V-71. 1 ruble 16 kop.

time for an official translation, the appearance of a reference journal where the desired information may be found, or such. But with only a slight knowledge of Russian and perhaps a not too good dictionary at hand, it can at times be quite hard to get the exact meaning of terms. However, at least for botanists, this dilemma is now solved with the appearance of a multilingual botanical dictionary, compiled by N. N. Davidov and edited by F. Kh. Bakhteyev.

The book is actually a list of botanical terms and plant names directly translated from Russian into English, German and French as well as Latin, and permits quick translation to or from any of these five languages. Thus it is actually of a much wider use than for those reading Russian texts only, and is a help also for English-speaking botanists reading French, German or even Latin works. According to the foreword, it is the first time that such a botanical dictionary has been published in Russia, and the authors are to be congratulated on their achievement.

The dictionary contains about 6000 botanical terms of which some 30% refer to plant names only. The choice of vernacular names in English, French and German has certainly been a difficult task, and some rarely used names are met with here and there. But as the Latin names — in some cases the specific name, in others only the generic name, but always the family name — are included also, no real difficulty of identification of the common name is met with. Names of wild plants are of course referable mostly to Russian species, but common names for a goodly number of cultivated plants from the world over are also included.

Regarding the about 4000 proper terms themselves, it is pleasant to note that they cover the botanical field very widely and seem to reach out into neighboring fields such as cytology and genetics as well.

It is quite evident, however, that the authors have done their utmost to make the book compact, and to give for each Russian word, if possible, only a single-word expression in the other languages. This has resulted in the choice of a number of the English terms seemingly rather unfamiliar to the young botanists who do not have the knowledge of Latin and Greek, which was so useful to their older colleagues. Such words as grumous, hiant, irrorate, vittate and poecilophyllous, to mention a few random examples, might have been better translated with a more modern expression such as, respectively: lumpy (about roots), gaping, sprinkled with dew, with bands or stripes, with various-colored leaves. Fortunately most of these unfamiliar words are explained by a glance at the corresponding German or French expressions, or are relatively easy to find in the Oxford, Webster, or some other widely used English dictionaries. So far, I have been unable to find the English counterpart of the word "trullifolius" only, but as the Botanical Dictionary itself gives the word "trulliformis" as corresponding to "saucer-shaped", it requires only a small portion of imagination to understand that "trullifolius" means "with saucershaped leaves". This phrase would, of course, have been better to use than the old-fashioned Latin derivative. There are admittedly a number of such outmoded English expressions in the book, but not nearly enough to cause concern, and as demonstrated, usually possible to get at by some round-about way.

In rapidly reading through all the English terms listed in the English index, I came across a few unfortunate misspellings (e.g. s*k*iophyte for s*c*iophyte, diclin*y* instead of diclin*ism,* induvi*a* for induv*ium*) which have eluded the authors themselves, who found about 25 words from all the languages requiring correction on an inset leaf at the end of the book. In comparison to the total number of words in the book, these misprints are indeed very few and in no case really serious or misleading.

The few negative remarks above should not be allowed to obscure the more excellent properties of the book. A very good feature is the accentuation of the Russian words and the indication of the gender of all nouns in Russian as well as in German and French, even when these words are preceded by adjectives. This is actually more information than is given in some current and in other respects excellent Russian dictionaries, and a feature that will be very helpful to students using this book.

The unusual arrangement of numbering each Russian word in the actual dictionary part of the book, and using these numbers in the clear and easily read English, German, French and Latin indices for a quick reference to the location of the particular word in the dictionary is highly laudable. It is particularly this feature that makes the use of the book so universal and not only restricted to those who want to read a Russian text or translate into Russian. Now anybody, say English-speaking, who wants to read e.g. a French, German or even Latin text, can use this handbook to full advantage, even if he is completely ignorant of any Russian, its letters or order of alphabet. The following line may serve as an example of the system:

453 BÉTKA f || bough, branch, limb || Ast m, Zweig m || branche f || ramus.

The Botanical Dictionary is clothbound, of a handy, compact size, well printed and very easy to read. It is thus a pleasure to recommend this excellent book to all colleagues in the wide field of Botany and not only to those directly interested in Russian botanical literature. It could be said about it that it is truly an aid to international understanding. — DORIS LÖVE, INSTITUT BOTANIQUE, UNIVERSITÉ DE MONTRÉAL, CANADA.

A NOTABLE ASSEMBLAGE OF PLANTS IN NEW HAMPSHIRE. — This note concerns an area of hardwood forest several of whose plentiful species of ground-flora suggest conditions unusually rich for east-central New Hampshire.

The area — rather stony and originally alluvial, though most of it may be inundated only once in a decade or two — lies in the extreme northeast corner of Sandwich in Carroll County, N. H. It is reached from Route 113A at Wonalancet in Tamworth by crossing Wonalancet River at the bridge by the post office and then proceeding 0.7 miles up a gravelled public road to Squirrel Bridge (over the same river) 30 feet down a private road.

The plot of chief interest starts on the north edge of the private road — a narrow, wooded, dirt one — by a telephone pole about 70 feet south and west of the bridge and extends westerly along the road 100 feet. In width, it extends northerly toward the river a mere ten feet; beyond that width, the dense herbaceous cover thins out greatly and the more unusual species disappear.

The most unexpected plant is *Asarum canadense* L. This and *Viola pensylvanica* Michx. *var. leiocarpa* (Fern. & Wieg.) Fern. are perhaps the two most abundant herbs. They occur little if any beyond the ten foot line back from the road, and elsewhere in the general area and within 100 feet of the river they seem to be found only along the edge of the same road and of smaller wood roads and paths.

Two other rich-woods plants in the plot are *Botrychium virginianum* (L.) Sw. and *Dicentra Cucullaria* (L.) Bernh. Other more commonplace herbs readily identifiable in June include, more or less in decreasing order of abundance there, *Uvularia sessilifolia* L., *Viola rotundifolia* Michx., *Dryopteris Phegopteris* (L.) Christens., *Arisaema atrorubens* (Ait.) Blume, *Smilacina racemosa* (L.) Desf., *Polygonatum pubescens* (Willd.) Pursh, *Trillium erectum* L., *Streptopus roseus* Michx. *var. perspectus* Fassett, and the two species of *Actea* L.

The two commonest shrubs on the plot are *Acer spicatum* Lam. and *Prunus virginiana* L. The two commonest trees are *Acer saccharum* Marsh. and *Fraxinus americana* L. *Juglans cinerea* L. and *Tilia americana* L. overhang parts of the plot.

Additional plants of interest occurring nearby along the river or within 100 yards downstream and somewhat unusual for the region are *Sanguinaria canadensis* L., *Viola Selkirkii* Pursh, and *V. renifolia* Gray.

Frederic L. Steele assisted me with identifications in the field.

The plot on which the above plants are growing, as well as adjoining land, is threatened with development for house lots. — ALEXANDER LINCOLN, JR., MEREDITH, NEW HAMPSHIRE.

THE SPECIFIC EPITHET OF THE PECAN. — According to Article 73 of the International Code of Botanical Nomenclature (Regnum Vegetabile **8**: 46. 1956), "The original spelling of a name or epithet must be retained, except that typographic or orthographic errors should be corrected." Fernald (Rhodora **49**: 194-196. 1947) showed that *Juglans illinoinensis of* Wangenheim (Beytr. z. teutsch. holzg. Forstwiss. Nordam. Holz. 54. 1787) is the earliest valid name for the pecan. Koch (Dendrologie 1: 593. 1869) transferred *Juglans illinoinensis* to *Carya,* but altered the spelling of the specific epithet to *illinoënsis.* Koch's version of the epithet (with or without the diaeresis) is the one now universally used — in violation of Article 73 — in North American botany. Rehder (Journ. Arn. Arb. **22**: 572. 1941) expressed the opinion that the spelling *illinoinensis* used by Wangenheim is possibly "a typographical error or . . . a slip of the pen." Such would not seem to be the case because *illinoinensis* occurs at least twice in Wangenheim's work: in the description of the "Illinois Wallnut Tree" on page 54, and in the running head on page 55. *Illinoinensis* was surely intentionally spelled so. Admittedly, Wangenheim's spelling is perhaps not the best for a Latin adjective derived from a French word. "Illinoisensis" or even "illinoensis" may be preferred, although there would appear to be no hard and fast rule for the Latinization of a word such as Illinois. All this is beside the point, however. The fact remains that Wangenheim used *illinoinensis* and that this spelling must, according to the Code, be retained. The scientific name of the pecan is *Carya illinoinensis,* not *C. illinoensis.* — JOHN W. THIERET, CHICAGO NATURAL HISTORY MUSEUM.

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INTROGRESSION OF ALNUS SERRULATA AND ALNUS RUGOSA

FREDERIC L. STEELE

In the eighth edition of Gray's Manual of Botany, two species of alders in the subgenus Alnus are indicated as occurring in New Hampshire, each of which has a variety and several forms. The two species are distinguished as follows: *Alnus rugosa* (Du Roi) Spreng. has leaves with a rounded base, ovate or elliptical in shape with a tendency to be broadest below the middle, doubly-toothed leaf margin, strong veins on the green lower surface, prominent lenticels on the stems, and nutlets and bracts with a characteristic shape. Its variety *americana* (Regel) Fern. differs in having leaves glaucous rather than green underneath. *Alnus serrulata* (Ait.) Willd. has leaves with angled or cuneate base, obovate and broadest above the middle, a margin almost singly toothed, weak or vanishing veins on the green or glutinous lower surface, inconspicuous lenticels, and nutlets and bracts differing from *A. rugosa* in a way to be stated later. Its variety *subelliptica* Fern. has broader leaves, although still broadest above the middle, and a rounded leaf base.

The present study was started when the writer became interested in the northern limits of the ranges of these two species and their varieties in New England. *A. rugosa* var. *americana* is a well-marked variety occurring throughout northern New England and extending north to Labrador. Fernald (1945) states that this variety is decidedly more northern in range than var. *rugosa*. An investigation of the range of the latter from herbarium sheets presented some difficulties. The question of whether leaves are glaucous or green can only be determined from mature leaves and in natural light. Under these conditions, if the observer has had some practice, the distinction is readily apparent. Many of the herbarium specimens were collected in April when there were no leaves, so that the distinction can not be made. In other cases, the specimens were mounted in such a way that it was possible to examine the lower surfaces of the leaves. Subsequent field observations indicate that the new leaves of var. *americana*, as they appear in June are green; by early July they become glaucous. Alder typically grows in swamps or open low land; when it grows in shady environments the leaves are thin and pale green with the glaucous character barely discernible. The material on some sheets that were labeled var. *rugosa* was of uncertain identity. Altered notations on many sheets indicated confusion of *A. serrulata* with *A. rugosa* var. *rugosa*.

In Tamworth, New Hampshire, A. *rugosa* var. *americana* is common in open moist habitats. There plants are quick to invade a poorly-drained hayfield and are also common along streams. *A. serrulata* is near its northern limit in Tamworth and is confined to shores of lakes and occasionally along edges of rocky streams. Some plants occur that can be referred to *A. rugosa* var. *rugosa*. These, however, although having green leaves which set them off from var. *americana* are not readily distinguishable from *A. serrulata*. As the scope of this investigation was broadened to include the whole state of New Hampshire, this situation was observed to be characteristic. It seemed probably that hybridization and introgression were going on between *A. rugosa* var. *americana* and *A. serrulata* producing a mixed assemblage of plants, some of which could be referred to var. *rugosa*.

To investigate this situation, it was decided to study populations and analyze them by pictorialized scatter diagrams of the type devised by Anderson (1949, 1952, 1953). Characters to be used were based on leaves, lenticels, and fruit. As there is considerable variation in leaves on sterile plants, especially on young shoots, only leaves on fruiting branches were used. Preferably these were collected after the middle of July when the fruit was mature. An alder colony typically consists of a number of separate clumps of plants, which, judging from the variation that occurs, are clonally distinct, although it is possible that in some cases a new clump could arise from a rootstock. In a colony extending for a distance of two or three hundred feet, many plants may not fruit, so the sampling consisted of collecting branches from available fruiting plants that appeared to be separate. Leaves on fruiting branches are typically quite small. Where possible a branch was collected with at least one undamaged leaf six to eight centimeters in length. Lenticel type is significant, and, as collection of bark is difficult, the character of the lenticels was noted at the time. Notches were then cut on the branches in accordance with a standardized code; three notches indicating prominent lenticels, two indicating that some were indefinite, and one indicating the lenticels were indistinct.

Seven characters were scored including most of those used by Fernald in the eighth edition of Gray's Manual. The angle at the base of the leaf was measured on a 15° degree sector scale.

Single as opposed to double serration was determined by counting the major teeth on one leaf margin using certain "typical" leaves from well marked samples of the two species as standards for comparison.

The character of the lower surface of the leaves, ranging from glutinous to glaucous, was determined by examining the leaves in daylight and again comparing with standards. Usually the distinction between green and glaucous was obvious, but where the glaucous character could barely be discerned, the leaves were marked pale. Sometimes it appeared as if the leaves were glaucous because of disease.

To measure whether the leaf was broadest above or below the middle, it was placed on graph paper and the broadest point determined. The distance from this point to the midpoint of the leaf was divided by half the length of the leaf to form the "midratio". This was taken as positive if the broadest point was above the middle and negative if it was below.

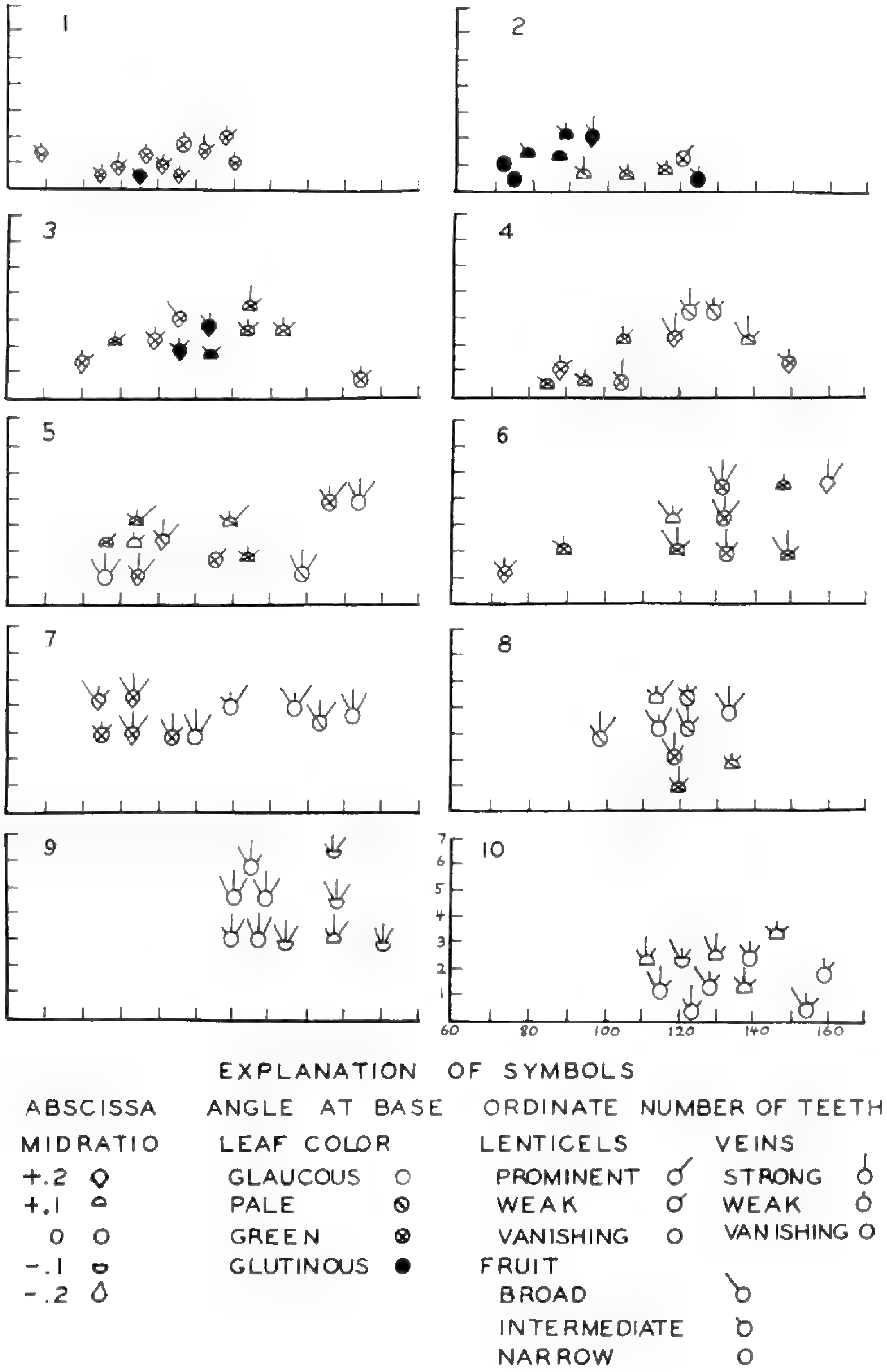
Lenticels, especially on larger stems, are usually prominent in the case of *A. rugosa* var. *americana* and indistinct in the case of *A. serrulata*. The lenticel character was recorded at the time of collection as indicated above.

Veins on the lower surface were ranked as prominent, intermediate or vanishing. This character was somewhat variable, but well-marked trends were apparent. The leaves were compared with characteristic leaves of *A. serrulata* and of *A. rugosa* var. *americana* and rated according to which one of the two they most nearly approached.

Well developed nutlets and bracts of the two taxons seemed to be markedly different. The bracts of *A. serrulata* have a lower portion with straight narrow sides with the upper portion rather abruptly flaring; the bracts of *A. rugosa* var. *americana* have the lower portion with diverging sides, with the upper portion less distinct. Nutlets of var. *americana* tend to be rhombic with the top portion triangular. Nutlets of *A. serrulata* are obovate with prominent shoulders at the top. These differences become apparent when the fruit is mature; about the middle of July in New Hampshire. On the diagrams the fruit is labeled broad if the nutlets and bracts resemble var. *americana;* narrow if they resemble *A. serrulata.*

Some fifty populations were sampled from different areas of New Hampshire and northern Massachusetts, with an effort made to sample different environments. Then populations believed to be typical of the situation are shown in Figures 1 - 10. Following Hardin (1957), intermediates are labeled "species A" × "species B", while apparent back crosses are labeled as "species A" (× "species B") indicating that "species B" contributed the minority of the genes. Figure 1 from a swamp shows typical *A. serrulata.* Figure 2 from a lake shore shows *A. serrulata* near the northern limit of its range where much *A. rugosa* var. *americana* is present. It appears to be good *A. serrulata* but may not be genetically pure. Figure 3 from a swamp shows *A. serrulata*

Fig. 1-10. Pictorialized scatter diagrams showing introgression between *A. serrulata* and *A. rugosa* var. *americana*. All collections by the author. 1. *A. serrulata* (Boxford, Mass.). 2. *A. serrulata* (Tamworth, N. H.). 3. *A. serrulata* (× var. *americana*) (Hampton, N. H.). 4. *A. serrulata* (× var. *americana*) (Freedom, N. H.). 5. *A. serrulata* × var. *americana* (Hampton, N. H.). 6. *A. serrulata* × var. *americana* (Freedom, N. H.). 7. *A. rugosa* var. *americana* (× *A. serrulata*) (Tamworth, N. H.). 8. *A. rugosa* var. *americana* (× *A. serrulata*) (Milton, N. H.). 9. *A. rugosa* var. *americana* (Sandwich, N. H.). 10. *A. rugosa* var. *americana* (Ossipee, N. H.).


1
2
3
4
5
6
7
8
9
10
7
6
5
4
3
2
1
60
80
100
120
140
160
EXPLANATION OF SYMBOLS
ABSCISSA ANGLE AT BASE
ORDINATE NUMBER OF TEETH
MIDRATIO
+.2
+.1
0
-.1
-.2
LEAF COLOR
GLAUCOUS
PALE
GREEN
GLUTINOUS
LENTICELS
PROMINENT
WEAK
VANISHING
VEINS
STRONG
WEAK
VANISHING
FRUIT
BROAD
INTERMEDIATE
NARROW

modified by genes from var. *americana* and contains three plants in the upper right of the diagram that could be called var. *rugosa.* Figure 4 from a sandy lake shore also shows modification of *A. serrulata* by genes from var. *americana.* In this case some of the plants might be referred to *A. serrulata* var. *subelliptica.* Figure 5 from a swamp and Figure 6 from a lake shore show populations about intermediate between *A. serrulata* and var. *americana.* Figure 7 and Figure 8 both from swamps show var. *americana* modified somewhat by *A. serrulata* and include plants that could be referred to var. *rugosa.* Figure 9 from a poorly drained field shows good var. *americana* unmodified by any *A. serrulata.* Figure 10 from the edge of an acid peat bog shows var. *americana* apparently modified by the acid environment. The leaves are smaller and the major teeth less prominent.

TABLE 1

TAMWORTH			FREEDOM		
Plant No.	Leaf angle	Width/length	Plant No.	Leaf angle	Width/length
1	75	.45	1	90	.65
2	75	.5	2	105	.6
3	90	.5	3	105	.7
4	90	.6	4	120	.6
5	90	.7	5	120	.75
6	105	.7	6	120	.8
7	120	.6	7	135	.7
8	120	.7	8	150	.8

These populations are apparently typical of the alder situation, judging from field studies in northern New England and herbarium studies for the whole area in eastern North America. *A. rugosa* var. *americana* is a distinct taxon with constant characteristics, especially in the northern part of its range where no *A. serrulata* is present. *A. serrulata* is a distinct species, with a range more southern than that of var. *americana,* extending north to north-central New Hampshire and central Maine. When the two taxa occupy the same area, introgression occurs producing intermediates, and plants that approach one or the other of the supposed parent. These intermediates do not seem to demand any particular hybridized environment, although they normally occur in places that may be regarded as somewhat intermediate, and that have almost invariably been disturbed by man. Plants close to var. *americana* but green underneath could be referred to var. *rugosa;* however, these usually are variable and resemble *A. serrulata* in some respects.

The key characters that distinguish var. *subelliptica* from var. *serrulata* are leaves gradually rounded at base as opposed to cuneate or subacute, and broad leaves with a width-length ratio of .6 to .9 as opposed to narrower leaves with a ratio of .35 to .65. Width to length ratios were measured for a number of populations. Table 1 shows some typical results. Var. *subelliptica* appears to be one extreme of the normal variation of *A. serrulata* populations, although in some cases these populations may be modified by gene flow from var. *americana.* There is no indication that var. *subelliptica* is a geographic variety.

There are various named forms of both species and varieties, some of them depending on pubescence of lower surfaces of leaves. Many populations of both species had leaves varying from glabrous to varying degrees of pubescence. *A. serrulata* forma *nanella* is described as a dwarf shrub with small leaves and aments. Alders growing in adverse environments, such as peat bogs or silty shores of rivers are frequently stunted. *A. serrulata* forma *emarginata* has emarginate leaves. It is not infrequent to find an alder with some of the leaves emarginate.

In conclusion it appears that in the subgenus Alnus, in the northeast, the two good native taxa are *A. serrulata* and *A. rugosa* var. *americana.* The latter can readily be distinguished by the glaucous character of the lower surface of the mature leaves. Any plant with this trait, if not diseased, will possess the other characteristics of the taxon. Plants with deep green or glutinous leaves and cuneate leaf bases will possess the specific characters of *A. serrulata.* These two taxa hybridize and backcross frequently, the resulting gene exchange producing a variable assemblage of plants including some intermediates that would be referred to *A. rugosa* var. *rugosa.*

ACKNOWLEDGEMENTS. During the course of this study the author has been greatly helped by the encouragement and criticism of Dr. A. R. Hodgdon, Durham, N. H. Extensive use was made of the Herbarium of the New England Botanical Club. Dr. R. C. Rollins kindly allowed me to use the Gray Herbarium at Harvard University. — ST. MARY'S-IN-THE-MOUNTAINS, LITTLETON, N. H.

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SOME NEW OR OTHERWISE INTERESTING REPORTS OF LILIACEAE FROM THE SOUTHEASTERN STATES[1]

EDWARD T. BROWNE, JR.

Several interesting plants in the Liliaceae have been found as a consequence of field work in the southeast. As might be expected, this family is one of the best represented ones in our herbaria, but it is still incompletely known.

One of these collections consisted of several specimens of *Aletris* collected by Dr. W. H. Duncan of the University of Georgia. Dr. Duncan found both white- and yellow-flowered *Aletris* plants growing in approximately equal numbers in the same population in Chatham Co., Georgia, and they appeared at first to be plants of *A. farinosa* L. and *A. lutea* Small, respectively.

Since perianth color and shape are the two most important characteristics for specific separation in the North American species of *Aletris*, the identifications appeared to be obvious. However, upon closer examination, it was discovered that in neither of these types was there semi-epigyny, one of the

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[1] This paper was supported in part by grants from the Faculty Research Fund, Graduate School, University of Kentucky.

most outstanding floral characteristics of *A. farinosa*. Microscopic and macroscopic examination of leaves of these plants revealed that both exhibited the narrow hyaline margin which is typical of the leaves of *A. lutea*. From this information it has been concluded that this population consists of typical *A. lutea* and white-flowered individuals of *A. lutea*. Thus, the latter are hereby designated as a new color form as follows:

Aletris lutea Small, forma **albiflora** E. T. Browne, Jr., f. nov. Forma nova floribus albis.[2]

This new form differs from the typical form only in flower color. The perianth tube is cylindric with recurved tepals.

This is the first reported color form of North American *Aletris* species. Because of the importance attached to flower color in the identification to species of plants in this genus, careful review of the specimens presently deposited in herbaria will be necessary for proper determination. It is significant that *A. farinosa* has apparently not been collected in the Lower Coastal Plain of Georgia, and although these specimens are obviously those of a population of *A. lutea*, this latter species has not turned up in the collections made in connection with the Flora of the Carolinas Project which includes a geographic area in part not very far removed from this Chatham County locality (H. E. Ahles, personal communication).

Specimens cited: GEORGIA. Chatham Co. Open area, low ground at edge of cypress stand, 15.3 mi. W4°S of Savannah City Hall. Coastal Plain Province. *W. H. Duncan, 20982.* 13 June 1958.

The holotype has been retained in the Herbarium of the University of Georgia. Dr. Duncan has presented an isotype and a specimen of the typical form *(Duncan, 20980)* to the Herbarium of the University of Kentucky.

Another *Aletris* variant was observed in mixed populations of *A. lutea* and *A. obovata* Nash. These individuals had cream-colored flowers instead of yellow and white flowers as in *A. lutea* and *A. obovata*, respectively. The perianth tips of *A. lutea* are recurved while those of *A. obovata* are not. This variant is characterized by a perianth of intermediate color

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[2] Appreciation is expressed to Dr. W. L. Carr, Department of Ancient Languages, University of Kentucky, for the Latin diagnoses in this paper.

and shape but without recurved perianth tips. Since these plants were observed only in mixed populations of the two species previously referred to, or in the near vicinity of populations of both species, the variant individuals are strongly suggestive of probable interspecific hybridization between these two species. Therefore, this putative hybrid is designated in the following way:

Aletris × Tottenii E. T. Browne, Jr., hybr. nov. *Aletris × Tottenii*, hybrida naturalis nova inter *A. luteam* et *A. obovatam*. Herbae mediae inter species parentales. Folia basalibus rosettis, hyalino margine, colore sulfureo-viridi, lanceolata, 52-96.5 mm. longa et 6.2-11.5 mm. lata. Calami et bracteati racemi 5.1-7.7 dm. alti cum multis floribus. Flores horizontales aut prope horizontales, colore aliquantum vario inter ochroleucum et ebureum (cream-colored). Ultimae partes perianthorum non recurvatae. Forma et magnitudo tubae perianthi aliquantum variae inter species parentales.

Plants intermediate between the parental species. Perianth segment tips not recurved (perhaps appearing so in pressed material).

Specimens examined: GEORGIA — Berrien Co. Highway right of way, Ga. 135, 1.3 mi. S of Berrien-Atkinson Co. line. Flowers cream color. May 7, 1960. *Elizabeth M. and E. T. Browne, Jr. 2516;* Colquitt Co. Highway right of way, US 319, 0.1 mi. N of Colquitt-Thomas Co. line. Flowers varying in color from light to deep cream color in the three specimens collected at this locality. May 8, 1960. *Elizabeth M. and E. T. Browne, Jr. 2524.* (holotype, KY); Cook Co. Highway right of way, Ga. 76, 5.3 mi. N of Cook-Brooks Co. line. Flowers light cream color. May 7, 1960. *Elizabeth M. and E. T. Browne, Jr. 2519.*

This putative hybrid was first reported in the literature by Harper (1905, 1906). He did not name the hybrid, but he did suggest its hybrid nature. Since in form of the perianth there is a somewhat closer resemblance to *A. obovata* than to *A. lutea,* some botanists might suggest that this variant constitutes only a color form of *A. obovata.* However, this suggestion is not tenable since these plants are found only in mixed populations of *A. lutea* and *A. obovata* or in the near vicinity of pure populations of both species. In addition, while these species usually occur in separate populations, especially along highways they have become mixed presumably as the result of highway maintenance operations, and this fact has undoubtedly contributed to their hybridization. Apparently, the parental species are not highly interfertile since there are very few of the putative hybrids to begin with, and there is no evidence to indicate that offspring are produced beyond the F_1 generation.

The putative hybrid, *Aletris* × *Tottenii,* has been named for Dr. Henry Roland Totten, Professor of Botany in the University of North Carolina, Chapel Hill.

A double-flowered form of *Lilium superbum* L. was found near Oakland, Garrett Co., Maryland, in 1954. Bulbs of this form were transplanted to Chapel Hill and Elon College, N. C., where they flowered the two following years. While this form is not as attractive as the typical form, it is worthy of mention since this is the first reported double-flowered variation of a native species of *Lilium.* As such, this new form is being designated as:

Lilium superbum L., forma **plenum** E. T. Browne, Jr., f. nov. Forma nova cum tepalis plenis.

In this double-flowered form some of the stamens have been changed entirely or in part to tepals. The pistil is unaffected, and plants of this form could, therefore, be fertile. This collection represents the only occurrence of this variation among several thousand individuals of this species observed at this locality and elsewhere by the writer in Maryland, Virginia, West Virginia, North Carolina and Kentucky.

Specimens cited: MARYLAND. Garrett Co. Near Oakland. July 6, 1954. *Edward T. Browne, Jr., s.n.* (holotype, NCU; isotype, KY).

A student in an undergraduate botany class has discovered a population of *Trillium pusillum* Michx. in Casey Co., Kentucky. This is the first report of this species from the state. The determination has been verified by Stanley J. Smith, New York State Museum, Albany. Mr. Smith writes that this species has been previously reported from only four other widely separated localities in the United States: the Chesapeake Bay region, the Carolinas, the Ozarks and the Sabine River region of Texas, and he feels that the Kentucky specimens are nearest those from the Ozarks, *T. pusillum* Michx., var. *ozarkanum* (Palmer and Steyerm.) Steyerm. (Stanley J. Smith, personal communication).

Specimen cited. KENTUCKY. Casey Co. Pricetown, 4 mi. S of Liberty and E of US 127. Open field, rocky soil. April 28, 1961. *Glenn W. Murphy, 92.* (KY).

In connection with a taxonomic monograph of the Liliaceae of Kentucky which the writer is undertaking preliminary to biosystematic studies in this family, several species have been found in herbaria or collected which have apparently not been reported for the state. Among these species is *Smilacina stellata* (L.) Desf. which would be expected to occur in Kentucky on the basis of its distribution in adjacent states, but, according to the distribution given by Small (1933) and Fernald (1950) and the smaller works of McFarland (1942) and Braun (1943), the species does not occur in Kentucky. However, *S. stellata* is reported from Kentucky (as *Vagnera stellata*) in the second edition of Britton and Brown (1913), but it is not reported for Kentucky in the New Britton and Brown (Gleason, 1952). Although Galway (1945) indicates the presence of *S. stellata* in Kentucky on the distribution map of this species in her monograph of North American *Smilacina*, she does not cite any specimens from the state.

Specimens cited: KENTUCKY. Jefferson Co. In sylvis. Louisville, Ky. *C. Mohr, 2921.* (Annotated by Desma H. Galway, 1939; MO, 147191); Kentucky. (No county or other data given). 1840. *C. Short, s.n.* (GH).

Xerophyllum might be expected to occur in Kentucky based on its distribution in adjacent states. However, this writer has not collected any specimens of this genus in Kentucky although a considerable effort has been made to locate plants. One collection apparently made in the state has come to the writer's attention nevertheless. If the validity of this collection can be established, it will constitute a new state record since this genus is not given for Kentucky in any of the manuals, floras or papers of more limited extent.

On the sheet in question is an annotation label of K. J. Stone who has written: "*X. tenax* (Pursh) Nutt. Locality highly doubtful." *X. tenax* has a reported range from Wyoming to British Columbia and California (Abrams, 1940). On the other hand, *X. asphodeloides* (L.) Nutt. has a range from "Virginia to Georgia and Tennessee" (Fernald, 1950), and this fact would support the identification of this specimen as *X. asphodeloides*. In addition, in floral characteristics this specimen most closely approximates the latter species. Fernald (1950) points out that *X. asphodeloides* also occurs on "sandy pinelands, New Jersey, Delaware and North Carolina." Situations similar to these, though of not the same geological origin, occur in various areas of west-central and western Kentucky, and it is not unlikely, therefore, that this specimen was collected in one of these places. It should be further pointed out that the place of collection, Bowling Green, is situated in the Barrens area of Kentucky.

Specimen cited: KENTUCKY. (Warren Co.) Bowling Green. 1903. *Sadie F. Price, s.n.* (MO).

Intensive field work has been under way in an attempt to relocate this species as well as *Smilacina stellata* in Kentucky. At this writing these efforts have so far proved futile. In regard to *Xerophyllum*, much acreage of the Barrens has been put into pasture and cultivation. It may be that both of these species, which in recent times have not been abundant, are now extinct or nearing this status in the state.

Fernald (1950) indicates that *Yucca Smalliana* Fern. is probably only introduced and escaping north of North Carolina and Tennessee. This species occurs widely in Kentucky, and in some instances, it is freely reproducing and persisting around abandoned homesites. Braun (1943) writes that *Y. filamentosa* L. is "occasional along roadsides and railroad tracks". The writer has not seen any specimens of *Y. filamentosa* in a natural state anywhere in Kentucky, and presumably it is actually *Y. Smalliana* to which this reference applies if these species are distinct. This latter species is not recorded by Fernald (1950), Gleason (1952), Small (1933), McFarland (1942) or Braun (1943) as occurring in Kentucky. While perhaps it may not be native to the state, *Y. Smalliana* should certainly be considered a member of the vascular flora of this area.

Specimens cited: KENTUCKY. Barren Co. US 68, 0.8 mi. E of Barren-Warren Co. line. July 15, 1961. *Elizabeth M. and E. T. Browne, Jr. 4570;* Boone Co. US 25, 5.2 mi. N of Boone-Kenton Co. line. Open field between highway and Southern Rwy. tracks. Scattered plants. July 8, 1961. *Elizabeth M. and E. T. Browne, Jr. 4469;* Boyle Co. US 68, just S of Boyle-Mercer Co. line at bridge. July 15, 1961. *Elizabeth M. and E. T. Browne, Jr. 4507;* Carter Co. Dry roadside cut about ½ mi. E of bridge over Tygarts Creek, Ky. 182. July 1, 1961. *Elizabeth M. and E. T. Browne, Jr. with J. C. Warden. 4421;* Edmonson Co. Ky. 259, 6.9

mi. E of junct. Ky. 185 and Ky. 70. Dry roadside bank. July 16, 1961. *Elizabeth M. and E. T. Browne, Jr. 4598;* Fayette Co. Lexington. Persisting and spreading after cultivation on vacant tract of land across the Southern Rwy. tracks from the passenger station near S. Broadway. July 6, 1961. *Elizabeth M. and E. T. Browne, Jr. 4460;* Grant Co. US 25, 6.8 mi. N of Grant-Scott Co. line. Open dry hillside. Plants of all ages. Very abundant. July 8, 1961. *Elizabeth M. and E. T. Browne, Jr. 4466;* Mercer Co. US 68, 11.3 mi. S of Mercer-Jessamine Co. line. Roadside. July 15, 1961. *Elizabeth M. and E. T. Browne, Jr. 4504;* Scott Co. US 25, 5.4 mi. N of Scott-Fayette Co. line. Open roadside. July 8, 1961. *Elizabeth M. and E. T. Browne, Jr. 4462;* Woodford Co. US 421, 3.6 mi. S of Woodford-Franklin Co. line. Steep road fill. Several plants in row as if planted. July 9, 1961. *Elizabeth M. and E. T. Browne, Jr. 4496.*

Allium ampeloprasum L. has been collected in three counties of west-central Kentucky. In each instance, these plants were found growing without cultivation apparently having originated from this source. As this species has not been previously reported from Kentucky, its mention here is justified. Undoubtedly, there are other localities in the state, other than those cited below, where this species is naturalized, but no other reports are available from elsewhere. As far as this writer is able to determine, this is apparently the first report of the occurrence of the typical variety of *A. ampeloprasum* in the United States as an escape (Small, 1933; Fernald, 1950; Gleason, 1952) since Fernald describes var. *atroviolaceum* (Boiss.) Regel as having "deep purple" flowers and Gleason, giving no varietal status to this, describes the flowers as "purple-red". The flowers of my collections were of several stages of development, and their color was light lavender becoming slightly darker upon drying.

Specimens cited: KENTUCKY. Butler Co. Ky. 185, 6.2 mi. N of ferry over Green River. Wet road cut. July 16, 1961. *Elizabeth M. and E. T. Browne, Jr. 4595;* Edmonson Co. Ky. 259, 6.9 mi. E of junct. Ky. 185 and Ky. 70. Dry roadside bank. July 16, 1961. *Elizabeth M. and E. T. Browne, Jr. 4599;* Warren Co. Ky. 67, 3.2 mi. E of junct. Ky. 67 and Ky. 263. Open roadside. July 16, 1961. *Elizabeth M. and E. T. Browne, Jr. 4591.*

The writer wishes to express his appreciation to the curators of the Gray Herbarium, the Herbarium of the Missouri Botanical Garden and the Herbarium of the University of North Carolina for permitting examination of specimens referred to herein. Dr. Herbert P. Riley has

kindly read the manuscript. — UNIVERSITY OF KENTUCKY, LEXINGTON, KENTUCKY.

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HYBRID ASPENS IN THE LOWER PENINSULA OF MICHIGAN[1]

BURTON V. BARNES[2]

INTRODUCTION

One explanation for the polymorphism and diversity found in the aspens, *Populus tremuloides* Michaux and *P. grandidentata* Michx., is an exchange of genes between these species through hybridization and backcrossing. Anderson (1949) and others have demonstrated the importance of introgression as a vital force in evolution. In a study of the natural variation and clonal development of the aspens in the Lower Peninsula of Michigan I searched for hybrids on two research sites on forest land of the University of Michi-

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[1] Information from the author's dissertation submitted in partial fulfillment of the requirements of the degree of Doctor of Philosophy at the University of Michigan, Ann Arbor.

[2] Research Forester, Intermountain Forest and Range Experiment Station, Forest Service, U. S. Dept. of Agriculture, stationed at Northern Idaho Forest Genetics Center, Moscow, Idaho.

gan Biological Station, near Pellston, Michigan, and in other parts of Lower Michigan.[3] In this paper I shall list and describe aspen hybrids and putative introgressants discovered in the Lower Peninsula of Michigan and shall discuss briefly the ubiquity of the *P. grandidentata* × *P. tremuloides* hybrid in southeastern Michigan as compared with its apparent rarity in the northernmost part of Lower Michigan.

HYBRIDS AND INTROGRESSANTS

POPULUS GRANDIDENTATA × TREMULOIDES

A hybrid between *P. grandidentata* and *P. tremuloides* was first reported and described by Victorin (1930). Heimburger (1936) produced hybrid plants by crossing the two species. He reported a scarcity of natural *grandidentata-tremuloides* hybrids and said this might be explained by the fact that "*P. tremuloides* flowers about a week to ten days before *P. grandidentata* in nature." Pauley (1956) reported that *P. tremuloides* flowered from 10 to 14 days before *P. grandidentata* and stated that the hybrids were not infrequent in central and eastern Massachusetts. He had observed scattered hybrid individuals and hybrid swarms as well as what were presumed to be F_2 plants or backcrosses to one of the parents.

In April 1956 I discovered one hybrid clone on an abandoned field in Section 17, T. 10 N., R. 6 E., Saginaw County, Michigan. This hybrid was tentatively identified on the basis of the scattered hairs that were found on the terminal and lateral bud scales. Fallen leaves collected at the base of several trees in the group closely resembled the hybrid leaves illustrated by Pauley (1956).

A second hybrid was discovered in October 1957 on the forest land of the University of Michigan Biological Station (NW1/2, Section 25, T. 37 N., R. 4 W., Emmet County). The 13 living ramets of this clone were severely damaged by hypoxylon canker and were apparently unable to compete successfully with vigorous neighboring clones of quaking and bigtooth aspen. In August 1958 Dr. Warren H. Wagner,

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[3] Barnes, Burton V. 1959. Natural variation and clonal development of *Populus tremuloides* and *P. grandidentata* in Northern Lower Michigan. 334 pp. Unpublished.

Jr., discovered a hybrid swarm in Monroe County. Consequently, in the fall of 1958 a more intensive search for hybrids was directed in southeastern Michigan. Thirty hybrid clones and putative introgressants were discovered in eight 3- to 8-hour trips. Many more hybrid clones could be located by systematic search in southeastern Michigan. Dr. Wagner located five additional clones in 1960. Hybrid clones have now been located in 10 counties of Michigan's lower peninsula. Location of these hybrid clones and putative introgressants is shown in the Appendix. Specimens of these will be deposited in the University of Michigan Herbarium.

Hybrids are typical in many localities in southeastern Michigan where the parent species occur. The number of hybrid clones is estimated at from 1 to 5 percent of those present in the localities observed. On the University of Michigan Biological Station land, however, the frequency is much lower, and this seems to be true for the entire Douglas Lakes area of the northern tip of the Lower Peninsula.

The apparent abundance of the hybrid in Lower Michigan may be due to several factors. The difference in flowering time between bigtooth and quaking aspen may not be as great as one might suspect. I can offer no proof, however, that this barrier is stronger in northern Michigan than in southeastern Michigan. I did observe numerous receptive female flowers on several *P. tremuloides* clones near Pellston, Michigan, at the time when *P. grandidentata* pollen was being discharged. These flowers were usually located at the base or tip of a catkin and represent an intraclonal lag in flowering. Einspahr and Joranson (1960) reported a somewhat similar intraclonal lag in flowering for seven aspen clones when their flower buds were forced to develop in the greenhouse. This intraclonal lag was apparently verified on only one tree under natural conditions. This developmental phenomenon may be closely related to the early-late leaf situation described by Critchfield (1960). Late flowering may be largely restricted to greenhouse conditions because not all flower buds may be in the same developmental stage when branches are collected 4 to 6 weeks before normal flowering time.

While intraclonal variation might explain the source of receptive female *P. tremuloides* flowers, there are at least two other explanations. Pauley (1956) pointed out that in areas of temperature inversion the flowering of female *P. tremuloides* clones may be retarded until it corresponds with the flowering time of neighboring *P. grandidentata* clones. Recognizing the wide range in the variability of both species, interclonal differences in flowering time might also account for pollination of *P. tremuloides* flowers by *P. grandidentata*.

Establishment of aspen seedlings is extremely difficult *(ibid.)*. This may be the reason why the hybrid is apparently much more abundant in southeastern Michigan than in the northern tip of the Lower Peninsula. In southeastern Michigan many hybrid clones were discovered in abandoned fields or along the edge of cultivated fields where they bordered a woodlot. There appears to be more repeated disturbance, primarily by cultivation, in southeastern Michigan than on University of Michigan Biological Station property and surrounding areas. More disturbance, coupled with more fertile soil and a somewhat more moderate climate in southeastern Michigan, probably means that the establishment of seedlings is easier.

Most ramets of the hybrid clones were not more than 2 or 3 inches in diameter at breast height and were probably younger than 20 years in age. Leaf samples from 25 of the hybrid clones were measured and examined in detail.[4] In general, the size of the hybrid leaves is intermediate between that of the parent species. The leaf shape of the hybrid clones varies as much as that within either of the parent species. To illustrate part of the variation among hybrid clones, two leaves typical of eight hybrid clones and typical leaves of the parent species are pictured in Fig. 1.

INTROGRESSION

Introgression, the flow of genes from one species into another through repeated backcrossing to either parent, has

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[4] At least 50 leaves from each hybrid clone were measured to obtain the mean blade width, blade length, and petiole length. The number of teeth along both margins of at least 30 leaves of each clone was counted.

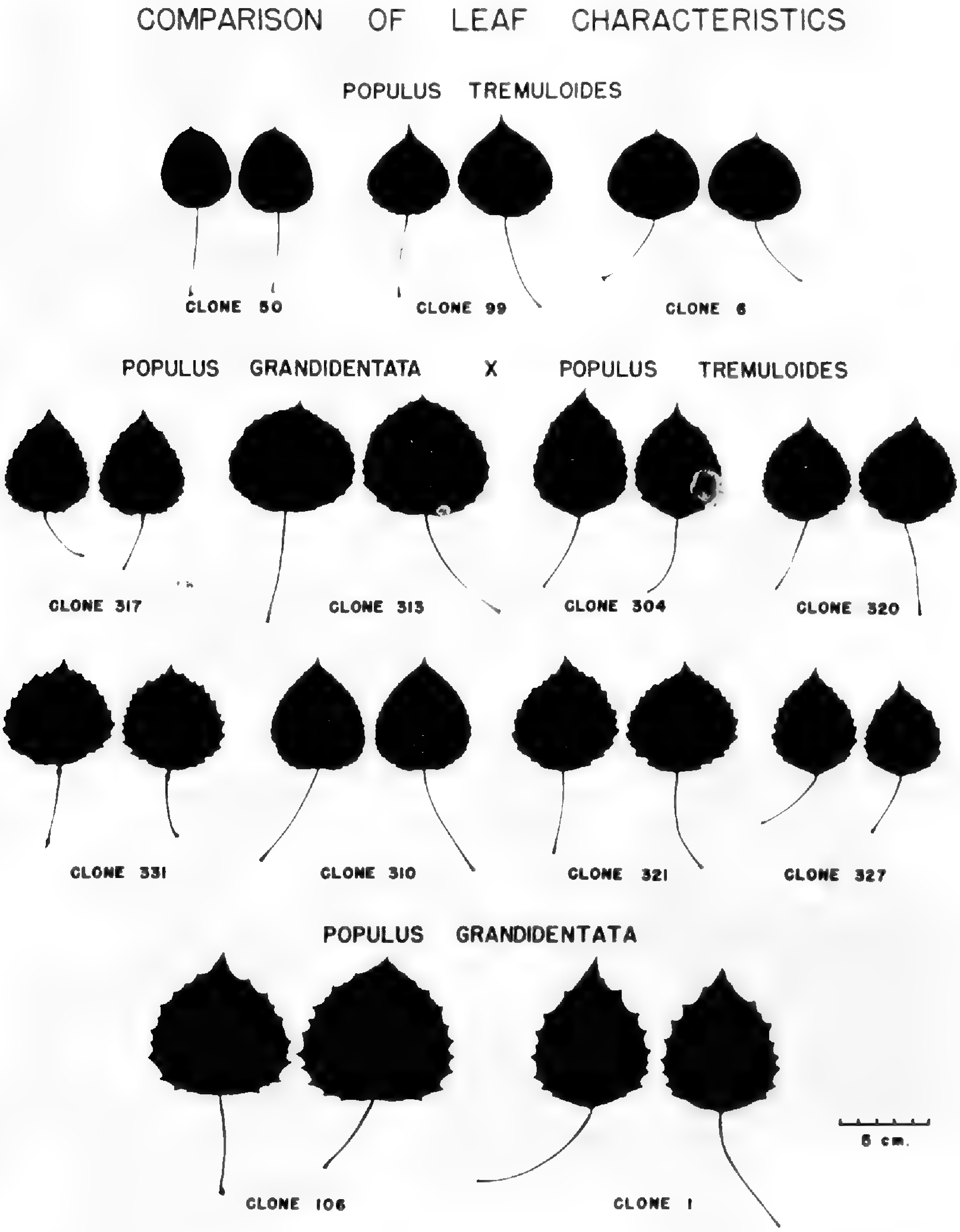


Figure 1

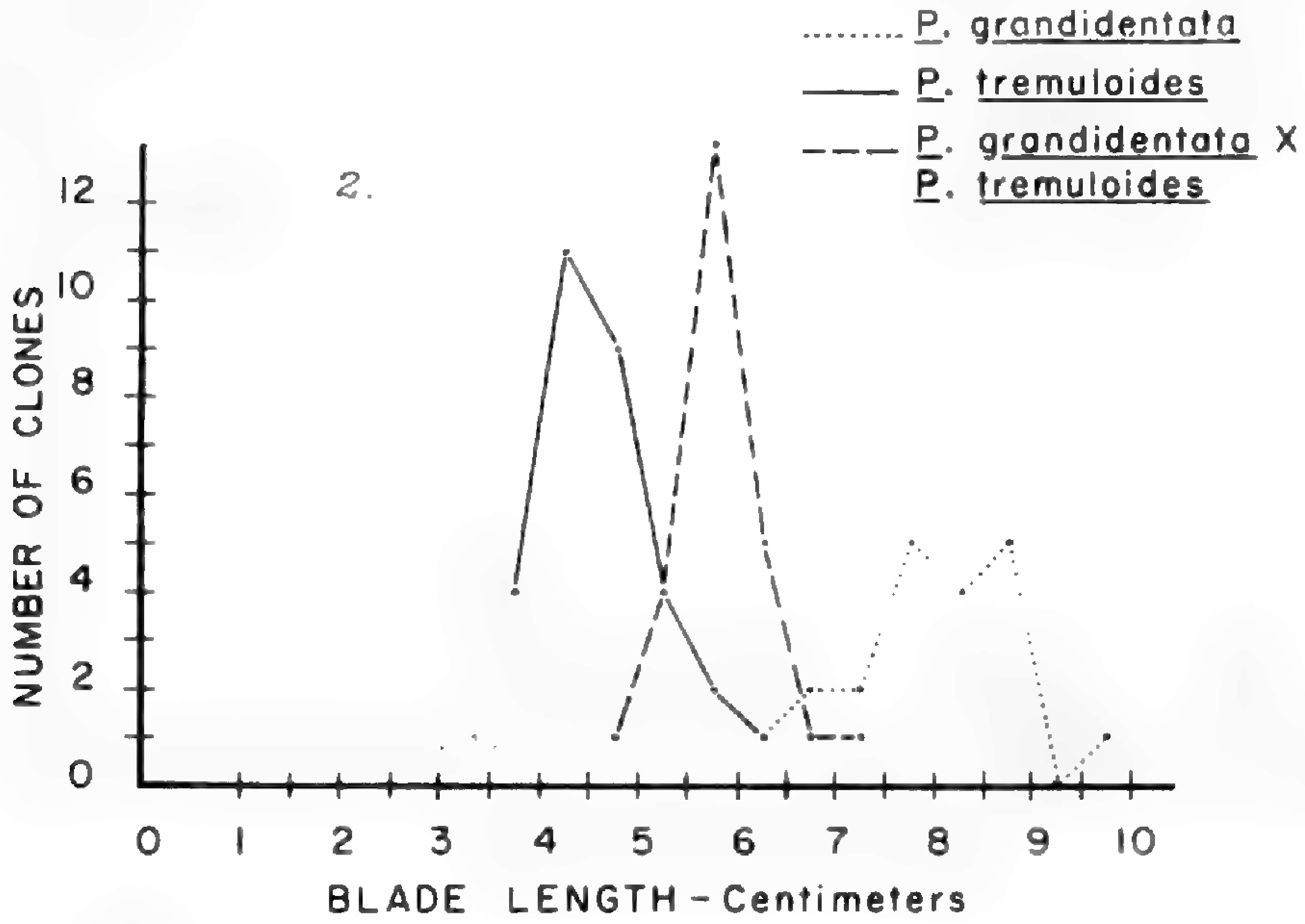
Comparison of leaf characteristics of *P. tremuloides*, *P. grandidentata*, and hybrids.

been described in *Acer* (Desmarais, 1952), *Quercus* (Cooperrider, 1957), and in several other plant genera (Anderson, 1949, 1953; Stebbins, 1950). A few hybrids collected in southeastern Michigan closely resemble *P. tremuloides*, yet have several characteristics of *P. grandidentata*. A series of frequency polygons illustrates leaf differences between the hybrids and the parent species (Figs. 2, 3, 4, 5). Since leaf specimens were not collected from the parents in southeastern Michigan, data from the aspen clones studied intensively in the forest of the University of Michigan Biological Station were used (Barnes, 1959). The hybrid clones are more nearly like *P. tremuloides* in respect to blade width, blade length, and petiole length. The number of teeth per leaf side, however, corresponds more closely to *P. grandidentata*. Of the four characters illustrating the intermediacy of the hybrid clones, the number of teeth per leaf side and the blade length are the most explicit quantitative characters separating hybrids from the parent species.

Hairiness of the terminal and lateral bud is one of the most striking differences between *P. tremuloides* and *P. grandidentata*. This character, however, lends itself less easily to quantification than the four leaf attributes. Anderson (1957), with a semigraphical method, used four of the more distinct features to characterize the differences among clones of the hybrids and parent species (Fig. 6). The hybrids are intermediate between the two parents, but they resemble *P. tremuloides* more closely than *P. grandidentata*. Three of the putative hybrid clones are suspected as being introgressants or backcrosses (clones 310, 317, and 333).

Without additional study and analysis of the parent and hybrid populations in southeastern Michigan, one can report only that the leaf characteristics of several hybrid clones closely resemble *P. tremuloides*. Usually, F_1 hybrids between distinct species are uniform in their characteristics, while segregates appear in the second and following generations (Anderson, 1949). However, the variation within both parents is so diverse and as yet only so summarily described, that F_1 plants seeming to resemble *P. tremuloides* in one, two, or more characteristics might be expected in the F_1 generation.

Sympatric introgression may occur between two distinct species that are ecologically or physiologically separated.



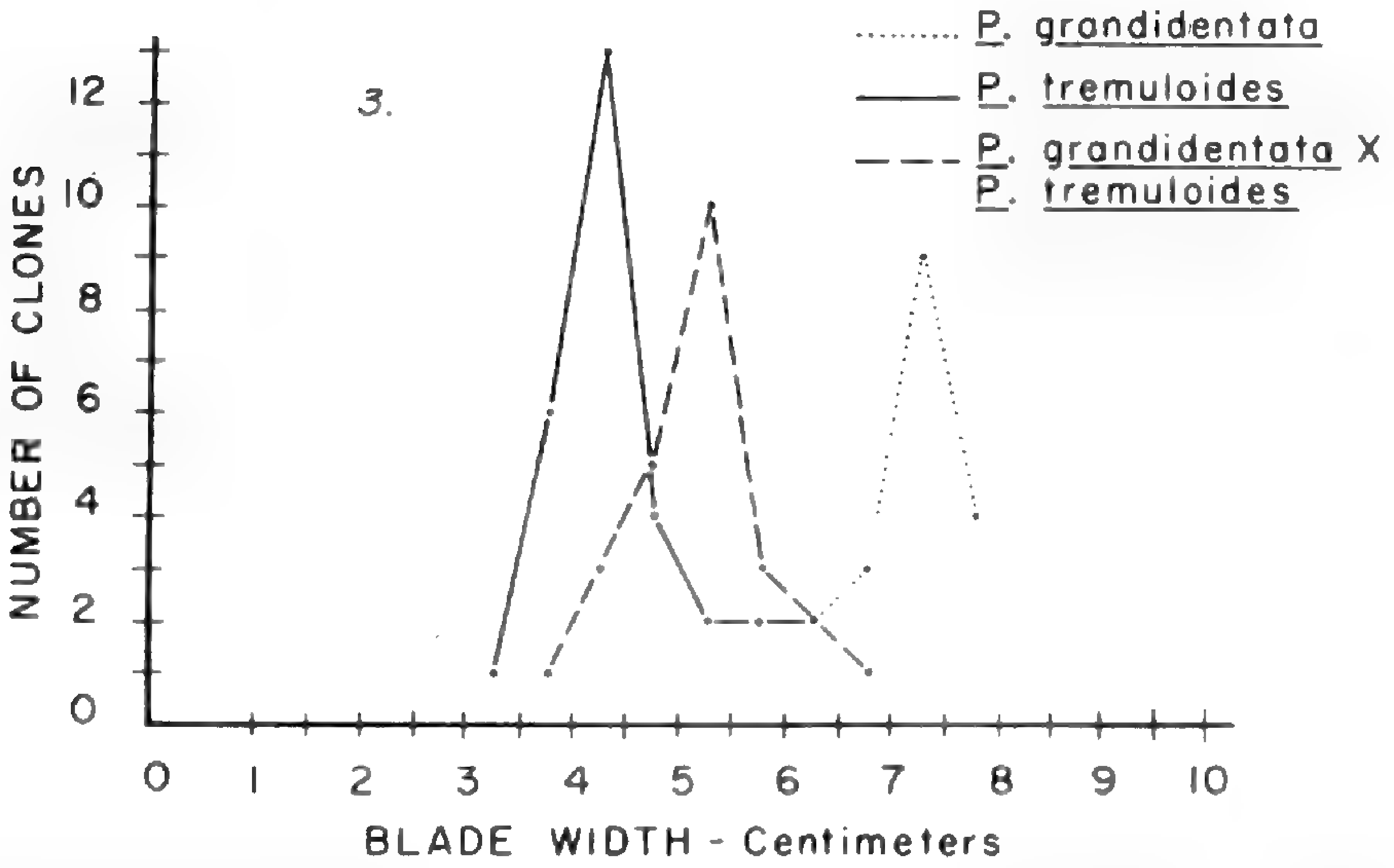


FIG. 2. Frequency polygons illustrating differences in blade length for clones of the hybrid and the parent species.

FIG. 3. Frequency polygons illustrating differences in blade width for clones of the hybrid and the parent species.

Anderson (1948, 1949) pointed out that where the species are separated by habitat requirements, only when the "habitat is hybridized" can the F_1 hybrids find an ecological condition suitable for establishment and survival. In succeeding generations, according to Anderson (1949), the hybrids segregate but the habitat usually does not. Thus, hybrid plants possessing about the same habitat requirements of either of the parent species, i.e. backcrosses to either parent, are favored over F_2 or successive generation segregates. *P. tremuloides* and *P. grandidentata*, however, are not isolated ecologically by their habitat requirements. The habitat of *P. tremuloides* overlaps that of *P. grandidentata*, and both species are frequently growing together on the same site. Therefore, disturbance by man or natural agents, is probably more important as a prerequisite to seedling establishment than "hybridizing the habitat." Thus, it is probable that in southeastern Michigan, F_1 and F_2 hybrids, as well as introgressants, would be about equally fitted for a given habitat that is suitable for both parents.

The variability of the parental species, *P. tremuloides* and *P. grandidentata*, may be due to multiple alleles for genes in the gene pool, mutation, drift, and introgression. Without further analysis it is difficult to say what combination of these factors is responsible for the polymorphism exhibited by the two species.

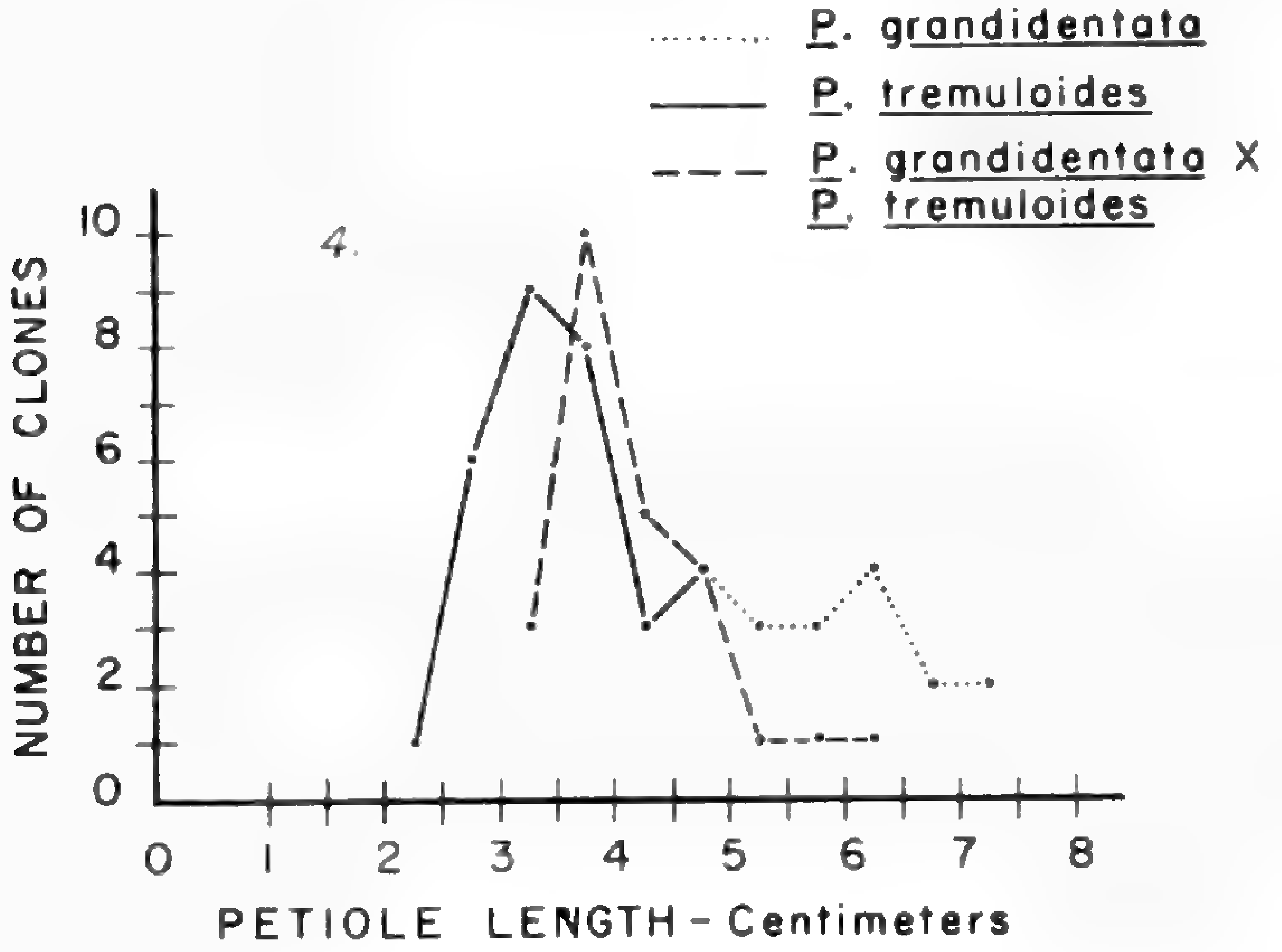
POPULUS ALBA × TREMULOIDES

Two individuals of the *P. alba* × *tremuloides* hybrid were discovered in the Lower Peninsula. One clone was located at the edge of an abandoned field near the juncture of Woods Road and Highway M-18 (SE1/4, SE 1/4, Section 23, T. 23 N., R. 2 W., Gladwin County. The form of this tree resembles that of *P. tremuloides* rather than *P. alba* trees in Lower Michigan.

A second *P. alba* × *tremuloides* hybrid was discovered along the Deckerville Road, S1/2, Section 30, T. 13 N., R. 10 E., Tuscola County. This hybrid was recognized by its extremely shiny green leaves and its silvery bark.

P. alba × *P. tremuloides* hybrids were reported in Canada by Heimburger (1936) and Peto (1938). According to Peto, the *P. alba* × *tremuloides* hybrid was not as frequent as the *alba* × *grandidentata* hybrid in the vicinity of Ottawa, Canada.

The leaves of the *P. alba* × *tremuloides* hybrid are intermediate in shape and serration between the parents. *P. alba* leaves are palmately lobed and tomentose on the undersurface. The margin of *P. alba* leaves is irregularly and shallowly serrate. The leaves of the hybrid are not lobed but are irregularly toothed. The teeth of the hybrid leaves resemble



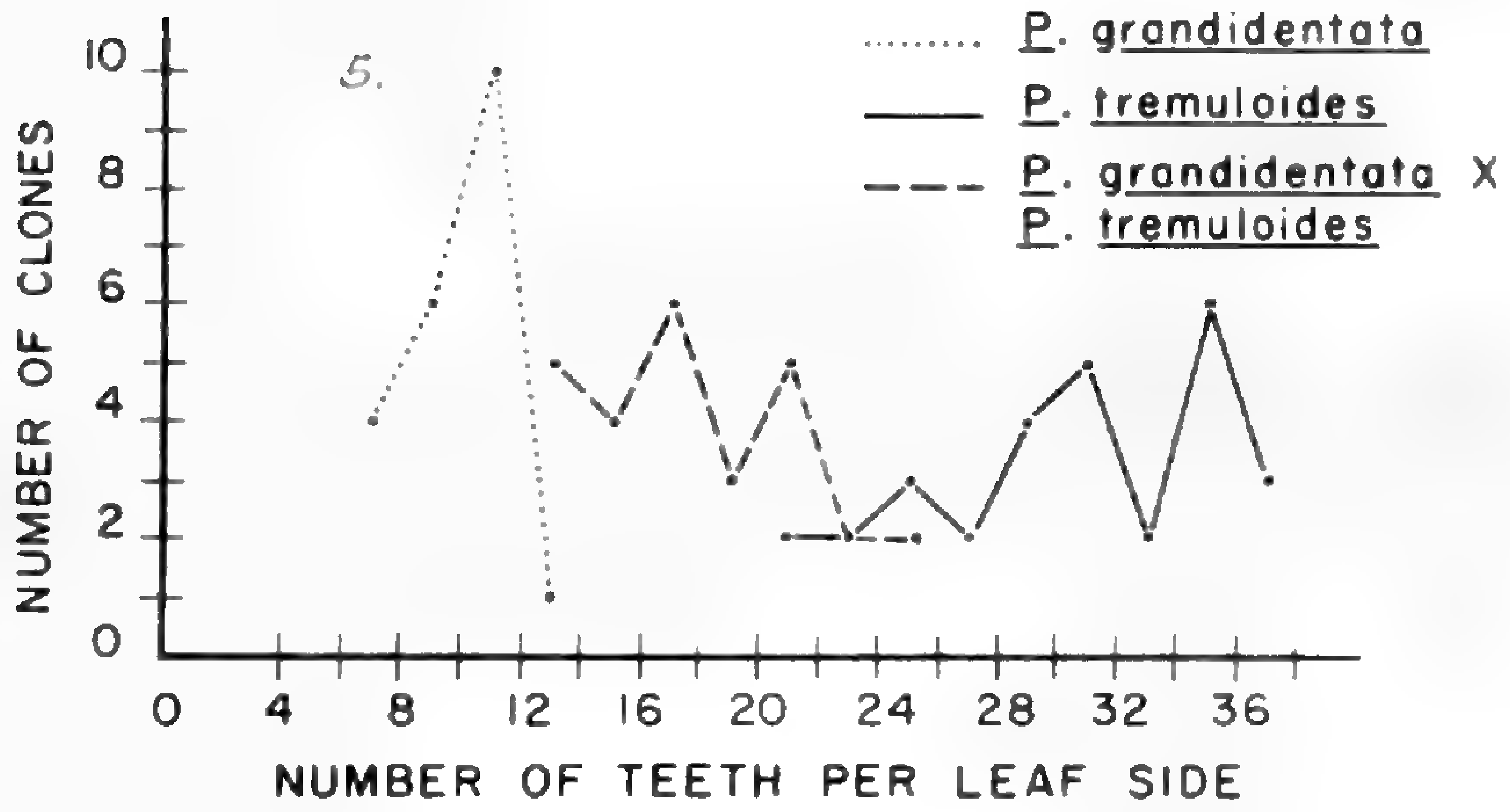


FIG. 4. Frequency polygons illustrating differences in petiole length for clones of the hybrid and the parent species.

FIG. 5. Frequency polygons illustrating differences in number of teeth per leaf side for clones of the hybrid and the parent species.

those of *P. tremuloides* more than those of *P. alba*. The numbers of teeth per leaf side for the Gladwin and Tuscola County hybrids were 14.6 and 15.1, respectively. The underside of the immature leaves of the hybrid is moderately tomentose and becomes glabrous as the leaves mature.

Buds of the hybrids were covered with a tomentum that was not as dense as the tomentum on buds of *P. alba.* The immature shoots were also covered with a moderate amount of tomentum that did not entirely disappear from the new shoots during their initial year. The bark of the hybrid had many diamond-shaped cracks — a typical characteristic of *P. alba* trees of the same size. The bark was rougher in texture and more silvery-white in color than bark of typical sapling or pole-size trees of *P. tremuloides.*

Catkins collected from the hybrid in Gladwin County were predominantly male, but some female flowers were discov-

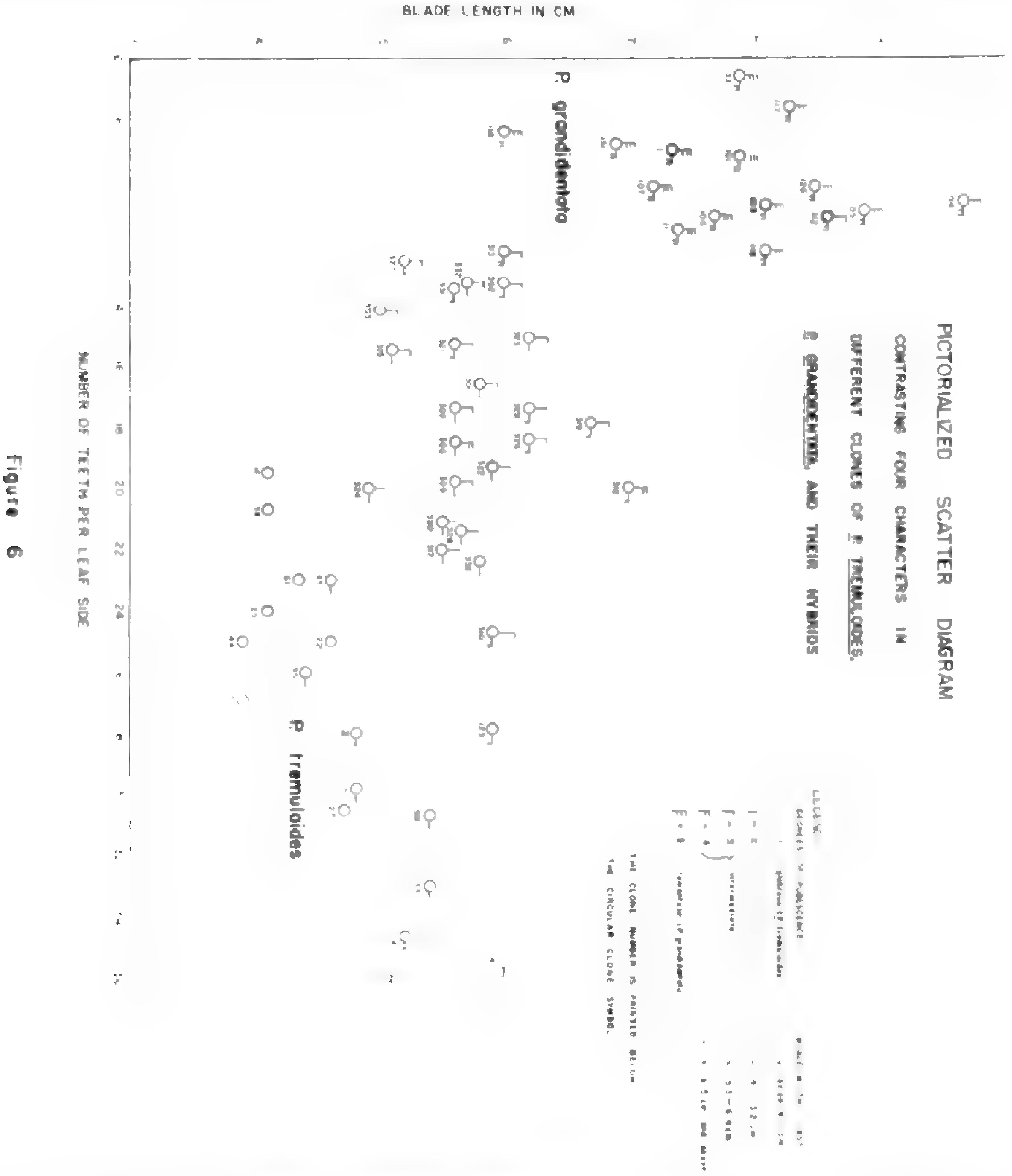


Fig. 6. Pictorialized scatter diagram, contrasting four characters in different clones of *P. tremuloides*, *P. grandidentata*, and their hybrids.

ered on several catkins. Peto (1938) reported that one of the three hybrids near Ottawa, Canada, was "monoecious." An interesting phenomenon observed on one of the catkins from the predominately male hybrid was a row of female flowers proceeding from the base to the tip along one side of the catkin.

The bracts of the aments in the hybrid are characterized by digits that are not as deeply cleft as in *P. tremuloides*, but not as shallow as in *P. alba*. The stigma color of the hybrid (pink) is intermediate between that of its parents. The receptive stigma of *P. tremuloides* is typically red or scarlet, whereas that of *P. alba* is "yellow-green to rose" (Amann, 1956).

POPULUS ALBA × GRANDIDENTATA

One clone of the *alba* × *grandidentata* hybrid was discovered in Section 17, T. 10 N., R. 6 E., Saginaw County. This clone consisted of about 10 to 15 ramets, the largest of which was about 8 inches in diameter at breast height. Victorin (1935) was probably the first to recognize that *P. alba* was hybridizing with the native aspens of Quebec. Heimburger (1936) stated that the *P. alba* × *grandidentata* hybrid was probably the one that Victorin had observed, since the parents flower approximately at the same time. Heimburger (1936) discovered several hybrid trees, and Peto (1938) listed what were apparently seven different clones of this hybrid from Ontario and Quebec. McComb and Hansen (1954) reported two hybrid clones from southeastern Iowa, which were described by Little, Brinkman, and McComb (1957). Subsequently Gatherum (1960) has reported two additional clones from Iowa.

SUMMARY

Thirty-eight clones of the *P. grandidentata* × *tremuloides* hybrid are reported from 10 counties in the Lower Peninsula of Michigan. Although the majority of hybrids have leaf and bud characteristics intermediate between the two parents, three clones are suspected of being introgressants. The reasons for the abundance of hybrids and the greater frequency of hybrid clones in southeastern Michigan than in the northern part of the Lower Peninsula are discussed.

Two clones of the *P. alba* × *tremuloides* hybrid and one clone of the *P. alba* × *grandidentata* hybrid are reported and described.

APPENDIX

Location of *P. grandidentata* × *tremuloides* clones in the Lower Peninsula of Michigan

Clone number	Number of trees in clone	Location
301	5	Section 17, T. 10 N., R. 6 E., Saginaw County
302	13	NW1/4, SE1/4, Section 25, T. 37 N., R. 4 W., Emmet County
303	3	SE1/4, SW1/4, Section 25, T. 37 N., R. 4 W., Emmet County
304	2	Section 6, T. 7 S., R. 7 E., Monroe County
305	2	Section 6, T. 7 S., R. 7 E., Monroe County
306	1	Section 6, T. 7 S., R. 7 E., Monroe County
307	2	Section 6, T. 7 S., R. 7 E., Monroe County
308	4	Section 6, T. 7 S., R. 7 E., Monroe County
309	3	Section 6, T. 7 S., R. 7 E., Monroe County
310	1	Section 6, T. 7 S., R. 7 E., Monroe County
311	1	Section 6, T. 7 S., R. 7 E., Monroe County
312	3	Section 6, T. 7 S., R. 7 E., Monroe County
313	8	NE1/4, Section 33, T. 10 N., R. 5 E., Saginaw County
314	6	S1/2, SE1/4, Section 23, T. 4 S., R. 7 E., Washtenaw County
315	6	S1/2, SE1/4, Section 23, T. 4 S., R. 7 E., Washtenaw County
316	ca. 50	N1/2, NW1/4, Section 28, T. 4 S., R. 8 E., Wayne County
317	ca. 20	N1/2, NW1/4, Section 28, T. 4 S., R. 8 E., Wayne County
318	3	N1/2, NE1/4, Section 30, T. 4 S., R. 8 E., Wayne County
319	1	N1/2, NE1/4, Section 30, T. 4 S., R. 8 E., Wayne County
320	ca. 30	Section 5, T. 8 N., R. 7 E., Genesee County
321	ca. 12	Section 5, T. 8 N., R. 7 E., Genesee County
322	2	SE1/4, Section 17, T. 9 N., R. 7 E., Genesee County
323	3	SE1/4, Section 17, T. 9 N., R. 7 E., Genesee County
324	1	SE1/4, NW1/4, Section 19, T. 7 S., R. 6 E., Monroe County

Clone number	Number of trees in clone	Location
325	1	SE1/4, NW1/4, Section 19, T. 7 S., R. 6 E., Monroe County
326	1	E1/2, SW1/4, Section 24, T. 7 S., R. 5 E., Lenawee County
327	1	E1/2, SW1/4, Section 24, T. 7 S., R. 5 E., Lenawee County
328	1	E1/2, SW1/4, Section 24, T. 7 S., R. 5 E., Lenawee County
329	ca. 50	E1/2, SW1/4, Section 24, T. 7 S., R. 5 E., Lenawee County
330	1	NW1/4, Section 30, T. 6 S., R. 7 E., Monroe County
331	2	SE1/4, NE1/4, Section 33, T. 3 S., R. 9 E., Wayne County
332	6	SE1/4, NE1/4, Section 33, T. 3 S., R. 9 E., Wayne County
333	1	SE1/4, NE1/4, Section 33, T. 3 S., R. 9 E., Wayne County
334	Not recorded	Cedar Lake, Waterloo Recreation Area, near camp, Washtenaw County. (Wagner s.n.)
335	Not recorded	East side Jefferson Rd., Section 15, T. 16 N., R. 2 E., Midland County. (Wagner 8993)
336	Not recorded	Edge of Muskegon State Park, SW1/4, Section 16, T. 10 N., R. 17 W., Muskegon County. (Wagner 9250)
337	Not recorded	North side Water-Munith Rd., Section 15, T. 1 S., R. 2 E., Jackson County. (Wagner 9259)
338	Not recorded	M-83, 4.7 mi. south of Frankenmuth, T. 10 N., R. 6 E., Section 22, Saginaw County. (Wagner 9285)

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A DISJUNCT COMMUNITY OF CHESTNUT OAK IN MISSISSIPPI

Edward G. Roberts

Coker and Totten (1944) and Harrar and Harrar (1946) report the range of chestnut oak (rock oak, rock chestnut oak), *Quercus prinus* L. as being south to Georgia and Alabama. The range map of Munns (1938) shows it in the northeastern tip of Mississippi — Tishomingo County. Mattoon and Beal (1936) report "It is found in the extreme northeastern counties, where it is common on the sandstone bluffs." Lowe (1913) writes of the vegetation of the North-Central Plateau of Mississippi that the typical upland forests of the more sandy eastern parts of the region contain, among other things, *Quercus prinus*. This geographic description would include the western part of Calhoun County. But then Lowe goes on to report chestnut oak as being present in the bottoms of the same region and in the hills and bottoms of the deep loessal soils region to the west. There is unquestionably some confusion between *Quercus prinus* and *Quercus michauxii*. In a later bulletin, Lowe (1921) reports that chestnut oak is found in the northern part of the Pontotoc Ridge and, elsewhere in the bulletin, in the high hills about the headwaters of the Hatchie River. These seem to be two descriptions for essentially the same area. Further on in the bulletin he gives the range of chestnut oak as Tishomingo County and the high, rocky divides of Itawamba, Alcorn, and Tippah Counties. Itawamba is immediately to the south of Tishomingo. Alcorn and Tippah are immediately to the west and are at the headwaters of the Hatchie.

Recently, Newton Hanson of Bruce, Mississippi, forester for the E. L. Bruce Company, took the writer to see some chestnut oak in northwestern Calhoun County, Mississippi. One tree by the side of the road is over 16 inches d.b.h. It is in every respect a typical chestnut oak. Several others are within a few hundred feet of it. Mr. Hanson says that they are scattered over perhaps a thousand acres on a ridge which runs roughly north and south. Superficially, at any rate, there seems to be nothing to distinguish this ridge from countless others in north Mississippi. The area where the trees were seen is about three-quarters of a mile east of the Yalobusha County line and about three and one quarter miles south of the Lafayette County line in Section 22, Township 11 South, Range 3 West from the Chickasaw Base Line and Chickasaw Meridian or at Latitude 34° 7′ N, Longitude 89° 30′ W. This location is some eighty miles southwest of the range shown by Munns and perhaps sixty miles south and west of the locations reported by Lowe (1921).

The day may not be far distant when man converts this oak-hickory ridge to loblolly pine with the elimination of this disjunct chestnut oak community. — FORESTRY SCHOOL, MISSISSIPPI STATE UNIVERSITY.

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The Editors

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VIOLA RAFINESQUII: NOMENCLATURE AND NATIVE STATUS

LLOYD H. SHINNERS

The name *Viola bicolor* Pursh, Fl. Am. Sept. 1: 175, 1814 (Dec. 1813), was long rejected as a later homonym of *V. bicolor* Gilibert, Fl. Lithuanica 2: 123, 1782. It has been pointed out, however, that Gilibert used his own peculiar system of descriptive species names consisting of varying numbers of words (Hylander, 1945; McVaugh, 1949). That is to say, he used abbreviated polynomials, many of them short enough to simulate Linnaean binomials, but shown by their association with indubitable polynomials to be really the latter. Hence *V. bicolor* Gilibert does not invalidate *V. bicolor* Pursh, an authentic binomial. For this reason I employed the latter in my *Spring Flora of the Dallas-Fort Worth Area, Texas* (1958), and distributed specimens so named. Unfortunately there does exist a validly published homonym earlier than that of Pursh, not listed in Index Kewensis. This is *Viola bicolor* Hoffmann, Deutschlands Flora (ed. 2) p. 170, 1804. Though only briefly described incidentally to the account of *V. tricolor* L., the name is both valid and legitimate. Hence *V. Rafinesquii* Greene, Pittonia 4: 9, 1899, remains the correct name for the American plant if considered a species distinct from the European *V. Kitaibeliana* R. & S.

Fernald (1938) considered it so similar to the Old World species that he reduced it to varietal rank as *V. Kitaibeliana* var. *Rafinesquii*. But the morphological similarity is not the whole story. Breeding behavior (specifically, the occurrence of cleistogamy in *V. Rafinesquii* but not in *V. Kitaibeliana*) and chromosome number (so far as known, from rather few counts) are different. Further, the question of nativity is intimately involved with taxonomic evaluation. For reasons to be detailed later, I believe that *V. Rafinesquii* is indigenous to North America, and that this gives additional support to its recognition as a species distinct from *V. Kitaibeliana*.

Two sources of evidence have been taken to indicate an Old-World origin for our plant. The first, its weedy behavior in the Atlantic States, must be rejected, since a number of field weeds in the East are immigrants, not from the Old World, but from areas farther west in North America. (This is more fully discussed below under item 2, Geography and Ecology.) The second, its close resemblance to members of the *V. Kitaibeliana* complex of southern and eastern Europe, is not at all as conclusive as Fernald (and Wilmott) found it. We have had a number of publications on the so-called amphigean or amphi-Atlantic members of the floras of northeastern North America and northwestern Europe. But our knowledge of the flora of the Southern United States, and more particularly its relationships with the Mediterranean and other floras, is in a primitive state. For the present one suggestive example must suffice. The small umbelliferous genus *Bifora* comprises two species in the Mediterranean region, one in Indo-China, and one in the United States (Texas, Oklahoma, Arkansas). The Mediterranean and American species are extremely similar in general appearance, though differing more markedly in technical morphological details than do *Viola Rafinesquii* and the *V. Kitaibeliana* complex. *Bifora americana* is annual and decidedly weedy. In North Central Texas it is a familiar late-spring wild flower, on "prairies, rocky slopes, and roadsides, limestone areas; very common, often abundant" (Shinners, 1958). In Dallas it is a common weed in vacant lots. It has also been found introduced as a roadside weed in Rusk County, Texas, about 100 miles east of its main range. Nevertheless its native status is beyond question. So close is the parallel with the *Viola Rafinesquii* — *V. Kitaibeliana* situation that the morphological similarities between the latter cannot be taken as proof of common nativity.

The sources of evidence in support of the nativity of *V.*

Rafinesquii in North America are more numerous. While no single one can be taken as conclusive beyond all question (owing in part to the incompleteness of our knowledge, especially of the cytology, breeding behavior, and microforms of *V. Kitaibeliana*), there is remarkable agreement among them. Taken together, I believe that they demonstrate that *Viola Rafinesquii* is a native American species. The arguments may be grouped under six overlapping and closely interrelated headings.

1. EARLY RECORDS. Fernald observed that the earliest record of this species was in 1739 in Gronovius's *Flora Virginica* (actually 1743, since it appeared in the addenda on p. 182 in part 2, published in the latter year). The brief description fits quite well, but there is no information as to exact locality, habitat, or abundance. Pursh, in describing it as *V. bicolor*, said only that it grew "in fields of Pennsylvania and Virginia." This sounds weedy enough, but a field recently cleared from wilderness, and still surrounded by wilderness, is a different thing from fields in the 20th Century. The importance of this point will appear in the discussion of geography and ecology (item 2, below). Barton (1818), treating the area within 10 miles of Philadelphia, reports its occurrence "on the grassy borders of cultivated fields bordering Cooper's creek, Jersey, not far from the Market-street ferry and the Burlington road." Nuttall (also in 1818), without specifying any localities, said "apparently native." Other early reports give stronger evidence of the plant's being native. Elliott (1817) says "Found near the Chatahouchie river, Creek nation, by Dr. Latham," far removed from cultivated fields. His predecessor in the area, Thomas Walter, remaining close to civilization, did not find it. Schweinitz, writing at Salem, North Carolina, in 1821, declared that "this interesting Viola grows with us, along the river bottoms and in retired mountain vallies in such a manner as to leave no doubt, that it is a true native." West of the Mississippi (where the plant is today and has long been far more abundant than to the east) there are likewise early testimonials in support of native status. Reverchon (1880) had no doubt of its being native in Dallas County, Texas. T. C. Porter (1880) quoted Reverchon and added

evidence of its natural occurrence in Colorado: "Mr. Reverchon, in the last number of the GAZETTE, reports it from Dallas county, Texas, and says, 'I am satisfied it is native. I have met it in large patches in remote woods and prairies, sometimes *very far* from settlements.' To this I may add the fact that it has also been collected in Colorado by Mr. Wm. A. Henry, who thus wrote me Aug. 29, 1876 — 'I send you more of the violet. It grows on a warm, dry slope at the mouth of Boulder canon, in a rather inaccessible place. I have seen a few stalks farther up the canon. It blooms very early, along with Leucocrinum montanum, so that it has probably escaped the notice of other collectors. I gathered it three years before in the same place. It *could* have been introduced, but I greatly doubt that seeds of recent introduction could have reached the spot where I found these plants.' " It was collected in Oklahoma ("Indian Territory") in 1875 (*Butler,* no other data; SMU). These early records do not support Fernald's belief that the plant was an introduction from Europe.

2. GEOGRAPHY AND ECOLOGY. Both the geographic area and weedy behavior of *Viola Rafinesquii* are strikingly like those of certain other species of unquestionably native status. *Bifora americana* has already been cited. *Mirabilis albida,* first described in Walter's *Flora Caroliniana,* is rare and local east of the Mississippi River, but common and widespread west of it, especially in Texas and Oklahoma. There it is distinctly weedy, appearing on roadsides, pastures, and old fields. There is an endemic var. *lata* in eastern Texas (Shinners, 1951). *Hedyotis nigricans,* first described from Florida, is abundant and weedy on limestone outcrops, disturbed prairies, and eroding ground in central Texas and Oklahoma, but in eastern Texas and Louisiana and in states farther east it is much less common. *Helenium amarum (H. tenuifolium)* early in the 19th Century occurred as far east as Mississippi. Gray's *Synoptical Flora* (1886) says "Arkansas to Mississippi, Florida, and Texas; becoming a naturalized weed throughout Southern Atlantic States." Undoubtedly its indigenous range centered in Texas, where (in strikingly resemblance to *Mirabilis albida*) there is an endemic var. *badium* (perhaps better treated as a distinct

species). I long ago reported instances of the same species occurring in the same general region in populations of two origins: one native, the other introduced. *Sporobolus neglectus* and *S. vaginiflorus* var. *inaequalis* are present in southern Wisconsin as very localized natives on rocky hillsides and, at the same time, as rapidly spreading railroad weeds largely introduced from elsewhere (Shinners, 1941). This I believe has been precisely the history of *Viola Rafinesquii*. Fernald's argument that because of its weedy behavior and habitats in the eastern states it must have been introduced from Europe cannot be accepted.

The occurrence of the plant in Colorado is not out of order for a native of the Gulf Southwest. *Thalictrum dasycarpum* var. *hypoglaucum*, ranging as far west as British Columbia and Arizona, occurs east to Missouri, Arkansas, and Louisiana (Boivin, 1944). In Texas it occurs only in the eastern third of the state, so that there is a very wide gap in its range. *Brickellia grandiflora*, a Rocky Mountain and Pacific species, is known from a few stations in Arkansas and Missouri (Robinson, 1917), a distribution pattern resembling that of *Viola Rafinesquii* in reverse. *Aster laevis*, a common species of the northeastern United States, also occurs in Colorado, but is absent from a large area in between. (In the northern Rocky Mountain region var. *laevis* is replaced by var. *Geyeri*.)

3. VARIATION. According to Wilmott (quoted by Fernald, 1938, p. 446), one of the major differences between *V. Rafinesquii* and *V. Kitaibeliana* was in the sepals: with strongly ciliate margin in the former, with little or no ciliation in the latter. In north-central Texas and eastern Oklahoma, *V. Rafinesquii* occasionally has completely glabrous sepals, and there are rare intermediates with sepals ciliate only in basal portion or very sparsely. Fernald evidently had insufficient material from this area, for he states that the ciliation is "essentially constant." I have seen specimens with entirely glabrous sepals from Logan, Love, Payne, and Pontotoc counties in Oklahoma, and from Wise County, Texas; with partially glabrous sepals from Cherokee and Delaware counties in Oklahoma, and from Wise County, Texas. It might at first be thought that this weakens the case for taxonomic

distinctness and native status of *V. Rafinesquii.* But there is a difference in sepal shape (see further under item 4, below), so that ciliation is not the only point of difference. The geographic distribution of the glabrous variants is, however, quite significant. If the plant were an alien which had first been introduced into the Atlantic states, one would not expect a minor variation to be thus restricted (though it is remotely possible). But if it is native, and in process of developing endemic races, that is precisely what one would expect. The occurrence of endemic varieties of *Mirabilis albida* and *Helenium amarum* within the Gulf Southwest, mentioned under item 2, are suggestive examples. I believe that, when taken in conjunction with the other items being cited as evidence of native status, the localized glabrous variants of *V. Rafinesquii* strengthen the case.

4. ABSENCE FROM THE OLD WORLD. Fernald and Wilmott were unable to match *V. Rafinesquii* with any forms in the *V. Kitaibeliana* complex. In checking through European floras, I found in Pereira Coutinho's *Flora de Portugal* (ed. 2, p. 500, 1939) *V. Kitaibeliana* var. *Machadiana*, described as "papiloso-aspera." Specimens of *V. Rafinesquii* were sent to A. R. Pinto de Silva of the National Agronomic Station at Sacavem, Portugal, with a request for an opinion as to whether they might be var. *Machadiana.* He very kindly took them to Lisbon (LISE) where, with the help of Dr. L. G. Sobrinho, they were compared with a paratype and other specimens determined by Coutinho. He reports (in letter of 23 December 1956) that "your *V. Ranfinesquii* is different from *Machadiana* and that its original country cannot be Portugal." He found that the main differences were in the basal leaves (with ovate limb and the incisions of the crenate teeth more "opened" in *Machadiana;* with depressed-orbicular limb, the incisions of the crenate teeth not "opened" in *Rafinesquii*) and in the sepals (lanceolate, broader near the base but narrower, and glabrous at the margin or scarcely, sparsely and hispidly ciliate in the upper part and near the base in *Machadiana;* sepals constricted as a shoe and regularly hispidly and strongly ciliate in *Rafinesquii*). He adds "I have observed also some specimens of *V. Kitaibeliana* (determined as so!) from South Spain (Sierra Nevada)

(LISE). These have sepals with a little more cilia but they are still different from your *Rafinesquii.*" The opinion of Fernald and Wilmott that *V. Rafinesquii* must be some very rare and local European race remains without proof.

5. CLEISTOGAMY. Gershoy (1934, p. 13) states briefly that only *V. Rafinesquii* in the sec. *Melanium* produces cleistogamous flowers. I have observed apparent cleistogamy in the species in northeastern Texas, but rarely. Color variations in roadside colonies suggest, however, that more careful observation might show it to be fairly common. Some colonies show considerable variation in flower color, while others — or certain patches within extensive stands — are perfectly uniform. This is what one might expect if the plants reproduce by both cross- and self-pollination. I have no information about the European members of the section beyond Gershoy's statement. He remarks that he considers *V. Rafinesquii* to be "functionally biennial"; as known to me, it is a winter annual. He considers the three forms of *V. Kitaibeliana* for which chromosome counts were made as annual.

6. CHROMOSOME NUMBER. For *V. Kitaibeliana,* Gershoy reports haploid numbers of 7, 18, and 24. For *V. Rafinesquii* he gives 17, but does not state the number of counts or source of material on which this figure was based. At my request, Dr. Walter H. Lewis of Stephen F. Austin State College, Nacogdoches, Texas, counted two plants growing wild on his campus and found the diploid number to be 34, thus confirming Gershoy's count for this species. Additional counts from different localities are needed, both in America and in Europe, before we can be reasonably certain that the same number is not found on both sides of the Atlantic, but the data so far available certainly fall into the same pattern as other lines of evidence.

It is concluded that *Viola Rafinesquii* is a native American plant with its major area in northeastern Texas, Oklahoma, and Arkansas, with outlying scattered stations farther east and in Colorado, that it has increased and spread as a weed since settlement, and that, although very similar to members of the *V. Kitaibeliana* complex of the Old World, it is preferably treated as a distinct species, the weak morphological differences being supported by differences in breeding behavior and chromosome number, as well as by geographic remoteness.

I wish to express my very deep appreciation to A. R. Pinto de Silva for his great trouble in comparing specimens, making tracings and microfilms, and supplying transcripts of all the Portuguese literature dealing with the *Viola Kitaibeliana* group; to Dr. L. G. Sobrinho for his assistance in checking the material at Lisbon; to Dr. Walter H. Lewis for the chromosome counts of *V. Rafinesquii;* to Dr. U. T. Waterfall for the loan of specimens in the Herbarium of Oklahoma State University; and to Dr. G. B. Van Schaack, Librarian, Missouri Botanical Garden, for a copy of the original description of *V. bicolor* Hoffmann. — SOUTHERN METHODIST UNIVERSITY, DALLAS 22, TEXAS.

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THE GENUS OLEANDRA OF COSTA RICA

EDITH SCAMMAN

This paper is the third of my studies of a genus of Costa Rican ferns, and follows the same plan as the previous ones on *Adiantum*[1] and *Pteris*.[2]

Again I want to express my gratitude to Dr. Leslie R. Holdridge of San José for his great help during my seasons of collecting in Costa Rica, and to Dr. Rolla M. Tryon of Harvard University for his advice and assistance so generously given in the preparation of these papers.

The drawings have been prepared especially for this article by Miss Ruth Hsu.

OLEANDRA Cavanilles

Oleandra is an isolated genus and is considered to be an old one. It is restricted almost entirely to the Tropics with numerous species in Asia to Polynesia, Africa, West Indies and Central and South America. The fronds are simple and entire, usually lanceolate-elliptical and firm, often lustrous in texture resembling the leaves of the Oleander, whence the name.

In some species the rhizome is stout (with appressed scales) and more or less erect, producing a shrubby growth habit. In others it is more slender (with spreading scales) and twines about tree trunks. The stipes are articulate (the portion below the joint being called a phyllopodium) and short or long, solitary or clustered. Veins are free (Fig. 3),

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[1] Contrib. Gray Herb. **187**: 3-22. 1960.

[2] Rhodora **63**: 194-205. 1961.

and the round dorsal sori are borne irregularly in a row or rows, generally near the costa (Fig. 1), with orbicular or reniform indusia. The scales on the costa of some species are characteristic and serve as an aid to identification.

The treatment and key have been adapted from Maxon, Contr. U. S. Nat. Herb. **17**: 392-398. 1914.

KEY TO THE SPECIES

a. Rhizomes slender, the spreading scales not entirely concealing the rhizome (Fig. 2); phyllopodia usually long (0.5-3 cm.), slender and naked (except at the base), like the upper portion of the stipe. b.
  b. Rhizomes brownish with a rather dense covering of persistent scales; leaf-tissue subcoriaceous. ....1. *O. articulata.*
  b. Rhizomes pruinose with fewer, more laxly spreading, deciduous scales; leaf-tissue membrano-papyraceous. .... 2. *O. Bradei.*
a. Rhizomes stout, pruinose, the appressed scales strongly imbricate, completely concealing the rhizome (Fig. 6); phyllopodia short (rarely to 0.5 cm. or a little more), stout and scaly at least at first, like the rhizome. c.
  c. Stipes 0.5 to 2 cm. long above the articulation, the fronds variable in size and shape, narrowly or abruptly cuneate at base, minutely glandular-pubescent beneath, but soon glabrous; indusia not ciliate, nearly glabrous. .... 3. *O. costaricensis.*
  c. Stipes wanting or nearly so above the articulation, never more than 0.5 cm. long, the frond tapering downward to a long-attenuate, alate base, minutely pubescent; indusia long-ciliate and pilose. .... 4. *O. decurrens.*

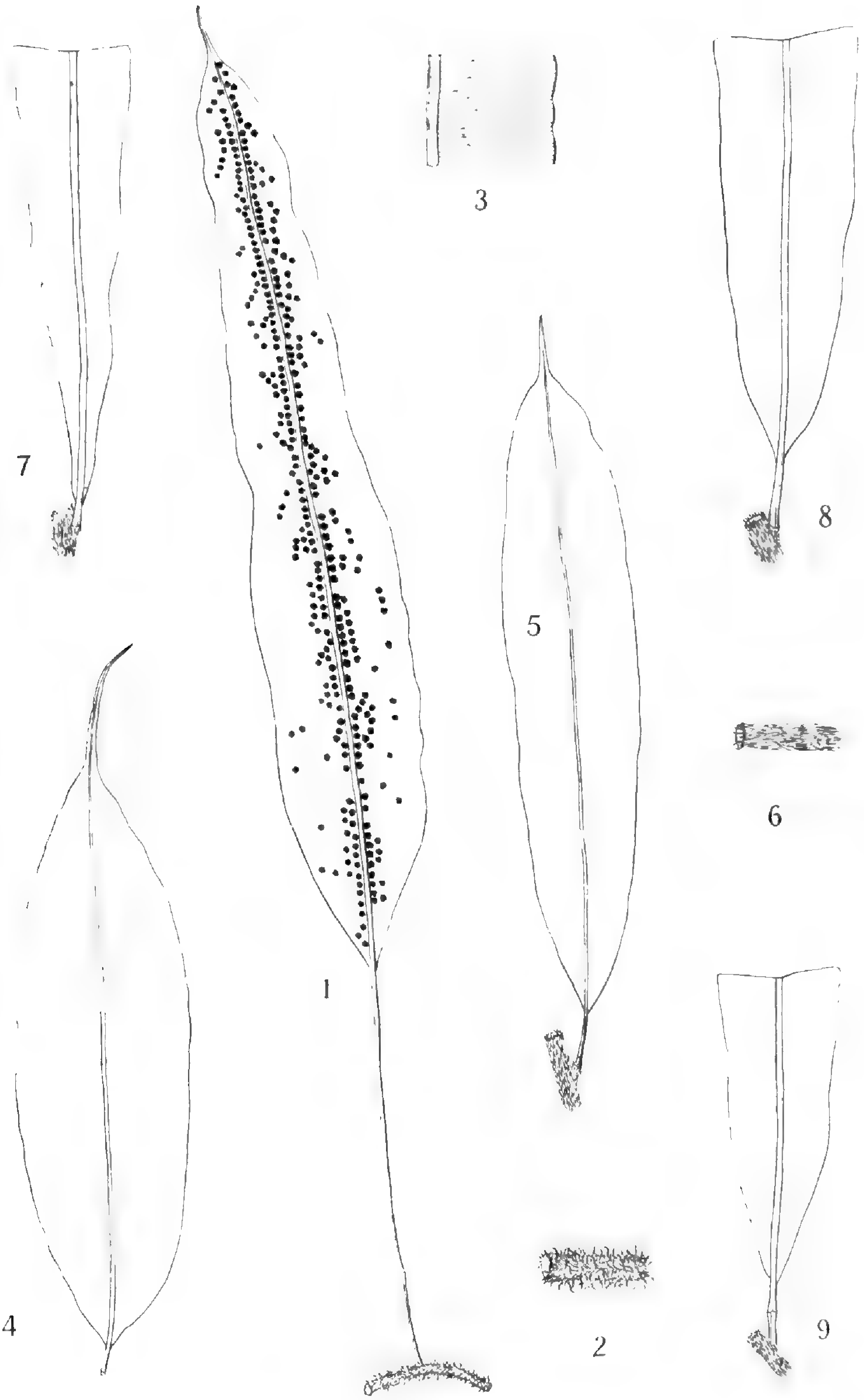
1. **Oleandra articulata** (Swartz) Presl, Tent. Pterid. 78. 1836. FIGS. 1-3.

Oleandra nodosa (Willd.) Presl, Tent. Pterid. 78. 1836.

Of the four species of Oleandra collected in Costa Rica this is the only one of widespread distribution, occurring in the West Indies and Central and South America; two of the others seem to be endemic to Costa Rica.

Climbing up the trunks of trees in the forest, the wide-creeping, brownish rhizomes are densely covered with spreading, ferruginous, linear-filiform scales with a dark-centered peltate base. The fronds, lance-linear to oblong-acuminate, caudate at the apex, are glabrous and shining.

FIG. 1-3. *Oleandra articulata* (from *Scamman 7600*): Fig. 1. leaf and portion of rhizome, × ½. Fig. 2. portion of rhizome, × ¾. Fig. 3. venation, × ¾. FIG. 4. *O. Bradei* (from *Scamman & Holdridge 7886*): lamina, × ½. FIG. 5-6. *O. costaricensis*



(from *Scamman 7604*): Fig. 5. leaf and portion of rhizome, × ½. Fig. 6. portion of rhizome, × ¾. FIG. 7. *O. decurrens* (from *Brenes 14240*): portion of leaf and rhizome, × ¾. FIG. 8. *O. panamensis* (from *Pittier 5322*): portion of leaf and rhizome, × ¾. FIG. 9. *O. guatemalensis* (from *Tuerckheim 983*): portion of leaf and rhizome, × ¾.

The costae are elevated beneath, with cordate, deltoid to long triangular, castaneous scales.

Guatemala to Panama, to Bolivia and Brazil; West Indies. In moist forests from sea level to 1200 m.

Specimens seen: Cocos Island (Pacific): *Waldo L. Schmitt 132* (US), *A. Stewart 239* (GH). HEREDIA: Finca La Selva, Río Puerto Viejo, *Scamman & Holdridge 7884* (GH). CARTAGO: San Juan del Norte, *Scamman 7600* (GH).

2. **Oleandra Bradei** Christ, Bull. Soc. Bot. Genève II, 1:231. 1909. FIG. 4.

Based on *Oleandra nodosa*, var. *caudata*, Christ, Bull. Herb. Boiss. II, 4:964. 1904. Type: Talamanca, Costa Rica, 1000 m., 1898, *Pittier 12699*.

Oleandra Bradei has been collected often in Costa Rica, especially in the region of La Palma. The whitish rhizomes and their fewer, more deciduous, reddish-brown, lanceolate scales distinguish this from the former species. The fronds are generally wider and of thinner texture than those of *O. articulata*. The often ovate-elongate blade, with undulate margins is variable in size and shape. The costa in the specimens seen, has substantially no scales.

Known only from Costa Rica. On mossy tree trunks at edge of forests from 300 to 2500 m.

Specimens seen: LIMON: Los Diamantes, Rubber Plant Station, *Scamman 7041* (GH); Hamburg Finca, on the Río Reventazón below Cairo, *Standley & Valerio 48691* (US.). ALAJUELA: Zarcero, *Austin Smith 48/194* (US); La Palma de San Ramón, *M. Quiros 264* (GH), La Palma near San Ramón, *A. Brenes 5113* (US). SAN JOSE: Las Nubes, Jan. 30, 1938, *Wm. Knight* (US), *Scamman & Holdridge 7885* (GH); La Palma, *Standley 33066* (GH, US), *38188* (US), *Maxon 389,404* (US), *H. E. Stork 420* (US), *H. Berlolini 608* (US), *Scamman 7601* (GH); On the Road to La Hondura, *Maxon & Harvey 7904* (GH, US), *Scamman & Holdridge 7886* (GH), *Standley 37911* (US). CARTAGO: Navarrito, *Lankester 750* (US).

3. **Oleandra costaricensis** Maxon, Contr. U. S. Nat. Herb. 17:397. 1914. FIGS. 5-6.

Type: La Palma, Costa Rica, 1459 m., September 1898, *A. Tonduz 12551* (US).

This species, the most common in Costa Rica, belongs to the second group of Oleandras with the stout, woody rhizome (covered with closely appressed scales) growing more or less erect on forest trees or on bushy banks. The fronds are at first minutely glandular-pubescent beneath, lustrous in texture and often iridescent. The sori are rather large with nearly glabrous indusia. The scales on the costa are characteristic, reddish brown, deltoid to ovate-lanceolate, and deeply lacerate.

Costa Rica, also Colombia. On roadside banks or climbing high on trees in moist forests, the stems sometimes supported by other plants, from 600 to 1700 m.

Specimens seen: 1901-1905, *Wercklé* (US); Nov. 1886, *J. J. Cooper* (GH, US). LIMON: On hills near Moravia, *Williams 16181* (US). HEREDIA: Cinchona, *Scamman 7604* (GH). SAN JOSE: La Palma, *Tonduz 12550* (US), *Standley 38229* (US), *Scamman 7602* (GH); La Hondura, *Standley 36210* (US); Vicinity of El General, *Skutch 2817, 2961* (GH, US). CARTAGO: Orosi, finca del Dr. Valverde, *A. Brade 16836* (US), Vicinity of Orosi, *Standley 39611* (US); Tapanti (Orosi), *R. Torres 185* (US), *Scamman & Holdridge 7887* (GH); Juan Viñas, *Cook & Doyle 222* (US), *Holdridge 7603* (GH); La Estrella, *Standley 39259* (GH, US), *39393* (US); East Turrialba, Aug. 9, 1924, *A. Alfaro* (GH, US); El Muñeco, on Río Navarro, *S. & R. Torres 50991* (US); La Fortuna entre Cervantes et Pacayas, March 1906, *Biolley* (US); Pejivalle, *Stork 2819* (US); San Isidro de Cartago, *Stork 4529* (US). GUANACASTE: La Tajana, north of Tilarán, *Standley & Valerio 45928* (US), El Silencio near Tilarán, *Standley & Valerio 44702* (US).

4. **Oleandra decurrens** Maxon, Contr. U. S. Nat. Herb. 17 :396. 1914. FIG. 7.

Type: El General, Costa Rica, January 1897, *Pittier 10649* (US).

This rare species has the stipe almost lacking, never more than 0.5 cm. long, the linear-oblanceolate, pubescent fronds tapering gradually downward to a slender, long-attenuate, alate base. The indusia are small and long-ciliate, and the many scales on the costa are linear-lanceolate, long-attenuate and bright brown. The leaf-tissue is rigidly herbaceous.

Known only from Costa Rica. From 1100 to 1500 m.

Specimens seen: ALAJUELA: Des collines de Piedades près San Ramón, *A. Brenes 14240* (GH, US). SAN JOSE: El General, *Pittier 10649* (US).

One variety described from Costa Rica has not been placed. Although described under *O. trinitensis* it is probably *O. costaricensis*.

O. trinitensis Maxon, var. *subcostaricensis* Suesseng. & Losch, Mitteil. Bot. Staats. München **1**: 23. 1950. Type: Turrialba, Costa Rica, 1500 m., June 18, 1932, *Kupper 1613*, not seen.

Two other species, *Oleandra guatemalensis* Maxon and *Oleandra panamensis* Maxon grow in Guatemala and in Panama to Colombia respectively. These might possibly occur in Costa Rica, although no specimens of them have been seen from there.

O. panamensis (Fig. 8) differs from the related *O. decurrens* in having the lamina base rather abrupt and the leaf distinctly stipitate above the articulation. In *O. decurrens* the lamina base is gradually reduced and the leaf is subsessile or nearly so above the articulation.

O. guatemalensis (Fig. 9) has long slender phyllopodia like the upper portion of the stipe and small distinctive heart-shaped, almost concolorous scales at the sides of the costa. It differs in these characters from *O. costaricensis* which has the phyllopodium like the rhizome and more elongate, deeply lacerate costal scales. — GRAY HERBARIUM, HARVARD UNIVERSITY.

VASCULAR PLANTS ON THE CINDER CONE OF PARICUTIN VOLCANO IN 1960[1]

JOHN H. BEAMAN

Plants growing on the cinder cone of Parícutin Volcano in 1958 have been reported previously (Beaman, 1960). The present study is based on collections made there on September 8, 1960, two years after the first visit and approximately eight and a half years after volcanic activity ceased. Voucher specimens are filed in the Herbarium of Michigan State University. I am indebted to Dr. R. L. Hauke, Dr. R. McVaugh, Dr. T. R. Soderstrom, and Dr. W. H. Wagner, Jr. for help in the determination of certain species as indicated below.

Ascent and descent of the cone were made on the southwest side. The entire circumference of the rim and both

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[1] Supported by Grant G-9045 from the National Science Foundation.

crater vents were examined. The physical features of the cone were about the same in 1958 and 1960. A description and illustrations of the cone, based on a 1957 visit, have been published by Segerstrom (1960).

EQUISETACEAE.

EQUISETUM HYEMALE L. var. AFFINE A. A. Eat. *(Beaman 4417).* The determination of this species was made by Dr. Hauke. Several stems were present on the northwest rim. These were relatively small, and strobili had not been produced.

POLYPODIACEAE.

PELLAEA TERNIFOLIA (Cav.) Link var. TERNIFOLIA *(Beaman 4414).* Only one small plant, growing on the northeast wall of the crater, was found. This is the area where most of the ferns were collected during the 1958 visit, but not where *P. ternifolia* was previously located. The 1960 collection was sterile, but one of the plants obtained in 1958 had produced sporangia.

PITYROGRAMMA TARTAREA (Cav.) Maxon *(Beaman 4415, 4423, 4431).* This was one of the most frequently observed species on the cone. The determination of collection *4415,* which includes only very young plants, was suggested by Dr. Wagner. The previously reported undetermined juvenile fern *(Beaman 2408D)* may also be this species. Both of these collections are from the northeast wall of the crater. Collection *4423* from the northwest rim of the cone includes plants with sporangia. Collection *4431,* from near a fumarolic vent on a small lava outcrop at the southwest base of the cone, is of plants at about the same developmental stage as those in collection *4423.*

GRAMINEAE.

DIGITARIA SANGUINALIS (L.) Scop. *(Beaman 4412).* Several plants were found in flower on the northeast saddle. In 1958 this area was devoid of plants except for one dicot seedling.

CALAMAGROSTIS MCVAUGHII Sohns *(Beaman 4426, 4429).* The determination of collection *4429* was made by Dr. Soderstrom. In 1958 this species (previously called *C. pringlei*) was found on a lava flow near the east base of the cone. Plants with young inflorescences were well established in 1960 on the northwest rim *(4426)* and at the southwest base near a fumarolic vent on a small lava outcrop *(4429).*

SPOROBOLUS CONFUSUS (Fourn.) Vasey *(Beaman 4410).* Flowering and fruiting plants of this annual species were abundant near the east peak in a local area which was kept moist by a fumarolic vent.

SALICACEAE.

SALIX HARTWEGII Benth. *(Beaman 4423).* This collection was made at the southwest base of the cone near a fumarolic vent on a small lava outcrop. Several plants were also observed on the rim of the cone. Eggler (1959) noted that *S. hartwegii* was one of only two species present in 1950 in volcanic ash on the adjacent north slopes of Cerro Tancítaro.

PHYTOLACCACEAE.

Phytolacca icosandra L. *(Beaman 4424).* Several fruiting specimens were found near the west peak. This collection makes it possible to determine the previously reported undetermined dicot seedling *(Beaman 2404)* as the same species.

ERICACEAE.

Gaultheria odorata Willd. *(Beaman 4408).* A single plant, about 22 cm. high and with one inflorescence, was found near the east peak. Presumably this shrub had attained its full development in two years, because it was not observed during the 1958 visit.

HYDROPHYLLACEAE.

Wigandia kunthii Choisy *(Beaman 4420).* The identity of this collection was suggested by Dr. McVaugh. Three seedlings were found on the northwest rim of the cone.

COMPOSITAE.

Aster subulatus Michx. var. **australis** (A. Gray) Shinners *(Beaman 4411, 4438).* Since 1958 this species (previously called *A. exilis*) has become well established in the area near the east peak. No flowering plants were found in 1958, but in 1960 many of the plants were in flower. One tiny seedling (collection *4438*, probably of this species) was found on the southwest side of the cone about 40 m. below the rim.

Baccharis glutinosa Pers. *(Beaman 4428).* A fairly large, sterile plant was found near a fumarolic vent on a small lava outcrop at the southwest base of the cone. Large flowering specimens *(Beaman 4392)* were collected about three kilometers east of the cone, where the plants were growing in volcanic ash.

Conyza canadensis L. *(Beaman 4413).* One small flowering specimen was collected in the northeast saddle on the rim of the cone.

Conyza coronopifolia H. B. K. *(Beaman 4406).* This species was obtained from near the east peak where it was also collected in 1958. The one plant was in flower and of about average size for the species.

Erigeron exilis A. Gray in S. Wats. *(Beaman 4422).* One depauperate, but flowering, specimen was found on the northwest rim of the cone.

Eupatorium pazcuarense H. B. K. ? *(Beaman 4427, 4432, 4437).* This species was found at three places on the cone. Two plants were located on the northwest rim *(4427)*; several plants were found at the southwest base on a small lava outcrop *(4432)*; and a small seedling was obtained on the southwest side about 40 m. below the rim *(4437)*.

Gnaphalium americanum Mill. *(Beaman 4407, 4430).* Two plants of collection 4407, both in flower, were obtained near the east peak. A larger population *(4430)* was found at the southwest base near a fumarolic vent on a small lava outcrop.

Gnaphalium semiamplexicaule DC. *(Beaman 4425, 4436).* One small, sterile plant *(4425)* was located near the west peak. Two other plants *(4436)*, in poor condition, were present on the southwest side of the cone about 40 m. below the rim. Specimens of this species collected in 1958 were more mature and in better condition that those found in 1960.

HETEROTHECA INULOIDES Cass. var. ROSEI Wagenknecht *(Beaman 4416)*. One vigorous rosette was found on the northwest rim of the cone. A flowering specimen *(Beaman 4404)* was collected near San Juan Viejo (formerly San Juan Parangaricutiro) in soil with a high volcanic ash content.

SONCHUS OLERACEUS L. *(Beaman 4421)*. A very small seedling was found on the northwest rim of the cone, but a flowering specimen *(Beaman 4389)* was collected on a volcanic ash deposit near the southwest base of the cone.

UNDETERMINED MATERIAL.

Two additional species *(Beaman 4418* and *4419)* were obtained on the northwest rim of the cone. Collection *4418* consists of one rosette, and *4419* is of two small, caulescent plants. Both may be species of the Compositae.

DISCUSSION

The vegetation on the cone of Parícutin Volcano was much denser and more species were present in 1960 than in 1958. In 1960 the cone flora was made up of 22 species in eight families and 20 genera, while 14 species in six families and 11 genera were present in 1958. Six species *(Pityrogramma calomelanos, Pteridium aquilinum* var. *feei, Pinus montezumae ?, Aegopogon cenchroides, Buddleia cordata,* and *Gnaphalium attenuatum)* reported from the 1958 visit were not relocated in 1960. The number of species of ferns decreased from five to two. The Gramineae increased from one to three species, although the one species found in 1958 was not recollected in 1960. The Compositae, with 10 species in 1960, had doubled its representation in the two-year period. The two woody species *(Pinus montezumae ?* and *Buddleia cordata)* found in 1958 were not relocated in 1960, but they were replaced by three other woody species *(Salix hartwegii, Gaultheria odorata,* and *Wigandia kunthii)*.

In 1958 the moisture from fumarolic vents appeared to be very important in enabling plants to become established on the cone. At that time a majority of the species were concentrated near such areas. In 1960 some of the most vigorous growth was near fumarolic vents around the east peak and at the southwest base. Many plants, however, were also found on the rim of the cone in areas away from fumarolic vapors. Coarse rubble on the outside of the cone and on the crater walls apparently is still not a habitat which vascular plants have been able to successfully invade.

In view of the species present in 1960, it still appears that dispersal by wind is the most important method of transport of propagules to the cone. Nevertheless, animal agencies, possibly birds, were very likely involved in the transport of *Phytolacca icosandra* and *Gaultheria odorata*, species with fleshy fruits. Animals may also be responsible for the dispersal of the grasses, particularly of *Digitaria sanguinalis*, which produces relatively large caryopses. The *Equisetum*, Polypodiaceae, *Salix*, *Wigandia*, and Compositae probably were all dispersed by wind.

Nearly half of the species found on the cone are weedy. These are *Digitaria sanguinalis*, *Phytolacca icosandra*, *Wigandia kunthii*, *Aster subulatus* var. *australis*, *Conyza canadensis*, *C. coronopifolia*, *Gnaphalium americanum*, *Heterotheca inuloides* var. *rosei*, and *Sonchus oleraceus*. It is not surprising that species which are well adapted for colonizing other disturbed and open habitats should be among the first plants to become established on the cone.

The species most vigorous in appearance and numerous in individuals were *Pityrogramma tartarea*, *Calamagrostis mcvaughii*, *Digitaria sanguinalis*, *Sporobolus confusus*, *Salix hartwegii*, *Phytolacca icosandra*, *Aster subulatus* var. *australis*, and *Gnaphalium americanum*. All of these species except *Salix hartwegii* had produced reproductive structures. Seven of the species which were present on the cone in 1958 were also found in 1960, thus demonstrating that these pioneer species were able to maintain themselves on the cone during the two-year period. Four species, *Pityrogramma tartarea*, *Phytolacca icosandra*, *Aster subulatus* var. *australis*, and *Eupatorium pazcuarense ?* have become more abundant since 1958. — DEPARTMENT OF BOTANY AND PLANT PATHOLOGY, MICHIGAN STATE UNIVERSITY, EAST LANSING.

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A WEEDY CRUCIFER AGAIN REACHES NORTH AMERICA. — The identification of a roadside weed from Yancey County, North Carolina was not difficult, but determining the correct name for the plant turned up several conflicts and proved to be a small "tour de force" through the literature. The plant, originally described as *Brassica cheiranthos* by Villars,[1] is apparently native in western, central and southern Europe. If the species were to be retained in *Brassica,* as was done for many years, there would be no nomenclatural problem. The plant would be referred to as *Brassica cheiranthos* Vill. However, most of the recent works dealing with this species place it in another genus. O. E. Schulz[2] not only revived the invalidly published generic name *Brassicella* of Fourreau[3] but in addition appears to have misapplied the name *Brassica erucastrum* L. to the species here considered. At least, this is essentially the conclusion of Dandy[4], who transferred *Brassica cheiranthos* Vill. to *Rhyncosinapis* to replace the name *R. erucastrum* (Vill.) Dandy earlier provided for the same taxon.[5] I do not know whether Dandy went over the same literature and specimens that were examined by Pugsley[6] but he reached the same conclusion, that the names *Brassica cheiranthos* and *B. erucastrum* do not apply to the same species as was assumed to be the case by Schulz. Pugsley points out that "the sheet in the Linnean Herbarium labelled "7. erucastrum?" by Linnaeus, contains two small plants of *Rhaphanus Raphanistrum* L. that look much more like *Erucastrum obtusangulum* than *Brassica cheiranthus.*"

Assuming for the moment that the species is not to be retained in *Brassica* and is not properly referrable to *Sinapis* or any other of the long established generic segregates of *Brassica,* we come back to the two divergent treatments of Schulz and Dandy. It is clear that *Brassicella,* published merely as a nomen in Fourreau's work, has to be dated from Schulz and was illegitimate when proposed because *Rhyn-*

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[1] Prosp. Pl. Delph. 40. 1779.

[2] Engler's Bot. Jahrb. 54: Beibl. No. 119. 52-3. 1916.

[3] Ann. Soc. Linn. Lyon 16: 330. 1868.

[4] Watsonia 4: 41-42. 1957.

[5] Clapham, Tutin and Warburg, Fl. Brit. Isles 158. 1952.

[6] Journ. Bot. 74: 326. 1936.

cosinapis had been validly published by von Hayek[7] in the meantime. Schulz was wrong both as to the generic and to the specific names. We agree then, with Dandy, that the species is to be referred to by the name *Rhyncosinapis cheiranthos* (Vill.) Dandy.

The specimen that evoked the above was collected by Harry E. Ahles, No. 42855, with J. A. Duke, June 7, 1958, roadside, 1.8 miles southwest of Burnsville on N. C. 197, Yancey County, North Carolina. It was distributed as *Diplotaxis muralis*. This is not the first time *Rhyncosinapis cheiranthos* has reached the North American continent. Nearly one hundred years ago when Addison Brown was combing the ballast fillings around New York City for new introductions he found it in Hoboken, New Jersey.[8] I have examined Brown's specimens and they are correctly identified. At first, he used the name *Brassica monensis*, but later made the correction to *B. cheiranthos*. This species apparently did not gain a continuing foothold in our flora at that time and we have seen no evidence of its presence from then until that provided by the North Carolina collection cited above. The fact that this came from a roadside habitat far inland from a coastal port indicates that the species may well be on its way to becoming a part of our weedy flora. — REED C. ROLLINS, GRAY HERBARIUM OF HARVARD UNIVERSITY.

AN ALBINO FRUITED FORM OF GAULTHERIA PROCUMBENS

On September 11, 1958, I stopped my car in a temporary parking place opposite the Naval Facilities Station at Tom Nevers Head, Nantucket Island, Mass. As I left the car, I noticed that the front wheels were on a luxuriant bed of *Gaultheria procumbens* L. Intrigued by the robust appearance of the plants, I made a closer inspection of them. To my surprise, I discovered that the fruits were a creamy white with many of them being almost pure white.

Outside the perimeter of this bed of albino-fruited plants, there was a far greater area matted solidly with the usual red-fruited form. The fruits, flowers, and foliage of these plants were considerably smaller by comparison. Several

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[7] Beih. Bot. Centralbl. 27: 260. 1911.

[8] Bull. Torrey Bot. Club 7: 123. 1880.

finger-like drifts of the more robust albino-fruited plants extended well into the area of the red-fruited plants showing that soil conditions played no major part in the dwarf condition of the latter.

Gaultheria procumbens L., forma **leucocarpa** MacKeever. Differt ab planta typica in fructibus albis. This form is similar to the species except for its albino fruits.

The type specimen, N309, was collected by *Frank C. MacKeever* at Tom Nevers Head, Nantucket Island, Mass., August 12, 1959, and is deposited in the herbarium of the New York Botanical Garden.

It may be of interest to write something of the history of this plant. My first encounter with it took place on my first visit to the island and I had then no intentions of doing a floristic study of the plant-life there. For that reason I collected only enough material to serve as voucher specimens, the two specimens being given the reassigned collection number N1 and deposited in the herbarium of the New York Botanical Garden, and in the herbarium of the Museum of Natural Science, Nantucket, Mass.

Upon realizing that this plant was a new form, I wished I had more sets of the original collection to present to other institutions. Therefore, on August 12, 1959, I recollected it in order that a set of this number, N309, could be presented as an isotype to Gray Herbarium, Cambridge, Mass.; Department of Agriculture, Plant Research Institute, Ottawa, Ont., Canada; and Instituto de Botanico, Sao Paulo, Brazil.

The sets of N309, now deposited in the above mentioned institutions, were collected from the same group of plants as those of N1. However, the fruits of N1 are somewhat more mature than those of N309, as N1 was collected later in the season.

On September 21, 1960, I took the Nantucket Garden Club for "a nature hike". We visited the station of f. *leucocarpa* only to find great piles of dirt and debris spread over the colony. A few albino-fruited plants were found, but the fruits possessed somewhat of "a blush" on the more exposed surfaces. These "blushed" fruits were not as white as those of the original collections. However, it does seem certain that the albino fruited plants were not completely destroyed. — FRANK C. MACKEEVER, NEW YORK BOTANICAL GARDEN.

CORRECTIONS IN REPORTS OF THE COMMITTEE ON PLANT DISTRIBUTION

In the Fourteenth Report (RHODORA 63: 47-55) the following corrections resulting from what we now consider to be misidentifications should be noted: —

Arabis canadensis L. Delete the + sign in the column for Maine. The reported occurrence of this species in Maine was based on the misidentification of a depauperate specimen of *Hesperis matronalis* L. in young fruit collected on July 3, 1901, by Kate Furbish at Skowhegan in Somerset County. The nearest and otherwise most northeasterly station for *A. canadensis* so far discovered is some one hundred fifty miles to the southwest in Rockingham County, New Hampshire.

Ribes rotundifolium Michx. Delete the + sign in the New Hampshire column. A specimen from Crawford Notch in the White Mountains, well north of the normal range for the species, collected by H. H. York on July 18, 1919, labeled *R. rotundifolium*, proves to be *Ribes hirtellum* Michx.

Ribes cynosbati L. (Page 53, Line 17 *et seq.*) Delete the second sentence and substitute: It occurs sparingly in western Maine south of 45° and is frequent elsewhere in New England west of a line drawn from Strong in Franklin County, Maine, through Jaffrey in Cheshire County, New Hampshire, Hartland in Hartford County, Connecticut, to New Milford in Litchfield County, this line forming a well-marked boundary with the exception of a single station in southeastern New Hampshire and two stations in north-central Connecticut.

Three errors in earlier Reports have been pointed out by Hodgdon and Steele[1]. Accordingly, the following plants should be excluded from the New Hampshire list: *Juniperus horizontalis* Moench. (Fifth Report, RHODORA 28: 43). *Carya tomentosa* Nutt. (Eleventh Report, RHODORA 58: 127). *Betula papyrifera* Marsh. var. *commutata* (Regel.) Fern. (Eleventh Report, RHODORA 58: 128). — R. C. BEAN, A. F. HILL AND R. J. EATON, COMMITTEE ON PLANT DISTRIBUTION.

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[1] HODGDON, ALBION R., AND FREDERICK L. STEELE — The Woody Plants of New Hampshire. S. B. 447. Agr. Exp. Sta. U. of N. H., Durham, N. H., 1958.

A BOTANICAL ATLAS OF THE DANISH FLORA[1] — This fine illustrated work contains figures, drawn from living material, of most of the species of Bryophyta and vascular plants of the Danish flora. The first volume, with 515 plates, is devoted to the Angiosperms and the second one, with 240 plates, to the Bryophyta, Pteridophyta and Gymnosperms. One to several species are illustrated on each plate. The whole plant, or a portion of it, is presented and in addition some of its more significant details.

The second volume has a parallel English text and especially in this volume there is an introductory description and discussion of the larger families or groups. This text gives a valuable account of the life-history of the group and the seasonal development of the different structures. The ecology of the group is discussed and closely correlated with its life-history.

The phyletic theory presented at the end of the second volume is somewhat novel in presenting the Angiosperms as triphyletic. Each of the three lines is considered to have evolved from separate groups of the Bryophyta through groups of the lower vascular plants. This phylogeny is developed chiefly through a concept of the conifer cone and the *Equisetum* and *Selaginella* strobilus as primitive kinds of "flowers". While this theory will be of interest, its morphological basis may not be acceptable to many.

These volumes are not only useful as an iconography of the principal elements of the Danish flora, but also for information about the smaller structures of the species (stamens, ovaries, seed, peristome, spores, etc.) and about their ecological life-history as well. — ROLLA TRYON, GRAY HERBARIUM, HARVARD UNIVERSITY.

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[1] Botanisk Atlas, Danmarks Daekfrøede Planter, by Olaf Hagerup and Vagn Petersson. vol. 1. pp. 1-550. 1956. vol. 2, pp. 1-299. 1960. 4°. Ejnar Munksgaard. København.

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New scientific names and combinations are printed in bold face type