Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

VOLUME 57

1955

The New England Botanical Club, Inc.

8 and 10 West King St., Lancaster, Pa.

Botanical Museum, Oxford St., Cambridge 38, Mass.

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Vol. 57 **January, 1955** **No. 673**

CONTENTS:

The New England Botanical Club, Inc.

8 and 10 West King St., Lancaster, Pa.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of the Gray's Manual Range and regions floristically related. Price, $4.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) of not more than 24 pages and with 1 plate, 40 cents, numbers of more than 24 pages or with more than 1 plate mostly at higher prices (see 3rd cover-page). Back volumes can be supplied at $4.00. Some single numbers from these volumes can be supplied only at advanced prices (see 3rd cover-page). Somewhat reduced rates for complete sets can be obtained on application to Dr. Hill. Notes and short scientific papers, relating directly or indirectly to the plants of North America, will be considered for publication to the extent that the limited space of the journal permits. Illustrations can be used only if the cost of engraver's blocks is met through the author or his institution. Forms may be closed five weeks in advance of publication. Authors (of more than two pages of print) will receive 15 copies of the issue in which their contributions appear, if they request them when returning proof. Extracted reprints, if ordered in advance, will be furnished at cost.

Address manuscripts and proofs to Reed C. Rollins,
Gray Herbarium, 22 Divinity Ave., Cambridge 38, Mass.

Subscriptions (making *all remittances* payable to RHODORA) to

Dr. A. F. Hill, 8 W. King St., Lancaster, Pa., or, preferably, Botanical Museum, Oxford St., Cambridge 38, Mass.

Entered as second-class matter March 9, 1929, at the post office at Lancaster, Pa., under the Act of March 3, 1879.

Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 57 January, 1955 No. 673

A REVISION OF THE NORTH AMERICAN GENUS SABATIA (GENTIANACEAE)[1]

ROBERT L. WILBUR

THE genus *Sabatia* is restricted in distribution to continental North America and the West Indies. It is frequently encountered throughout much of its range, which extends from Nova Scotia south as far as the mountains of Hispaniola and the central plateau of Mexico and from the Atlantic seaboard westward to the prairies of Oklahoma and central Texas. All of the members of the genus recognized in this paper, seventeen species and two varieties, are to be found in the southeastern United States. The distribution of most of them is either entirely restricted to that area or is largely centered there. Most of the entities are either found in or are restricted entirely to the Coastal Plain, the oldest portions of which have been available to the occupancy of land plants only since the close of the Cretaceous.

This genus is believed to be an ancient one whose intrageneric divisions appear to have been clear-cut and well-defined for a long period of time. Even the species seem, in most instances, to be genetically so well isolated from their closest relatives as to show no indication of hybridization even when flowering in close proximity to one another. These are almost certainly indications of great age.

This group of plants has not been monographically treated since the time of Grisebach (1845) although it has been subjected

[1] Part of a dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the University of Michigan. I should like to take this opportunity to express my appreciation for the friendship, encouragement and guidance of Dr. Rogers McVaugh throughout this investigation.

to numerous regional interpretations. The present treatment is based upon the examination of more than 6500 specimens borrowed from over thirty herbaria[2] and the prized opportunity, made possible largely through the assistance of Professor H. H. Bartlett, director of the Botanical Gardens of the University of Michigan, of studying all but one of the species in the field.

History of the Genus

Plants now considered to belong to *Sabatia* were first described as species of *Gentiana* in Gronovius' "Flora Virginica" (1739). Linnaeus, having assisted Gronovius in that work, was personally familiar with the specimens upon which the two polynomials were based and later provided binomials for both of them in "Species Plantarum" (1753). Two additional species, based upon specimens collected by Kalm, were described for the first time in that work. Three of these species were placed by Linnaeus in the genus *Chironia* together with four very different species from the Old World while the remaining species known to him was assigned to the genus *Swertia*. Later he transferred one of the species that he had formerly assigned to *Chironia* to *Chlora* and thus the four different species known to Linnaeus were treated as representatives of three different genera.

Adanson (1763), resisting what seemed to him to be the excessive generic "lumping" of Linnaeus, recognized many pre-Linnean genera and initiated some new ones as well. *Sabatia,*

[2] The abbreviations employed in referring to these herbaria are those of Lanjouw and Stafleu (1952) and are as follows:

BRU	Brown University	NCU	University of North Carolina
CHARL	Charleston Museum	NO	Tulane University
CU	Cornell University	NY	New York Botanical Gardens
DENN	Dennison University	OKL	University of Oklahoma
DUKE	Duke University	OKLA	Oklahoma A. & M. College
F	Chicago Natural History Museum	PENN	University of Pennsylvania
		RUT	Rutgers University
FLAS	Florida Agr. Exp. Sta.	SMU	Southern Methodist Univ.
GA	University of Georgia	TAES	A. & M. College of Texas
GH	Gray Herbarium	TENN	University of Tennessee
K	Kew (part of collection)	TEX	University of Texas
KSC	Kansas State College	UARK	University of Arkansas
MICH	University of Michigan	UC	University of California
MO	Missouri Botanical Garden	US	U. S. National Herbarium
MT	Université de Montréal	WIS	University of Wisconsin
NA	U. S. National Arboretum	WVA	West Virginia University
NCS	North Carolina State College	YU	Yale University

one of the latter, was entirely based upon "Gentiana Gron. virg. 29" which Linnaeus had called *Chironia dodecandra.* Later authors frequently "corrected" Adanson's spelling of the generic name to *Sabbatia* since it was proposed in commemoration of an Italian botanist called Liberato Sabbati. In the "Familles des Plantes" the generic name *Sabatia* is invariably spelled with a single "b" while the botanist's name always appears as Sabbati. One can therefore only conclude that Adanson deliberately chose to spell the generic name as *Sabatia* and, according to Article 82 of the International Code of Botanical Nomenclature, his choice in this matter is binding.

Pursh (1814) accepted Adanson's genus but defined it to include all of the American species which had been placed by most earlier authors in the genus *Chironia.* Grisebach (1839, 1845) provided a very complete account of the eleven species and one variety that were known to him in his two monographic treatments of the Gentianaceae. These monographs were very similar in regard to the species of *Sabatia,* with the exception of the disposition of *S. gentianoides.* In the first account this species was considered to form a monotypic section while six years later its distinctive characteristics were warranted to be of generic status and, furthermore, it was then placed in a different subtribe from that of its former congeners.

Gray's understanding of those species found within the United States was summarized in the "Synoptical Flora" (1878) in which he recognized thirteen species and two varieties.

Blake (1915) provided a formalized system of classification for the genus by arranging the twenty-two species and one variety accepted by him into named subgenera, sections and subsections. This was in large part merely the application of subgeneric names and validating diagnoses to the groups of species that long had been associated together under the synoptical and indented keys of earlier authors.

Generic Relationships

Sabatia was associated in Gilg's (1895) treatment of the family in the tribe Gentianeae, subtribe Erythraeinae together with seventeen other genera. Most of the genera of the Erythraeinae are composed of but few species and more than half of the genera are known only from the Old World. None of them seem particularly closely related to *Sabatia.* This genus has been placed most often near *Centaurium* Hill (=*Erythraea* Borkh.) from which it may be distinguished by many characters. The following key employs some of their more obvious differences.

Corolla rotate, the lobes much longer than the tube; stigma deeply 2-lobed, the lobes at least one-third the length of the style, at anthesis spirally twisted about one another but uncoiling and spreading apart with time; anthers either half-twisted laterally or becoming circinnately coiled or recurved after pollen discharge....................................SABATIA.

Corolla salverform, the lobes equal to or shorter than the tube; stigma capitate or but barely creased, the divisions scarcely discernible, position unchanged with age; anthers becoming tightly spirally coiled in the manner of a corkscrew after pollen discharge..........................CENTAURIUM.

Systematic Treatment

Sabatia Adans., Fam. Pl. **2:** 503. 1763.

Pleienta Raf., Fl. Tell. **3:** 30. 1837.

Neurola Raf., New Fl. **4:** 92. 1838.

Erect, glabrous, annual or perennial herbs. If perennial, sometimes stoloniferous and either arising from a short, erect caudex or from a short to elongate, almost always branched rhizome. Root-system of the annuals either a slender tap-root or a cluster of fibrous roots, that of the perennials a cluster of wiry to fleshy roots. Leaves mostly cauline but basal leaves also present in some species, decussate (or in aberrant specimens whorled), entire, sessile or somewhat amplexicaul, membranous to thick and turgid or even fleshy. Branches opposite or alternate. Inflorescence cymose, the cymules either compactly subcapitately clustered or loosely arranged, being often reduced to one or two flowers, or grouped into large, showy, compound dichasia. Flowers perfect, actinomorphic. Calyx 5–12(–14)-parted, gamosepalous, the tube campanulate to somewhat turbinate, membranous, the lobes minute to foliaceous, varying in length from shorter than the calyx-tube to many times longer. Corolla rotate, 5–12(–14)-parted, the tube urceolate to cylindrical, short but equaling or more commonly exceeding the calyx-tube; corolla-lobes usually widely spreading, dextrorsely contorted in bud. Stamens 5–12; filaments slender, inserted on the upper edge of the corolla-tube, alternating with the corolla-lobes, at first erect but strongly curving to one side after pollen discharge; anthers basally attached, linear to oblong, slender to stout, dehiscing laterally by means of longitudinal slits, after pollen discharge becoming either laterally twisted or circinnately recurved or revolute. Ovary bicarpellate, unilocular; carpel margins slightly intruding into locule and forming 4 parietally located placental lobes each bearing numerous scattered ovules. Style slender; stigmatic branches 2, linear to slightly spatulate, tightly spirally twisted at anthesis and bent to one side, later becoming erect, untwisting and exposing the densely papillate stigmatic surface. Capsule globose, ovoid, or cylindrical. Seeds numerous, globose or somewhat flattened, densely pitted with small depressions. TYPE SPECIES: *Sabatia dodecandra* (L.) BSP. (*Chironia dodecandra* L.)

KEY TO THE SECTIONS

Flowers usually long-pedicellate or, if short-pedicellate, the subtending bracts small and scale-like; flowers either solitary or loosely cymose; anthers becoming circinnately recurved after pollen discharge; plants, if annual, pentapetalous, if perennial, either pentapetalous or pluripetalous. I. EUSABATIA.

Flowers sessile or very nearly so, the subtending bracts large and leaf-like; inflorescence of few to several closely associated flowers, appearing capitate; anthers slightly twisted laterally even prior to pollen discharge, never becoming circinnately recurved; plants annual and pluripetalous. II. PSEUDOCHIRONIA.

I. Section EUSABATIA Griseb., Gen. et Sp. Gent. 120. 1839.

Subg. *Eusabatia* (Griseb.) Blake, RHODORA **17:** 56. 1915.

Annuals or perennials. Flowers either pentamerous or plurimerous (only the perennials 7–12(–14)-merous); typically long—pedicellate or at least not appearing to be sessile and capitately arranged with the clusters possessing large foliaceous bracts. Anthers becoming revolutely coiled or recurved after pollen discharge. TYPE SPECIES: *Sabatia dodecandra* (L.) BSP.

The fifteen species belonging to this, the larger, section of the genus show considerable diversity and may be arranged readily into several groups of species (subsections).

KEY TO THE SUBSECTIONS

A. Calyx-tube very prominently 5-nerved and thinly membranous-winged; the lateral nerves of the calyx-lobes much more strongly developed than the midnerve; flowers pentamerous; annuals ....(C) CAMPESTRES.

A. Calyx-tube smooth or finely nerved and lacking membranous wings; the midnerve of the calyx-lobes almost equaling or even more strongly developed than the lateral nerves; annual or perennial and flowers either pentamerous or plurimerous.

B. Perennials with elongate rhizomes; some species stoloniferous; either pentamerous or plurimerous.

C. Branches typically opposite throughout; flowers mostly 5-parted, the centermost in the cymules occasionally 6-parted; corolla white and lacking yellow "eye" at base of lobes; pedicels usually less than 1 cm. long; stolon and basal rosettes never present...(A) DIFFORMES.

C. Branches typically alternate (at least the uppermost); flowers 5–12 (–14)-parted (3 species 7–14-parted, the other species 5–6(–7)-parted); corolla typically pink or rose and with a yellow "eye" in the throat and base of the lobes; pedicels mostly over 1 cm. long; stolons and basal rosettes present in some species. (E) DODECANDRAE

B. Annuals or, if perennials, the caudex short, erect, and much-branched; rhizomes and stolons never present; flowers pentamerous.
D. Upper branches typically opposite; basal rosette present at some stage of life-cycle and often persistent; annuals........(B) ANGULARES.
D. Upper branches typically alternate; basal rosette lacking; either annuals or perennials......................(D) CAMPANULATAE.

(A) DIFFORMES subsect. nov.,[3] Subsect. *Angulares* Blake in part, RHODORA **17:** 56. 1915.

Robust perennials arising from a thick, gnarled, often much-branched, elongate rhizome bearing numerous fleshy roots about 2 mm. in diameter. Branches typically opposite. Leaves drying thick-chartaceous, margins revolute. Corolla white. TYPE SPECIES: *Sabatia difformis* (L.) Druce.

The two species associated in this subsection are strongly differentiated morphologically from the annual species of subsection *Angulares* with which they were formerly placed. Including these perennials with the radically different species belonging to the *Angulares* would be placing undue emphasis upon the single character of an opposite-branching pattern that is typical of both groups while underestimating features such as the perennial habit and fleshy roots which seem to me to be of greater phyletic significance. The habitat occupied by the perennials is typically that of savannas and ditches, whereas the annuals of the *Angulares* are generally inhabitants of drier situations.

The three entities forming subsection *Difformes* are a conspicuous floristic feature of savannas or pine-barrens, or the marshy borders of low hardwood forests throughout their combined extensive range. These plants are, with the exception of a very few Piedmont stations at the outer margin of that province, entirely restricted to the Coastal Plain, ranging from central New Jersey southward throughout much of peninsular Florida and westward into Louisiana. The three populations do not possess mutually exclusive areas but occupy ranges in the nature of overlapping arcs somewhat radially arranged about what may have been the ancestral home of the group, the ancient Appalachian land-mass. It may be speculated that the original population, which was perhaps polymorphic,

[3] Subsectio Difformes. Herbae perennes, rhizomatibus crassis, contortis, saepe multiramosis radicibus carnosis ca. 2 mm. diam. Rami plerumque oppositi. Folia in speciminibus siccis crasse chartacea, marginibus revolutis. Corolla alba. Species typica, Sabatia difformis (L.) Druce.

migrated from Appalachia onto the Coastal Plain. The fragments of the original population that reached the new home continued to evolve and to spread laterally along the Coastal Plain. When they had reëstablished partial contact with their close relatives, genetical and other barriers had developed which maintained the identity of the three entities.

Key to the Species of Subsection Difformes

Leaves and upper portion of the stem not glaucous; calyx-lobes typically more than 4 mm. long and often 10 mm. long or longer; upper bractlets linear, those subtending complete (i.e. 3-flowered) cymules 4–5 mm. or more in length; corolla-lobes almost invariably longer than 7 mm. and often up to 15 mm. and occasionally longer, their color often turning saffron or orange upon drying, especially along the veins; plants rarely taller than 9 dm. high; the main stem and branches becoming strongly angled or even quadrate above from 4 internodal ridges; ranging from central New Jersey southward and westward into western Florida. .1. *S. difformis.*

Leaves and upper portion of the stem glaucous; calyx-lobes rarely as long as 3 mm.; upper bractlets minutely scale-like, even those subtending complete cymules less than 3 mm. long; corolla-lobes 4–7 mm. long, color remaining white or creamy-white upon drying; plants more robust, mostly taller than 9 dm.; the main stem and branches terete throughout, not becoming angled or quadrate; ranging from central Georgia and ne. Florida westward into Louisiana. . . . . .2. *S. macrophylla.*

1. **Sabatia difformis** (L.) Druce *Swertia difformis* L., Sp. Pl. **1:** 226. 1753. *Chironia lanceolata* Walt., Fl. Car. 95. 1788. *C. cymosa* Lam., Tabl. Encyc. et Méth. Bot. **1:** 479. 1791, not Burm., Fl. Cap. **5:** 1768. *C. paniculata* Michx., Fl. Bor.-Am. **1:** 146. 1803. *C. venosa* Muhl., Cat. Pl. Am. Sept. 24. 1813. *Sabbatia paniculata* (Michx.) Pursh, Fl. Am. Sept. **1:** 138. 1814. *S. paniculata α latifolia* Pursh, *l.c.* *S. paniculata β angustifolia* Pursh, *l.c.* *S. corymbosa* Baldw. ex Ell., Sk. Bot. S. C. & Ga. **1:** 283. 1817. *S. corymbosa* var. *angustifolia* Ell., *l.c.* *S. lanceol.* [lanceolata Walt.] Raf., Fl. Tell. **3:** 30. 1837, without basionym. *S. cymosa* [Lam.] Raf., l.c. without basionym. *S. cymosa* (Lam.) G. Don, Gen. Hist. **4:** 207. 1838, as to basionym only. *S. lanceolata* (Walt.) T. & G., Man. ed. 1. 356. 1848. *S. difformis* (L.) Druce, Bot. Exch. Club & Soc. Brit. Is. **3:** 423. 1914, as to basionym only.

Perennial herb (25–)45–80(–105) cm. tall, 2–5 mm. in diameter, 1–several stems arising in a cluster from a gnarled, stout, branched rhizome 4–6 mm. in diameter. Stem stiffly erect, hollow, more or less terete below, becoming angular and sometimes almost quadrate above from the internodal ridges. Branches typically opposite, occasionally alternate at some nodes, ascendent at an angle of (10–)20–40(–50) degrees, generally restricted to the upper tenth or third of the stem, or less commonly in very robust plants branching almost throughout the entire length of the stem. Principal branches typically 3–4-times branched and together forming a compact, corymbose, flat-topped to convex inflorescence. Numerous fleshy roots descending from the rhizome, these 8–12(–20) cm. long, 1.5–3 mm. in diameter, usually bearing slender, fibrous, lateral roots. Leaves thick, rather succulent, drying somewhat thick-chartaceous, venation obscure except for the rather prominently elevated midvein and often the lateral pair of veins, or in the broader-leaved types with 2 lateral pairs prominent. Basal rosette none; the lowermost cauline leaves borne submerged or subterranean, at time of flowering usually represented only by scars, but when still present, often modified into appressed, obtuse, oblong bracts 2–3 cm. long. Upper cauline leaves strongly ascendent, linear to lanceolate or even somewhat oblong or ovate-lanceolate to strongly ovate (especially in peninsular Florida), usually acute, rarely obtuse, somewhat revolute and both scarious-margined and -tipped, usually rather strongly clasping, or merely sessile in the narrower leaved types, (0.9–)1.8–4(–6.2) cm. long, (3–) 4–14(–22) mm. wide, usually not more than twice exceeded by the internodes and usually less; internodes occasionally 3–5 times or more longer than the nearby leaves. Pedicels slender, erect, finely ridged, 2–8(–15) mm. long. Calyx-tube only slightly ridged, rather shallowly campanulate, crateriform or even turbinate, 1–2(–3) mm. long; calyx-lobes linear to somewhat subulate, very slender, (2–)4–10(–14) mm. long, 2–8(–10) times the length of the tube, more or less outwardly arching at anthesis, erect in bud. Corolla-tube narrowly cylindrical, (2.5–) 3–5(–6) mm. long; corolla-lobes typically 5, (the centermost flower of the central cymules often 6-parted), oblong, weakly spatulate, elliptic, obtuse to acute, wide-spreading, (5–)7–15(–21) mm. long, 2.5–6(–8) mm. wide, entirely white even at the base, but often turning orange or saffron upon drying, especially along the veins. Filaments 2–3 mm. long, pale-yellowish to almost white, slender; anthers slender, lanceolate, bright yellow, 2–3 mm. long. Style 2–5 mm. long; stigmatic lobes slender, linear, 2–5 mm. long. Capsule oblong-cylindrical, 4–8 mm. long, 2.5–4 mm. wide. TYPE LOCALITY: "In Virginia." TYPE: *Clayton 171* (British Museum); photograph of the type (GH!). DISTRIBUTION: Savannas and pine-barrens along the Coastal Plain from (perhaps Long Island) central New Jersey southward throughout much of peninsular Florida and westward into western Florida. Map. 1.

The only species with which *S. difformis* might be confused is *S. macrophylla*, which belongs to the same subsection and which shares with it the distinctive features of a stout, gnarled rhizome bearing numerous, thick, fleshy roots, characteristically opposite branches, thick leaves and white 5(6)-parted corollas. However, *S. difformis* may be readily distinguished from *S. macrophylla* by numerous striking differences among which are the absence of a glaucous bloom, the almost invariably longer calyx-lobes, bractlets, and corolla-lobes; the very common change of color to orange or saffron upon drying, the stem angled or quadrate above, and the typically smaller stature. The ranges of the two species overlap in Georgia and in Florida; but throughout the main part of the area occupied, they are not compatriots. (See Maps 1 and 2)

S. difformis and another typically white-flowered, opposite-branched species, here called *S. quadrangula* but referred to by recent authors as *S. paniculata,* have been closely associated together in many treatments of the genus and often the two are misidentified. Gleason's (1952) account of the species that has been passing as *S. paniculata* fails to distinguish clearly the two species. *S. paniculata,* according to Gleason, is "similar to *S. difformis* in habit, stature, and inflorescence" and is "very close to *S. difformis* in describable characters . . ." The two species may be easily distinguished and the differences are such that I feel that the two belong to different species-groups. The features of *S. difformis* mentioned in the preceding paragraph are in strong contrast to those of the other species which is a rosulate annual with a strongly 4-sided stem and membranous leaves.

The synonymy of this species is extensive and there has been much confusion and misunderstanding throughout the literature regarding these names. It therefore seems advisable to discuss each synonym briefly.

Swertia difformis L. is based upon the Gronovian "*Gentiana foliis linearibus acuminatis, pedunculis, longissimis nudis unifloris oppositis*"which in turn rested upon Clayton's collection *171* and also apparently two other specimens or perhaps descriptions sent by Clayton. These last two references apparently played no part in Linnaeus' concept and it is very unlikely that they entered to any extent into that of Gronovius as they presented characteristics that were in direct contrast to those described in the principal account. They certainly both belonged to at least a different species. The specimen in Clayton's herbarium is, as is shown by the photograph in the Gray Herbarium or by Blake's sketch (Rhodora **17:** pl. 112. 1915.), the uppermost portion of the rhizomatous perennial possessing characteristically opposite branches and a white, 5(6)-parted corolla. The specimen is peculiar in that the lateral branches, all six of them, are very much elongated and bear but one flower each. The inflorescence hence is very loose. The terminal flower is six-parted and this feature is shown very clearly in the photograph. The original description little suggests the plant that it is now known to depict and it is therefore not surprising that its proper disposition was but so recently accepted by most American botanists. The diagnosis, however, is excellent as a description of the somewhat atypical type specimen which is the opposite-branched perennial which was known throughout the latter half of the nineteenth century as *S. lanceolata.* Druce, in transferring the epithet, referred it to what has been called *S. elliottii,* an alternate-branched, white-flowered annual. In this he was following either the "Synoptical Flora" or the "Index Kewensis." Clayton's specimen has nothing to do with that species. The alternate-branched annual, furthermore, has not been found north of South Carolina; the opposite-branched perennial is known from southeastern Virginia, where Clayton served as a clerk of the court of Gloucester County for many years.

Card (Ann. Mo. Bot. Gard. **18:** 262. 1931.) in his monograph of *Frasera* listed *Swertia difformis* as a synonym of *Frasera caroliniensis* Walt. This mistake has been previously and emphatically pointed out by St. John (Am. Midl. Nat. **26:** 5. 1941.). Card was no doubt following Rafinesque (Med. Fl. **1:** 196. 1828.) who listed this name among others as being synonymous with his substitute name, *F. verticillata.* Merrill (1949) also equates *Frasera verticillata* in part to *Sabatia difformis.*

Of the seven fragmentary specimens of *Sabatia* still represented in Walter's collection two match the brief description of *Chironia lanceolata* and are certainly referable to the opposite-branched perennial. The association of Walter's name with the perennial has been almost invariably the rule from the time of Pursh (1814), who, as stated in his Preface, had examined Walter's collection. The combination of Walter's epithet with *Sabatia* can perhaps first be credited to Torrey and Gray in Gray's Manual (1848) who, after describing the plant, listed *S. corymbosa* Ell. as a synonym. The only name listed in synonymy under *S. corymbosa,* when it was originally described, was Walter's *Chironia lanceolata.* The synonymy of this species presented by Grisebach (1839, 1845) was complete and these accounts were doubtless the basis for Gray's treatment. It is to be remembered that Gray also examined Walter's collection in 1839.

Rafinesque (Fl. Tell. **3**: 30. 1837.) may have intended this transfer when he listed "*lanceol.*" in an enumeration of the genus *Sabatia*. Many of the names in this list were never described as the promised monograph never appeared. For *S. lanceolata* (as *lanceol.*), there were no basionym or description so even listing the name in synonymy may not be warranted.

A photograph of the type of *Chironia cymosa* Lam., which is located in Paris, was lent by the Gray Herbarium and it also proves to be a specimen of *S. difformis*. The specimen as is shown by the label was one of Fraser's from "eastern [South] Carolina."

Rafinesque (Fl. Tell. **3**: 30. 1837.) in the same list of names in which "*lanceol.*" appears, also included *cymosa* and again without basionym or description. It is possible that a transfer was intended.

This epithet, *cymosa*, was transferred formally by G. Don (1838) with the necessary basionym. The description that accompanies the name, however, applies only to *S. quadrangula*, a very different species.

Chironia paniculata Michx. is discussed more fully under *S. quadrangula*, a species with which it has long been confused. The original description was brief and the few clues presented there have been either overlooked or misunderstood. The species was known to Michaux from Georgia and "Carolina." The photograph at the Gray Herbarium of the collection in Michaux's herbarium labeled "Chironia paniculata Georgia," illustrates an excellent specimen and one which is unmistakably *S. difformis*. Pursh transferred Michaux's epithet to *Sabatia* and noted the synonymy with both *Swertia difformis* and *Chironia lanceolata*. He had seen the specimen upon which *Swertia difformis* is based in Bank's herbarium and was acquainted with authentic material of Walter's species. In addition Pursh designated two varieties, which, as I interpret the descriptions, are merely the broad- and narrow-leaved variations that are common among representatives of this species. However, Gray (1878) and following him Blake (1915) considered *Chironia paniculata β angustifolia* to be, excluding *C. lanceolata* listed in synonymy by Pursh, what is here called *S. quadrangula*.

Chironia venosa Muhl. was relegated to the synonymy of the opposite-branched, white-flowered perennial by Torrey as early as 1824. Those names published for the first time in Muhlenberg's Catalogue are so briefly characterized that Merrill and Hu (Bartonia No. 25: 22. 1949) stated that they should be considered as *nomina nuda* unless a basionym were included. The information presented with *Chironia venosa* was that the corolla was white and veiny and that the plant was a perennial found in "N. Caes. Ten." *S. difformis* is not known from Tennessee, nor is any other perennial or any other typically white-flowered species. It is found in New Jersey (N. Caes.). Otherwise there can be but little doubt that *Chironia venosa* is the same as *S. difformis.* The specific epithet aptly describes the orange discoloration especially noticeable along veins of the corolla-lobes in some dried specimens.

Sabbatia corymbosa Baldw. ex Ell. is the last of the new names proposed for the white-flowered, rhizomatose perennial. Authentic specimens from Elliott's herbarium prove the correctness of treating this name as a synonym of *S. difformis.* This sheet apparently bears two collections, which may be taken perhaps as types; one with ovate leaves apparently representing the typical element and the other with narrower leaves, probably a representative of his *S. corymbosa* var. *angustifolia.* This specific name was generally employed in designating the perennial species until the combination of *S. lanceolata* was made in 1848.

REPRESENTATIVE SPECIMENS:—NEW YORK: Nassau Co., Hempstead Flats, *Mackaness*, 1937 (NO). Since no other specimen of this species has been seen or has been reported from the state and since the region is rather well-known botanically, error in labeling is suspected. NEW JERSEY: Burlington Co., about 1.5 mi. se. of Atsion, *Fogg 5663* (F, GH, PENN); Ocean Co., Tom's River, *Mackenzie 2774* (MO, US). DELAWARE: Sussex Co., 0.5 mi. w. of Concord, *Tatnall 3129* (GH). MARYLAND: Worchester Co., Stockton, *Rusby*, Aug. 1889 (NY). VIRGINIA: Sussex Co., sw. of Wakefield, *Fernald, Long & Clement 15340* (GH, MO, US). NORTH CAROLINA: Bladen Co., 4 mi. n. of Elizabethtown, *Wilbur 2900* (MICH); Harnett Co., about 3 mi. se. of Dunn, *Wilbur 2897* (MICH); New Hanover Co., Carolina Beach, *Godfrey*, PL. EX. GRAYANAE 974 (F, GA, GH, MICH, MO, MT, NCS, NCU, NY, OKL, PENN, SMU, TENN, TEX, WIS, WVA, US). SOUTH CAROLINA: Berkeley Co., about 6 mi. ne. of Summerville, *Wilbur & Webster 2854* (MICH); Georgetown Co., 12 mi. n. of Georgetown, *Godfrey & Tryon 65* (DUKE, F, GH, MO, NY, PENN, TENN, US). GEORGIA: Charlton Co., below Trader's Hill, *Small*, 12–15 June 1895 (F, NY); McIntosh Co., 1.5 mi. n. of Darien, *Cronquist 5375* (GA, US) Thomas Co., about 1 mi.

n. of Coolidge, *Duncan 8468* (FLAS, GA, MO). FLORIDA: Dade Co., Biscayne Bay, *Rusby* (MICH) [Since otherwise not known south of Lake Okeechobee, this station seems questionable.] Highlands Co., near Sebring, *Small, Small & Dewinkeler*, 17 July 1924 (FLAS, GH, NY, US); Lake Co., Eustis, *Nash 849* (CU, F, GH, MICH, MO, MT, NY, US); Manatee Co., Bradentown, *Tracy 7541* (CU, F, GH, MO, NY, US, WIS); Okaloosa Co., 4 mi. e. of Crestview, *Webster & Wilbur 3592* (MICH); Polk Co., 16 mi. sw. of Kissimmee, *Wilbur & Webster 2637* (MICH); Santa Rosa Co., e. bank of Blackwater River across from the town of Milton, *Webster & Wilbur 3579* (MICH); Walton Co., near DeFuniak Springs, *Curtiss 5906* (CU, F, FLAS, GH, KSC, NCU, NY, SMU, US); Washington Co., 1 mi. e. of Caryville, *Webster & Wilbur 3601* (MICH).

2. **Sabatia macrophylla** Hook., Compan. Bot. Mag. **1:** 171. 1836.

Perennial herb (50–)90–120(–140) cm. high, 2–7 mm. in diameter, usually with several stems arising in a cluster from a stout, gnarled, branched rhizome up to 1 cm. in diameter and often 10 cm. or more in length. Stem stiffly erect, hollow, terete throughout, without ridges or fine lines extending between the nodes, strikingly glaucous above. Numerous white to reddish-brown fleshy roots often 15 cm. or more in length and about 2 mm. in diameter descending in clusters from the rhizome with occasional slender, fibrous, lateral roots. Branches typically opposite, very rarely alternate, generally restricted to the upper tenth or quarter or, more rarely, throughout the upper half of the stem, ascendent to rather strongly divergent forming an angle of 15–60 degrees with the stem, producing a compact, corymbose, flat-topped to somewhat convex inflorescence. Leaves thick, somewhat succulent, drying thickly chartaceous, strongly ascendent, very noticeably glaucous when fresh, ovate-lanceolate, lanceolate (sometimes very narrowly so), oblong, to ovate-oblong or even ovate, acute or rarely obtuse, scarious-mucronate tipped, margins conspicuously scarious and often slightly revolute, strongly clasping, (2.5–)3–6(–8.5) cm. long, (0.5–)1–2.5(–4.5) cm. wide, midvein prominently elevated beneath, 1–2 pairs lateral veins also often rather conspicuous. Basal rosette none; the lowermost cauline leaves absent at time of flowering. Internodes typically 3–5 times the length of the leaves. Inflorescence of numerous cymules corymbosely arranged forming a compact flat-topped to somewhat convex cluster. Leaves within the inflorescence abruptly reduced to acute, scale-like, usually non-chlorophyllous bracts 1–4 mm. long, the ultimate bracts less than 2 mm. long; the flowering clusters thus appearing naked. Pedicels slender, erect or ascendent, 1–5 mm. long. Calyx-tube and lobes more or less colorless, non-chlorophyllous; the tube campanulate, scarcely ridged or lined by elevated vascular traces, 1–2 mm. long; the lobes triangular-dentate, subulate, or linear, erect, slightly spreading, or somewhat outwardly curved at the tip, or strongly recurved, (0.1–)0.2–2.5(–3.0) mm. long, 0.1–3.5 times the length of the calyx-tube. Corolla-tube narrowly cylindrical, white, (2–)3–3.5(–4) mm. long. Corolla-lobes oblong to oblong-spatulate, obtuse, widely spreading at anthesis, (4–)5–7(–8) mm. long, 2–3(4) mm. wide, entirely white or creamy-white, color not changing, or changing but little, upon drying. Filaments (1.5–)3–4 mm. long, white; anthers slender, lanceolate, creamy white to pale yellow, 1–2 mm. long. Style 1–3 mm. long; stigmatic lobes slender, 1–3 mm. long. Capsule globose or nearly so to ovoid, (3–)3.5–4(–4.5) mm. high, (2–)3–4 mm. wide.

Small (1933) described *S. recurvans* and, according to him, this species differed from *S. macrophylla* by the characteristics presented below.

S. macrophylla Hook.	*S. recurvans* Small
Calyx 2–3 mm. long, lobes shorter than the tube.	Calyx 4–5 mm. long, lobes longer than the tube.
Corolla-lobes 6–8 mm. long.	Corolla-lobes 5–6.5 mm. long.
Capsule 3–4 mm. long.	Capsule 3.5–4.5 mm. long.
Style and stigma about equal in length.	Style much shorter than the stigma.

Available to Small at New York were five sheets which here are considered part of the *recurvans* population. Two of these, *Harper 1415* and *708*, were so annotated by Small. Excellent specimens of Harper's *1415* are represented in several herbaria. The specimen of this number at New York is chosen as the lectotype. It, however, lacks fruit, which was described from Harper's *708*.

The specimens of *S. recurvans* available to Small at New York were too few to be significant in evaluating the supposedly distinguishing characters. This is especially true in regard to the overlapping size-ranges of the corolla-lobes and capsules published as additional evidence. These overlapping ranges might be of some significance if based upon a large series of specimens but in this case furnished only "padding" to an otherwise scantily characterized entity. Even now few fruiting specimens are available but measurements of them indicate a range of 3–4.5 mm. in length of capsule in both species. The length of the corolla-lobes is equally useless as a distinguishing feature as the range of *S. macrophylla* was between 4–8 mm. and that of *S. recurvans* between 4–7 mm. The slight discrepancy would very likely disappear if a larger series of measurements were made. The length of the corolla-lobes is apparently strongly affected by environmental conditions and the season in which the flowers are produced. Flowers developing later in the season are generally much smaller than those appearing earlier in the year. Therefore, all of the characters with overlapping ranges presented by Small as supporting evidence of the distinctiveness of the two entities prove completely useless upon examination of more collections.

The ratio of the style to the stigmas was indicated by Small to be a reliable distinguishing feature. It was even used by him as a secondary key-character. However, the comparative length of these structures varies enough so that one may find either the stigma or the style longer on the same plant; consequently this character is not of taxonomic value. The comparative length of the stigma to the style varies considerably in different stages of maturity.

The calyx does possess features which seem to be valid; specimens can be assigned to one group or the other by the calyx characters and the two groups thus delineated occupy, as far as is now known, adjacent but distinct areas. Small's very convenient hiatus of 1 mm. between the size-range of the calyx in the two entities disappears upon examination of a number of flowers. The overall calyx-length of *S. macrophylla* is 1.1–3(–4) mm., while that of *S. recurvans* is (2–)2.5–4.0(–4.5) mm. long. The overlap of these ranges is too great to be of much aid in identification.

A comparison of the length of the calyx-lobes has much more promise, but that, too, fails to provide a clear-cut distinction that might be mechanically applied. The *macrophylla*-population has lobes (0.1–)0.2–1.2(–2) mm. long. Of the more than six hundred lobes measured in this group nearly sixty per cent were less than 1 mm. long, and over ninety-six per cent of the lobes were less than 1.2 mm. long. The few flowers with calyx-lobes longer than 1.2 mm. were always the centermost flower of the inflorescence or the oldest flower of the cymules closest the center of the compound inflorescence. Their lobes are often longer than those of other flowers on the same plant. Calyx-lobes of the *recurvans*-group measured (1–)1.5–3 mm. long with only five flowers (less than three per cent of the total) with lobes less than 1.5 mm. long and with more than seventy per cent of the nearly two hundred lobes measured 2 mm. long or longer.

The ratio of the lobe/tube-length provides a somewhat sharper means of separation but even this provides no clear-cut division between the two populations. This ratio-range of the *macrophylla*-group is (0.1–)0.2–1(–2) with all but five flowers possessing lobes equaling or less than the tube in length. These few flowers were again the centermost which are often strikingly different from the others in the inflorescence. The same ratio-range in the *recurvans*-population is (1–)1.3–3(–3.5) with only four flowers (2.3 per cent) equaling the tube and nearly forty per cent of the flowers possessing lobes two or more times greater than the tube.

Even the feature of the recurved lobes is not restricted to the *recurvans*-group; some of the longer-lobed representatives of *S. macrophylla*, which are found in the extreme eastern portion of its range, show at least the beginnings of this tendency by possessing lobes slightly recurved at the extreme tip.

The most useful criterion known to me for the separation of the two populations is that based upon the length of the calyx-lobes. Future study may demonstrate that the group known as *S. macrophylla* possesses pronounced clinal variation from west to east and that this variation is in the direction of the even more easternly population previously known as *S. recurvans*. The calycine lobes of the plants from western Florida seem longer on the average than those from Louisiana. The even more eastern *S. difformis*, the species most closely related to the above-discussed complex, is usually readily distinguished by calyx-lobes which are almost invariably longer than even those of *S. recurvans*. Again in regard to characters of the calyx there is no sharp separation between the two populations but the upper limits of *S. recurvans* overlap but slightly the relatively few calyx-lobes measured in *S. difformis* which were shorter than 4 mm. long.

The material at hand may be readily assigned to one population or the other with little more than a glance at several calyces and the two groups have, as far as is now known, separate ranges. The two entities, here considered to represent weakly differentiated geographical varieties, are not distinguished by strong, or even exclusively delimiting morphological characters. Nor are the two varieties widely separated geographically as they are now known to occur at least within fifty miles of one another.

Key to the Varieties

Calyx-lobes erect or only slighty outwardly curved at the tip, equaling or less than the calyx-tube in length.......2a. *S. macrophylla* var. *macrophylla*.

Calyx-lobes strongly recurved, exceeding the calyx-tube in length. 2b. *S. macrophylla* var. *recurvans*.

2a. **Sabatia macrophylla** Hook., var. **macrophylla.**

Calyx lobes (0.1–)0.2–1.5(–2) mm. long, triangular-dentate to linear, erect or only slightly outwardly curved at the tip, equaling or less than the calyx-tube in length (very rarely the centermost flower of the central cymules may have a ratio of lobe/tube greater than 1). TYPE LOCALITY: near Covington, Louisiana. Type: *Drummond s. n.* (K!). DISTRIBUTION. Savannas and pine-barrens and margins of low hardwoods from western Florida and Georgia westward to Louisiana. Map 2.

REPRESENTATIVE SPECIMENS:—GEORGIA: Muscogee Co., Columbus, *Boykin* (BRU, GH, NY); Sumter Co., Americus, *Harper*, 30 July 1897 (GH). FLORIDA: Bay Co., 1 mi. n. of Lynn Haven, *Webster & Wilbur 3626* (MICH); Calhoun Co., 2 mi. s. of Chipola, *Thorne & Muenscher 8744* (CU); Columbia Co., Lake City, *collector not stated* (F); Escambia Co., 9 mi. w. of Pensacola, *Webster & Wilbur 3575* (MICH); Franklin Co., Apalachicola, *Biltmore Distrib. Chapman Herb. 4508a* (GH, NY); Gadsen Co., inter Quincy et Aspalga, *Rugel*, July 1843 (MO, NY); Gulf Co., Port St. Joe, *Knight*, 18 June 1936 (FLAS); Liberty Co., Bristol, *West & Arnold*, 23 July 1940 (FLAS); Okaloosa Co., about 3 mi. e. of Crestview, *Webster & Wilbur 3584* (MICH); Wakulla Co., 1.5 mi. s. of Sopchoppy, *Webster & Wilbur 3628* (MICH); Walton Co., near Argyle, *Curtiss 5931* (CU, FLAS, GH, KSC, MO, NCU, NY, SMU, US); Washington Co., 8 mi. s. of Chipley, *Webster & Wilbur 3614* (MICH). ALABAMA: Baldwin Co., 13.5 mi. w. of Foley, *Webster & Wilbur 3530* (MICH); Mobile Co., about 8 mi. w. of Mobile, *Webster & Wilbur 3481* (MICH); Washington Co., 40 mi. n. of Mobile, *Sargent*, 18 June 1950 (GA, NCS). MISSISSIPPI: Forest Co., Lake Shelby State Park about 14 mi. s. of Hattiesburg, *Webster & Wilbur 3402* (MICH); Harrison Co., Biloxi, *Tracy 7006* (F, MO, NY, US); Jackson Co., Ocean Springs, *Pollard 1064* (CU, F, MO, NY, US); Perry Co., 9 mi. n. of Beaumont, *Webster & Wilbur 3422* (MICH); Stone Co., 3 mi. s. of Wiggins, *Webster & Wilbur 3439* (MICH). LOUISIANA: St. Tammany Parish, Covington, *Drummond* TYPE (K).

2b. **Sabatia macrophylla** Hook., var **recurvans** (Small) comb. nov. *Sabbatia recurvans* Small, Man. SE Fl. 1049. 1933.

Calyx-lobes (1–)1.5–3 mm. long, linear to subulate, strongly recurved, typically exceeding the calyx-tube in length (less than 3 per cent of the nearly 200 lobes measured had a lobe/tube ratio of 1 or 1.2). LECTOTYPE LOCALITY: Moist pine-barrens east of Ocilla, Irwin Co., Georgia. Lectotype: *Harper 1415* (NY!). DISTRIBUTION: Savannas and pine-barrens of southern Georgia and northeastern Florida. Map 2.

REPRESENTATIVE SPECIMENS:—GEORGIA: Brantley Co., 3 mi. e. of Nahunta, *Wilbur & Webster 2748* (MICH); Charlton Co., 8 mi. s. of Folkston, *Wright 881* (CU); Coffee Co. without exact locality, *Harper 708* (NY, US); Emanuel Co., e. of Swainsboro, *Duncan 2677* (MICH); Irwin Co., e. of Ocilla, *Harper 1415* (F, GH, MO, NY, US); Laurens Co., 10 mi. e. of Dublin, *Pyron & McVaugh 750*

(GA, US); Worth Co., 3.5 mi. w. of Sylvester, *Thorne 6363* (CU). FLORIDA: Baker Co., without exact locality, *Curtiss 2224* (CU, F, MO, NY, US, YU); Clay Co., without exact locality, *Todsen*, 30 July 1939 (FLAS); Duval Co., 15 mi. w. of Jacksonville, *Wiegand & Manning 2566* (CU, GH); Nassau Co., without exact locality, *Knight*, 1 July 1941 (FLAS).

(B) Subsection ANGULARES Blake, Rhodora **17:** 56. 1915.

Annuals with fibrous roots and with typically opposite branches. Leaves thin and membranous, margins not scarious. Basal rosette usually well-developed at some time during maturation of plant. TYPE SPECIES: *Sabatia angularis* (L.) Pursh.

The three species comprising subsection Angulares, as here defined, are readily distinguished from one another. As a group it is strongly differentiated from all other subsections of section *Eusabatia.* The annual habit separates them from subsections *Difformes* and *Dodecandrae,* the opposite branches and the typically 3-flowered cymules set them apart from the *Campanulatae,* and the thin, merely finely ridged calyx-tube and, again, the opposite branches easily distinguish the *Angulares* from the *Campestres.* This subsection occupies the largest area of any within the genus.

These three species and the other species reported as annuals in the paper have most often in the past been treated as biennials. Field observations and limited experience with some of the species in the greenhouse has led me to believe that they are all probably annuals but this point has not been definitely established.

KEY TO THE SPECIES OF SUBSECTION ANGULARES

A. Lower portion of the stem strongly 4-angled, quadrate, the corners with conspicuous membranously-winged margins.
  B. Corolla pink to roseate (very rarely white); pedicels elongate, 1 cm. or more in length; lower cauline leaves usually broadly ovate to ovate-lanceolate, usually less than 3 times as long as broad; calyx-lobes usually 1.5 mm. or more in width (rarely as narrow as 1 mm.). 3. *S. angularis.*
  B. Corolla white; pedicels short, less than 5 mm. long; lower cauline leaves usually oblong, generally 4 or more times as long as broad; calyx-lobes less than 0.5 mm. wide........................4. *S. quadrangula.*
A. Lower portion of the stem terete and not bearing thin membranous wings. 5. *S. brachiata.*

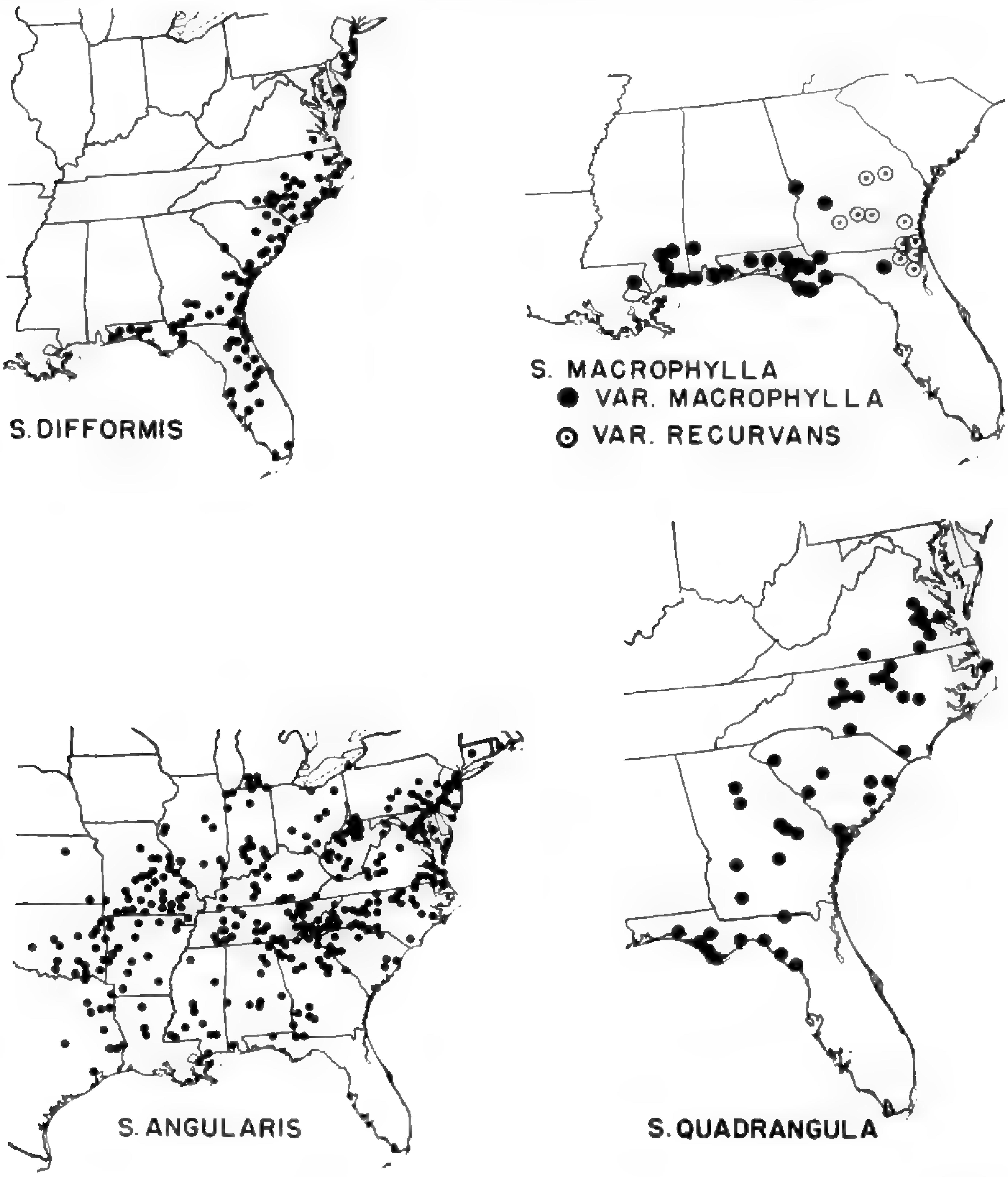
3. **Sabatia angularis** (L.) Pursh *Chironia angularis* L., Sp. Pl. 1: 190. 1753. *C. angularis* var. *α latifolia* Michx., Fl. Bor.-Am. 1: 147. 1803. *Sabbatia angularis* (L.) Pursh, Fl. Am. Sept. 1: 137. 1814. *S. angularis*

var. *albiflora* Raf., Med. Fl. 2: 77. 1830. *nom. nud.* *S. angularis,* var. *elatior* Raf., *l.c., nom nud.* *S. angularis,* var. *latifolia* Raf., *l.c., nom nud.* *S. angularis,* var *pauciflora* Raf., *l. c., nom nud.* *S. angularis,* f. *albiflora* Raf. ex House, Bull. N. Y. State Mus. 254: 566. 1924. *S. angularis* f. *cleistantha* Fern., Rhodora **42:** 474. 1940.

Erect annual (15–)30–50(–90) cm. tall, often robust and usually with the numerous branches presenting in plants developed under favorable conditions a bushily compact aspect. Stem strongly tetragonal, hollow, the corners conspicuously wing-angled by thin membranous extensions 0.1–0.5 mm. wide. Stem green in younger portion becoming yellowish straw-colored below, (1–)2–3(5) mm. in diameter. Branches typically opposite, although ultimate-branching often alternate, usually by marked abortion of opposing bud, or generally alternate in depauperate plants, often numerous, rarely extending to base, but more typically restricted to upper third or half of stem, rather closely ascendent forming an angle of about 20–45 degrees with main stem. Branches composed of 1–10 nodes in well-developed plants and forming a convexly-corymbose or pyramidal compact crown. Roots several, fibrous, 4–10(–20) cm. long, (0.2–)1–3(–4) mm. in diameter, wide-spreading and usually shallowly situated. Leaves thin membranous, spreading to ascendent, drying thin, 5–7-nerved or fewer in those leaves transitional to bracts, (1–)2–3.5 (–4.5) cm long, (0.8–)1–2.5(–3.5) cm. wide, venation prominently elevated beneath. Basal rosette rarely present at anthesis, composed of spreading, shortly-spatulate, broadly oblong to obovate, obtuse leaves up to about 4 cm. long and often 2–3 cm. wide. Lowermost cauline leaves usually absent at time of flowering, the lowest usually broadly ovate, always strongly clasping, obtuse, typically nearly as broad as long, the middle narrower, more typically ovate-lanceolate, obtuse or more commonly acute, and gradually reduced and modified above to the 1-nerved linear bracts. Internodes generally about 1.5–3 times as long as the leaves. Inflorescence of corymbosely- or pyramidally-arranged cymules, either or both of the lateral branches sometimes suppressed. Pedicel 5-sided, slightly wing-angled, (1–)2–3.5(–4.5) cm. long, erect or strongly ascendent. Calyx-tube thin, shallow, 2–5 times exceeded by the corolla-tube, usually about 1.5 mm. long (1–2 mm.), with venation somewhat elevated. Calyx-lobes thin, narrowly linear, linear-oblong, to somewhat foliaceous, usually about 1 cm. long (0.4–1.5 cm.) and (1–)1.5–2.5(–3.5) mm. wide, ascendent in bud, wide-spreading at anthesis, usually exceeded by the corolla by 5–12 mm. Corolla-tube 4–7 mm. long, 2–4 mm. in diameter, cylindrical, pale greenish-white within and without. Corolla-lobes oblong, spatulate, or elliptic, obtuse, wide-spreading, (0.6–)1–1.8(–2.2) cm. long, (2–)4–7(–9) mm. wide, greenish in bud turning white prior to full development and typically pink or roseate at anthesis or rarely white, coloration paler beneath, with an irregular, somewhat pointed, yellow or greenish-yellow area at base of lobe and in throat and usually bordered by a dark-red line. Filaments 2.5–4.5 mm. long, greenish-yellow to pale-yellow; anthers slender, bright yellow, 3–5 mm. long. Stigmatic lobes very slender, 3–6 mm. long. Style 4–6 mm. long, usually somewhat less than length of stigmatic branches. Capsule cylindrical at maturity 5–9 mm. high, 4–6 mm. wide. TYPE LOCALITY: "In Virginia." Type: *Kalm* (in the Linnean Herbarium), but not seen. DISTRIBUTION: Margins of woods, fields, and prairies from southern New York south to northern Florida and west to Illinois and Texas. Occasionally introduced in Massachusetts and Connecticut. Map 3.

This species is by far the most familiar representative of the genus because of its wide range, the greatest of any in the genus, and also because of the frequency with which it is encountered throughout most of that range. The characteristic features are the conspicuous tetragonal stem, the corners of which are strikingly membranously wing-margined; the typically opposite pattern of branching, the ovate-clasping leaves, the roseate corolla (although albinos are encountered rather rarely), and the shallow calyx-tube, the venation of which, although often slightly elevated, is not developed into a heavy costa. None of these characters alone is enough to distinguish the species but the combination of them in one plant is unique. In the western part of the range of *S. angularis*, it has been confused surprisingly often with *S. campestris*. This latter species may be readily distinguished from the former by its typically alternate branching-pattern and especially by the turbinate and comparatively long calyx-tube with strongly developed costae. In the southeastern region, it has been confused at times with *S. brachiata*, but is at once separable from that species which possesses an almost terete stem and oblong, non-clasping leaves.

The species is remarkably uniform throughout its range. None of the trivial variants designated previously is here deemed worthy of recognition nor have any others been discovered. Although I have not seen even a photograph of the type of *Chironia angularis β angustifolia*, if it is still extant, I am accepting for the time being the past interpretation that this entity is what is now called *S. brachiata*. Coordinate with this variety, Michaux published *C. angularis α latifolia* which is perhaps the typical element of *S. angularis*. The species remained unencumbered by the designation of minor varieties until Rafinesque. This author, after discussing *S. angularis*, stated that "it has some varieties: 1. Albiflora, 2. Latifolia,



MAPS 1–4. Map 1, upper left; map 2, upper right; map 3, lower left; map 4, lower right.

3. Pauciflora, 4. Elatior." None of these propositions is discussed or mentioned by him further in any manner and hence are merely *nomina nuda*. Therefore, they are not available for transferral to any other rank. House, in providing formal nomenclature to designate the albino form, erred in transferring a name which "has no status under the Rules." For those who find it useful or satisfying to name such striking minor variations the epithet for the albino might best be written as *Sabatia angularis* forma *albiflora* House. Fernald described

a teratological specimen as *S. angularis* forma *cleistantha*. It has not been seen again in any of the many hundreds of sheets of this species that I have examined. The branches are stunted and malformed bearing sessile or nearly sessile flowers which are aborted and modified in size and form as to be scarcely recognizable as flowers. Little is to be gained by formal designation of such rare chance monstrosities.

REPRESENTATIVE SPECIMENS:—CONNECTICUT: Locality not stated, *Wright* (YU). NEW YORK: Richmond Co., near New Dorp, *Britton*, 9 Aug. 1879 (YU). NEW JERSEY: Cape May Co., Cold Spring, *Pennell 2128* (US). PENNSYLVANIA: Berks Co., 0.5 mi. wnw. of Gibralter, *Berkheimer 2926* (GH, PENN). DELAWARE: New Castle Co., near Wilmington, *Canby*, Aug. 1878 (MO). MARYLAND: Harford Co., se. of Flintville, *Adams & Hopkins 923* (CU, PENN). DISTRICT OF COLUMBIA: Chain Bridge, *Earlanson & Martin 1210* (NA). VIRGINIA: Southampton Co., se. of Ivor, *Fernald & Long 10784* (GH, MO). NORTH CAROLINA: Buncombe Co., near Biltmore, *Biltmore Herb. 3303a* (F, GH, MO, NY, US); Durham Co., about 4 mi. ne. of Durham, *Wilbur 2898* (MICH); Halifax Co., Roanoke Rapids, *Godfrey 5178* (DUKE, GH, US). SOUTH CAROLINA: Williamsburg Co., 2 mi. ne. of Lane, *Godfrey & Tryon 399* (DUKE, F, GH, MO, NY, PENN, TENN). GEORGIA: Bartow Co., about 4.5 mi. s. 16° east of Allatoona Dam, *Duncan 8522* (FLAS, GA, GH, MO, TENN, US); Catoosa Co., 10 mi. w. of Ringgold, *Cronquist 5610* (GA, GH, US). FLORIDA: Jackson Co., Sneads, *Knight*, 29 June 1943 (FLAS). MICHIGAN: Kalamazoo Co., *Hermann 9042* (MICH). OHIO: Coshocton Co., near Coshocton, *Moldenke 13289* (OKLA, PENN, SMU). INDIANA: Morgan Co., about 2 mi. w. of Centerton, *Friesner 17008* (GH, NY, OKLA); Steuben Co., near Lake Gage, *Deam*, 11 Aug. 1903 (GH, US, WIS, YU). ILLINOIS: Marion Co., Salem, *Bebb* 1860 (F, GH, YU). WEST VIRGINIA: Cabell Co., overlooking Roland Park, *Gilbert 778* (DUKE, F, GA, GH, MICH, MO, MT, NA, NY, OKL, PENN, RUT, TENN, US, WIS); Putnam Co., near Hurricane, *Gilbert et al.*, SO. APP. BOT. CLUB DISTRIB. 146 (FLAS, MO, NCS, NY, OKL, PENN, TAES, TENN, WVA). KENTUCKY: Calloway Co., se. of Aurora, *Smith & Hodgdon 4050* (GH, NY, US); McCreary Co., Cumberland Falls, *McFarland & James*, 2ND CENT. FL. KENT. 35 (DUKE, GA, MO, NY, PENN, TENN, WIS, WVA, US). TENNESSEE: Cheatham Co., Pegram, *Svenson 10338* (GH, TENN). ALABAMA: Lowndes Co., 23 mi. se. of Selma, *Webster & Wilbur 3511* (MICH). MISSISSIPPI: Amite Co., 5 mi. sw. of Gloster, *Webster & Wilbur 3277* (MICH); Perry Co., 14 mi. w. of Beaumont, *Webster & Wilbur 3405* (MICH). MISSOURI: Howell Co., 4.5 mi. nw. of Willow Springs, *Steyermark 23461* (F, MO). ARKANSAS: Pope Co., Nogo, *Merrill 545* (TEX, UARK). LOUISIANA: Grant Parish, 15 mi. s. of Winnfield, *Webster & Wilbur 3259*(MICH). KANSAS: Cherokee Co., *Hitchcock*, Aug. 1896 (KSC). OKLAHOMA: Pushmataha Co., Antlers, *Palmer 8315* (MO, MT, NY, US). TEXAS: Smith Co., Swan, *Reverchon 3120* (MO, SMU).

4. **Sabatia quadrangula** sp. nov.[4]

Sabbatia cymosa in the sense of G. Don, Gen. Hist. 4: 207. 1838, as to

[4] Sabatia quadrangula sp. nov. Herba annua rosulata, caulibus quadrangularibus, ramis oppositis, pedicellis brevibus, 1–2(–4) mm. longis, corolla alba, 5-partita. Specimen typicum legit R. Wilbur (n. 2899) prope Durham, in Carolina Septentrionali, et in Herb. Universitatis Michiganensis conservatum.

Don's description but excluding reference to *Chironia cymosa* Lam., a synonym of *Sabatia difformis* (L.) Druce.

Sabbatia paniculata in the sense of authors after 1860 but not that of Michaux, the author of the basionym, nor of Pursh who made the combination. The earlier authors were describing the perennial now known as *S. difformis* (L.) Druce.

Sabatia brachiata f. *candida* Fern., Rhodora **39:** 443. 1937

Erect annual (15–)25–45(–75) cm. high, usually with but one stem arising from each rosette, but occasionally with two to several. Roots few to more typically numerous, slender, fibrous, usually widely spreading and shallowly situated, about 4–8 cm. long and less than 1 mm. in diameter. Branches usually restricted to upper one-quarter or one-third of stem, occasionally arising from nodes of the upper half of the stem or rarely from even the lowermost nodes, usually rather strongly ascendent, forming an angle of 15–30 degrees, or occasionally up to 60 degrees, typically opposite along the stem and principal branches, the ultimate ramifications more commonly alternate, the branches forming a flat-topped or convexly corymbose loose to compact crown. Stem strongly quadrate, conspicuously so below, 1–2(–3) mm. in diameter, strikingly although finely membranous wing-angled, wings thin, very low, less than 0.5 mm. in height in the lower portion of the stem and reduced above to the merest trace. Basal rosette present or absent at anthesis, even when present often not well-developed or conspicuous, when well-developed of spreading obovate to spatulate, obtuse to occasionally acute leaves tapering to an almost petiolate base, about 2–4 cm. long and 1.8 cm. wide. Cauline leaves membranous, ascendent, 3-nerved, or only 1-nerved in smaller leaves, somewhat revolute, (0.8–) 1.6–3.2 (–5.8) cm. long, (3–)4–8(–18) mm. wide, obtuse to acute, typically apiculate, usually narrowly to broadly oblong or lanceolate, usually about 3–5 times as long as broad but ranging from about 2–8 times as long as broad, typically at least the lowermost with a strongly clasping base. Internodes often equaling or slightly exceeding the leaf, commonly about 1–2 times as long, but ranging from 0.5–5 times as long as the leaves. Inflorescence of corymbosely to pyramidally arranged cymules, either one, both or none of whose lateral branches may be suppressed, flowers unusually closely associated in the cymule as the pedicels are always short, the flowers often sessile or nearly so, pedicels usually not more than 1–2 mm. in length, always less than 4 mm. long. Calyx-tube thin, 5 ridge-angled, about one-half as long as the corolla-tube, or about 2–3 mm. high, broadly turbinate, 1.5–3(–3.5) mm. long. Calyx-lobes thin, narrowly linear, (2–)4–8(–11) mm. long, usually about 0.5 mm. or less in width, but very rarely lobes as broad as 1.5 mm., erect in bud, and apparently ascendent at anthesis arching upward between the corolla-lobes, usually exceeded by the corolla-lobes by about 2–5 mm. Corolla-tube (2.5–)4–5(–7) mm. long, white but appearing greenish as the ovary is visible through the thin translucent wall. Corolla-lobes usually oblong, or spatulate, or somewhat elliptic, usually obtuse but not uncommonly acute, (4.5–)6–12(–15) mm. long, (1.5–)3–4(–6) mm. wide, spreading, pure white, occasionally with or more commonly without the basal yellow patch, often turning saffron-yellow upon drying, especially along the reticulate veins. Filaments slender, white, 2–4 mm. long; anthers pale yellow, 1.5–3 mm. long. Stigmatic lobes greenish, lanceolate to oblong, 2–4 times the length of white style, 0.5–1.5(–2) mm. long. Capsule cylindrical, 4.5–7 mm. long, 3–4 mm. in diameter. TYPE LOCALITY: About four miles northeast of Durham, Durham County, North Carolina, TYPE: *Wilbur 2899* (MICH). DISTRIBUTION: Fields, pinelands and drier savannas from southeastern Virginia south to central Florida. Map 4.

This species has been known for almost one hundred years as *Sabatia paniculata*. This name, based upon *Chironia paniculata* Michx., has long been a source of confusion and error and has been applied by various authors to at least three different species. For almost the past century its application has been rather consistently restricted to the species which is here called *S. quadrangula*.

Michaux's original description in full is as follows:

paniculata. C. firmiter erecta: foliis lanceolato-linearibus; panicula multiflora, brachiata, subfastigata; calyce subulato, corolla semibreviore.

Obs. Caulis lineis 4 prominulis quasiquadrangulus: folia inferiora interdum vali-lanceolata; suprema subulato-setacea. Corollae laciniae oblongae.

Hab. in Georgia et Carolina.

To be sure, there is very little descriptive information here that would be sufficient to allow anyone to be certain or even relatively confident as to which entity Michaux was attempting to characterize. Many of the phrases such as "C. firmiter erecta . . . panicula multiflora, brachiata, subfastigata: calyce subulato, corollae semibreviore . . . Corollae laciniae oblongae" might be applied with equal propriety to several other species. Of the five species included by Michaux, the flower-color of the four others is described as being rose; that of *C. paniculata* is not given. Those characters of the leaf that were mentioned are rather indicative of *S. difformis* (". . . foliis lanceolato-linearibus . . . folia inferiora interdum ovali-lanceolata; suprema subulato-setacea . . ."). The features of the stem described in the original diagnosis, especially "caulis lineis 4 prominulis quasi quadrangulus . . ." are also a much more apt description of the stem of *S. difformis* with its four elevated lines or ridges in the upper portion of the stem than it is of the very pronounced and strikingly 4-sided stem of *S. quadrangula.*

It was not surprising, therefore, to find that Michaux's collection, as shown by a photograph in the Gray Herbarium of the type, was a specimen of *S. difformis.* This species is a perennial with a large rhizome; the stem below is terete or with four lines or ridges superimposed upon it, and above the stem becomes somewhat quadrangular; the leaves are ovate-lanceolate, lanceolate, linear to setaceous in a gradually modified sequence from the base to the inflorescence; the corolla-lobes are often 5 mm. or more longer than the longest lobes observed in *S. quadrangula.* The specimen in Michaux's herbarium, as is witnessed by the very adequate photograph, is excellent and most of these features may be observed or interpreted from it. The underground portion of the plant, to be sure, is lacking. It is obvious that the lowermost part of the specimen (which can be seen even from the photograph to be terete or nearly so and approximately twice the diameter of the largest stem of the species that has most recently passed as *S. paniculata*) has been broken from a very substantial underground structure. Therefore *Chironia paniculata* is, both on the basis of its original diagnosis and upon the photograph of the specimen in Michaux's own collection in Paris, but a later synonym for *Swertia difformis* L. (1753), *Chironia lanceolata* Walt. (1788) and *Chironia cymosa* Lam. (1791).

Pursh (1814) transferred Michaux's epithet to *Sabatia* (as *Sabbatia*) listing *Swertia difformis* as a synonym, stating by way of explanation that this species "certainly is the long lost *Swertia difformis,* as the specimens in the Herbarium of Sir Joseph Banks, sufficiently prove." Pursh also formally named as varieties the broad- and narrow-leaved forms of this species with *C. lanceolata* Walt. as a synonym of the latter. Elliott (1817) rather hopelessly confused the white-flowered Sabatias nomenclatorially and the influence of his splendid "Sketch" was rather long-lasting. The very different *S. brevifolia* Raf. (*S. elliottii* Steud.) was very well-described, no doubt for the first time, but called *S. paniculata* with the following note by way of explanation: "Though the description of Michaux applies more peculiarly to the *S. corymbosa* [*S. difformis*], yet as this species was definitely included, and is the only one to which the term *paniculata* is correctly applicable, I have referred to him here." This freedom of interpretation on the part of Elliott caused confusion that persisted for many years. Grisebach (1839) pointed out the confusion but apparently felt that it would be best to apply the name *S. paniculata* in the sense of Elliott, who had been followed by all American authors, and to adopt the name *S. corymbosa* for the perennial species. His list of synonymy showed a very complete understanding of the nomenclatoral propositions that had been made for this last-mentioned entity for the names of Linnaeus, Walter, Lamarck, Michaux, Pursh, and finally Baldwin (or Elliott) are arrayed there. Grisebach apparently included the opposite-branched annual, here called *S. quadrangula*, in the same concept for a duplicate of the specimen of Beyrich cited by him under *S. corymbosa* is the earliest collection of *S. quadrangula* known to me. Chapman (1860) was the first to define *S. paniculata* in the sense that it has been applied in recent times. His action in this, as in most other matters, was heavily influenced by Gray as is shown from a letter (in the National Herbarium, dated December 1883) from Chapman to Dr. J. H. Mellichamp which is here quoted in part.

. . . I well remember the quarrel Gray and I had over it, I contending that the one we now call *S. elliottii*, our really only paniculate species, should bear that name. However, for the sake of uniformity as to our northern and southern Floras, I yield.

The appearance of the Synoptical Flora (1878) firmly established the usage of *S. paniculata* as the name of the white-flowered, opposite-branched annual and this name has been so applied since that date.

Rafinesque (Med. Fl. **2:** 77. 1830.) published a description that in some ways strongly indicates this entity. This name has never been identified and I am at a loss to know what species Rafinesque had. *Sabbatia nivea* was described by him as having snowy-white, trichotomose flowers, a four-angled stem and oblong leaves which all would indicate *S. quadrangula* as well or better than any other species. However, the species was definitely stated to have been discovered by him in eastern

Kentucky near the Cumberland River. There is no species known to me from that area which matches his description.

G. Don (1838) transferred Lamarck's *C. cymosa* to *Sabatia* applying it to what is here called *S. quadrangula.* This usage was not followed by any other author. The photograph of the specimen upon which Lamarck's species was based is again what is now known as *S. difformis.*

Gray (1878) placed *S. paniculata* var. *latifolia* Pursh under the synonymy of what is now considered *S. difformis* while placing *S. paniculata* var. *augustifolia* Pursh under the species which I am calling *S. quadrangula* and which he called *S. paniculata.* In other words he felt that Pursh was including two species under *S. paniculata* and Gray also implied that Michaux had done so as well. I am aware of no evidence that has been presented that would warrant such a conclusion.

The only name that has been published previously for this species, whose identity has been for so long known to American botanists, is *S. brachiata* forma *candida* Fernald. This name must be assigned to the synonymy of *S. quadrangula* rather than to *S. brachiata* as the type specimen, *Fernald & Long 6346*, is not an albino of *S. brachiata* as claimed by Fernald, but rather is a specimen of the white-flowered species, *S. quadrangula.* Its identity is shown by the stems which below are strongly quadrate with conspicuously membranous-margined angles and whose pedicels are 2 mm. or less in length so that the flowers appear almost sessile. The only specimen cited by Fernald besides the type was *Seymour 33* which came from Sussex Co., in southeastern Virginia as did the type-collection of Fernald's form. Seymour's plant, seen only at the Gray Herbarium, is *S. brachiata* as is indicated by the stem being terete below and some of the pedicels being over 5 mm. long and many of them over 2 mm. long. The flowers are bleached on the herbarium specimen but, as the sheet was originally determined as *S. paniculata,* they were very likely white. I also have seen white flowered specimens of *S. brachiata* in the field. However, since the designated type of Fernald's form is what is here called *S. quadrangula,* it will be necessary for those who feel it useful formally to designate such minor variations to provide another name for albino plants of *S. brachiata.* Fernald's name could have been elevated to specific rank for the annual species with a quadrate stem instead of providing an entirely new name. This procedure would seem undesirable as Fernald's intention in describing the form is clear; his choice of type was unfortunate. Besides this consideration, isotypes are not available for that number. Therefore, a new name has been provided and a type designated of which there are many duplicates.

REPRESENTATIVE SPECIMENS:—VIRGINIA: Chesterfield County, near Chesterfield Courthouse, *Fernald & Long 6342* (GH); Greensville Co., nw. of Taylor's Millpond, *Fernald & Long 10785* (GH, PENN); Hanover Co., 1 mi. s. of Ashland, *Ward*, 8 Aug. 1885 (US); Henrico Co., west of Elko Station, *Fernald & Long 8818* (GH); James City Co., south of Hotwater, *Fernald & Long 8817* (DUKE, GH); Pittsylvania Co., Falls Creek, *Heller 1105* (NY, US); Prince George Co., w. of Prince George Courthouse, *Fernald & Long 8816* (GH); Sussex Co., ne. of Homeville, *Fernald & Long 6341* (GH, MO, NY, PENN, US). NORTH CAROLINA: Anson Co., 6 mi. w. of Wadesboro, *Smith*, 30 July 1884 (GH, US); Columbus Co., Nakina, *Schallert*, 30 June 1928 (OKLA); Dare Co., Old Battle Ground, *Bartley & Pontius 489* (NY); Davidson Co., High Rock, *Schallert 8660* (DUKE); Durham Co., about 4 mi. n.e. of Durham, *Wilbur 2899* (MICH); Forsyth Co., without exact locality, *Schallert*, 18 Aug. 1940 (MO, UARK, WIS); Granville Co., Oxford, *Godfrey 5464* (DUKE, GH); Johnston Co., 0.5 mi. n. of Cox's Mill, *Fox 4942* (MICH); Orange Co., Hillsboro, *Gray & Carey*, July 1841 (GH); Randolph Co., Asheboro, *Hood 2399* (FLAS); Rowan Co., vicinity of Salisbury, *Heller 130* (F, MO, NY, PENN); Wake Co., just w. of Morrisville, *Godfrey 49518* (DUKE, FLAS, GA, GH, MICH, NCS); Wayne Co., Goldsboro, *Burlingame*, July 1887 (BRU). SOUTH CAROLINA: Aiken Co., Vancluse, *Eggert*, 6 Aug. 1898 (MO); Anderson Co., Long Branch Church, *Davis*, 29 July 1919 (MO, TEX, US); Beaufort Co., Bluffton, *Mellichamp*, 1884 (F, US); Berkeley Co., 8 mi. s. of Monks Corner, *Wiegand & Manning 2557* (mixed sheets) (CU, GH); Georgetown Co., 12 mi. n. of Georgetown, *Godfrey & Tryon 26* (DUKE, F, GH, MO, NY, US); Jasper Co., Ridgeland, *Mohr*, 1893 (MO); Lexington Co., 8 mi. s. of Columbia, *Godfrey & Tryon 1229* (mixed sheet) (NY); Williamsburg Co., Lanes Station, *Burlingame*, 20 July 1894 (BRU). GEORGIA: Emmanuel Co., near Graymont, *Harper 990* (GH, NY, US); Gwinnet Co., between the Alcovy River and No Business Creek, *Small*, 14 July 1893 (F, GH, MO, NY, US); Johnson Co., 2.5 mi. w. of Wrightsville, *Pyron & McVaugh 3083* (GA); Mitchell Co., few miles e. of Pelham, *Thorne 5078* (CU); Newton Co., 4 mi. n. of Covington, *Pyron & McVaugh 3036* (GA, NA); Sumter Co., without exact locality, *Harper*, July 1897 (NY); Telfair Co., McRae, *Biltmore Herb. 4511* (US); Washington Co., 3 mi. n. of Harrison, *Pyron & McVaugh 3104* (NA, NY). FLORIDA: Bay Co., Panama City, *Knight*, 6 July 1943 (FLAS); Calhoun Co., without exact locality, *Chapman* (MO); Dixie Co., near east limits of Jena, *Beaman 280* (MICH); Franklin Co., Apalachicola, *Chapman* (GH); Gulf Co., north of Port Saint Joe, *Small, DeWinkeler & Mosier*, 11 July 1924 (DUKE, FLAS, GH, MICH, MO, NCU, NY, PENN, TENN, WVA); Levy Co., Rosewood, *Garber*, June 1876 (BRU, F, NY); Hamilton Co., near Jennings, *Bright 3902* (WIS); Taylor Co., between Perry and the Gulf of Mexico, *Small, Small & DeWinkeler 11452* (NY, US); Wakulla Co., prope St. Marks, *Rugel* May 1843 (MO, US); Walton Co., Freeport *Mohr*, 18 June 1880 (US).

5. **Sabatia brachiata** Ell., Sk. Bot. S. C. & Ga. **1:** 284. 1817. *Chironia angularis* var. β *angustifolia* Michx., Fl. Bor. Am. 1: 147. 1803. *Sabbatia concinna* Wood, Class-Book ed. 2. 451. 1847. *S. angustifolia* (Michx.) Britton, Mem. Torr. Club **5:** 259. 1889.

Erect annual (10–)25–50(–67) cm. tall, usually but one stem arising from each rosette, more rarely with 2 or 3. Branching usually restricted to the upper one-third or half of stem but in more robust plants with branches sometimes developing from the lowermost nodes, usually rather strongly ascendent forming an angle of 15–40 degrees with the main stem, rarely spreading to as much as 70 degrees, typically opposite, although rarely alternate along main stem or principal branches, or ultimate branches somewhat more commonly alternate, forming convexly corymbose or somewhat pyramidal loose to compact crown. Stem 1–2(–4) mm. in diameter, terete, conspicuously so below and smooth, not wing-angled, although sometimes noticeably lined or finely ridged. The stem above and upon the branches becoming subquadrate or even quadrate and bearing very slight wings at the angles. Roots few to numerous, slender, fibrous, spreading or descendent, about 4–8(–10) cm. long, 0.5–1.5 mm. in diameter. Basal rosette typically present at time of flowering, usually conspicuous, typically composed of numerous overlapping, spreading, usually broadly spatulate, rarely elliptic, obtuse to seldom acute leaves tapering strongly to an almost petiolate base, (8–)15–30(–45) mm. long, (6–)10–14(–18) mm. wide. Cauline leaves membranous, ascendent, 3-nerved or rarely only 1-nerved in smaller leaves, (1–)1.5–3 (–4.5) cm. long, (3–)4–10(–16) mm. wide, often obtuse, especially below, or acute, commonly slightly callose-apiculate, oblong, with more or less parallel margins, or more rarely elliptic or somewhat lanceolate, tapering somewhat to base, at least usually not strongly or broadly clasping. Internodes usually about 1.5–3 times longer than the leaves, but ranging from but about three-fourths to about 4-times as long as the leaves. Inflorescence of corymbosely to pyramidally arranged cymules either 1, both, or none of whose lateral branches may be surpressed. Pedicels 5-sided, noticeably thin-ribbed, (1–)2–8(–13) mm. long. Calyx-tube thin, noticeably but finely 5-ribbed, usually about half as long as the corolla-tube, (1–)1.5–3(–4) mm. long, turbinate to campanulate. Calyx-lobes thin, narrowly linear, (4–)7–10(–15) mm. long, 0.3–1.0 mm. wide, ascendent in bud, wide-spreading at anthesis, usually exceeded by the corolla lobes by 3–8 mm. Corolla-tube (3–)4–5(–6) mm. long, 1.5–3 mm. in diameter, cylindrical, greenish within and without. Corolla-lobes oblong, or narrowly to broadly spatulate, usually obtuse, or occasionally tapering to an acute apex, (5–)7–14(–20) mm. long, (2–)3–6(–8) mm. broad, wide-spreading at anthesis, pale-pink to darker roseate, rarely white, with low triangular greenish-yellow area at base of lobe, usually bordered by reddish line. Filaments slender, pale yellow to nearly colorless, (1.5–)2–3(–4) mm. long; anthers bright yellow, usually about (2–)3(–4) mm. long. Stigmatic lobes slender, (2–)3–5(–7) mm. long; style 2–4 mm. long, usually less than the stigmatic branches in length. Capsule cylindrical, 5–8 mm. high, 3–4.5 mm. in diameter. TYPE LOCALITY: "Grows in the middle and upper country of Carolina. Near Columbia," Lexington Co., South Carolina. TYPE: *Herbemont s. n.* (CHARL!). DISTRIBUTION: Fields, dry and open oak and pine woods ranging from southeastern Virginia south into Georgia and westward to southern Missouri and Louisiana. Map 5.

This well-marked species has been rarely confused with any other, except occasionally with specimens of *S. angularis* or *S. quadrangula* (which for almost a century has been called *S. paniculata*). Both of these last-mentioned species are, however, readily distinguished from *S. brachiata* by their strongly tetragonal stems whose angles are strikingly membranous winged. *S. brachiata* is strongly contrasted to those two species by possessing, especially below, a smooth, terete stem. Above and on the branches the stem is somewhat finely ridged and angled but not conspicuously so. The corolla of *S. brachiata* is typically pink or roseate and very robust specimens, especially in areas where *S. angularis* is more commonly to be expected, have been rather often mistaken for that wide-spread species. Albinos of *S. brachiata* are rarely encountered, but when they are found or when the corollas become entirely bleached as they often do in drying, these plants are often mistaken for what has previously been called *S. paniculata* (= *S. quadrangula*). The type of *S. brachiata* forma *candida* (*Fernald & Long 6346*), is not *S. brachiata*, which normally has a rose-colored corolla, but *S. quadrangula* (*S. paniculata* in the sense of recent authors) which always has a white corolla. Fernald's misidentification of the type-sheet is easily demonstrated: the lower portion of the stem of the type is very distinctly quadrate with winged margins which is a distinctive feature of *S. quadrangula*. The only other specimen cited with the original description of this "form" was *Seymour 33* which is definitely a specimen of *S. brachiata*. A new name will be required by those who feel it essential to designate formally such minor variations.

Chironia angularis β augustifolia, of Michaux, has been assigned to the synonymy of this species at least since the appearance of the Synoptical Flora, where it was so listed. Not having seen an authentic specimen from Michaux's herbarium, it is only tentatively that I place the name in the synonymy of *S. brachiata*. The original characterization of the variety was very brief ("β augustifolia: foliis quasi lanceolatis; supremis etiam linearibus") and certainly states nothing that would exclude forms of *S. angularis* from consideration or indicates clearly that the entity described was *S. brachiata.* Both this variety of Michaux's and his *latifolia,* which has been considered the sole element of Michaux's concept that is *S. angularis* as now interpreted, were arranged under the generalized diagnosis of the species. The stem in that account of the species is stated to be "marginato-quadrangulo" and this would seem to exclude the entity now known as *S. brachiata.* Perhaps Gray saw an authentic specimen at Paris and hence may be correct in his treatment; in any event the question is yet to be settled.

S. concinna Wood is assigned to the synonymy of this species upon the basis of the original description which led Gray as early as 1856 to the same conclusion. It is perhaps of some significance that Wood himself later listed the name as a synonym of *S. brachiata.* The original description follows:

3. S. concinna. Wood (*Nov. sp.*) *Elegant Star Flower.* St. slender, sub-quadrangular, internodes 2–4-times longer than the leaves; *branches* opposite, sub-erect; *lvs.* linear and lance-linear, lower ones ovate, all acutish, sessile, *panicle* oblong; *cal.* segments linear, twice longer than the tube, twice shorter than the corolla; *cor.* 5-parted, segments oblong-obovate, obtuse, light purple.—Dry grassy prairies, Ia.! abundant. Stem a foot high, few or many-flowered. Leaves 9–12″ by 1–3″, flowers 15″ diam., of a delicate blush purple, the star in the center yellow, bordered with green. Jl. Aug.

Merrill (Rhodora 50: 127. 1948.) concluded that "it is the same as *S. campestris* Nutt., not *S. brachiata* Ell. as the latter species does not occur in Iowa; Wood's type was from Iowa." However, Wood described the branches as opposite and the calyx-segments as linear and only half as long as the corolla and these features would exclude from consideration anything but an unusual specimen of *S. campestris.* If the plant were *S. campestris,* it would hardly seem possible that the very peculiar and prominent costae of the calyx-tube could be overlooked in even the most cursory examination. I have seen no specimen of *S. campestris* from Iowa. Merrill placed considerable weight of evidence upon the locality of the plant but his interpretation of the abbreviation "Ia." is certainly an error. In 1846 between the first and second editions of his Class-Book, Wood, enlarging the area to be covered by his flora, made a short collecting trip to Indiana. *S. concinna* was presumably seen upon that trip. The explanation of geographical abbreviations appearing in the second edition informs one that "the names of . . . *states* . . . are often abbreviated, and always in the same manner as in other works; thus . . . Ia. or Ind., Indiana, &c." In this same edition (1847, p. 3) the area of the flora was said to be "essentially the States lying north of the Ohio River and Maryland." One also learns in Wood's "American Botanist and Florist" that the "geographical limits of the present flora are the same as those adopted in the Class-Book: viz, all the States of the American Union lying east of the Mississippi River." Although the area covered by Wood's publications was expanded in later years, they were never intended to cover the region west of the Mississippi River except indirectly. Wood meant Indiana by the abbreviation "Ia." Fernald (Rhodora **47:** 404–405. 1945) concluded as much from indirect evidence.

S. brachiata is not represented from Indiana in any of the herbaria that I have studied and neither it nor *S. campestris* were included by Deam in his Flora of that state. In fact, Deam (1940, p. 1080) after considering the evidence and after finding that that species was not represented in either the Gray Herbarium or in that of the New York Botanical Garden definitely excluded it from the known flora of the state. Fernald (1950) lists the range of the species as including southern Indiana. *S. brachiata* is not represented from Indiana, Illinois, or Kentucky in any of the collections that I have studied. The nearest known stations are southeastern Missouri and in Tennessee.

The description of the stem as being "subquadrangular" is also a bit puzzling if the name really is synonymous with *S. brachiata*, for that species is very conspicuously marked by a decidedly terete stem in at least the lowermost portion. The upper part of the stem and the branches do become rather strongly angled and, if *S. concinna* is the same as *S. brachiata*, this explanation probably accounts for that at first puzzling statement in the description. The disposition of Wood's name, in the absence of authentic material, will remain tentative, but the evidence available indicates that it was *S. brachiata*.

REPRESENTATIVE SPECIMENS:—VIRGINIA: Princess Anne Co., Little Neck, *Fernald & Long 4134* (GH, PENN); Prince George Co., just s. of Disputanta, *Fernald & Long 8815* (GH); Sussex Co., northeast of Homeville, *Fernald & Long 6344* (GH, NY, PENN, US). NORTH CAROLINA: Anson Co., 4 mi. n. of Ansonville, *Boyce 1127* (NCS); Beaufort Co., 7 mi. s. of Washington, *Godfrey 4400* (GH, US); Brunswick Co., 3 mi. n. of Bolivia, *Wilbur 2888* (MICH); Bladen Co., without exact locality, *Biltmore Herb. 4511a* (GH, MO, NCU, NY, PENN, US); Carteret Co., 3 mi. se. of Newport, *Godfrey 48192* (NCS); Cumberland Co., 7.5 mi. n. of Fayetteville, *Godfrey & Fox 49446* (DUKE, NCS); Harnett Co., 6 mi. e. of Cameron, *Fox 2546* (NCS); Montgomery Co., 1 mi. n. of Ether, *Wiegand & Manning 2543* (CU); Moore Co., 2 mi. s. of West End, *Fox & Whitford 3903* (MICH, NCS); New Hanover Co., Wilmington, *McCarthy*, Aug. 1885 (US); Onslow Co., at Richlands, *Godfrey 4475* (GH, US); Sampson Co., Roseboro, *Godfrey 4532* (DUKE, GH, US); Scotland Co., 12 mi. n. of Laurinburg, *Godfrey 5046* (DUKE, GH, US); Wake Co., Raleigh, *Godfrey 4918* (GH, NCU, NY); Wilkes Co., up Pores Knob, *Radford & Stewart 1743* (NCU). SOUTH CAROLINA: Chesterfield Co., near Cheraw, *Ward*, 25 June 1895 (NY, US); Darlington Co., Society Hill, *Canby*, July 1878 (F, NY); Horry Co., without exact locality, *Adams 30* (PENN); Lexington Co., 8 mi. s. of Columbia, *Godfrey & Tryon 1229* (GH, NY [a mixed sheet], US). GEORGIA: Bartow Co., 1.25 mi. e. of Emerson, *Duncan 8548* (GA, MO); DeKalb Co., northern slope of Stone Mountain, *Small*, 17 July 1893 (F, NY); Douglas Co., 10 mi. s. of Douglasville, *Duncan 3648* (MICH); Pickens Co., near Jasper, *Biltmore Herb. 4511a* (US); Richmond Co., Augusta, *Cuthbert*, Aug. 1876 (RUT); Taylor Co., without exact locality, *Pyron*, 3 Aug. 1930 (DUKE). TENNESSEE: Coffee Co., near Manchester, *Clebsch & Clebsch 4770* (TENN); Franklin Co., between Tullahoma and Estill Springs, *Svenson 9211* (GH); Grundy Co., east of Altamont, *Svenson 7137* (GH, TENN); McNairy Co., without exact locality, *Bain 431* (GH, NY); Van Buren Co., Falls Creek State Park, *Shanks, Clebsch & Sharp 3431* (MICH, TENN); White Co., sw. of Clifty, *Shanks, Clebsch & Sharp 2916* (TENN). ALABAMA: Mobile Co., about 8 mi. sw. of Mobile, *Webster & Wilbur 3479* (MICH); Washinton Co., Fruitdale, *collector not stated*, July 1904 (MO). MISSISSIPPI: Covington Co., 1.5 mi. se. of Mt. Olive, *Webster & Wilbur 3308* (MICH); Forest Co., about 14 mi. s. of Hattiesburg, *Webster & Wilbur 3397* (MICH); Harrison Co., 3 mi. s. of Saucier, *Webster & Wilbur 3442* (MICH); Jackson Co., Ocean Springs, *Pollard 1083* (MO, NY, US); Jones Co., Laurel, *Tracy 3356* (NY); Pearl River Co., Poplarville, *Tracy 1687* (GH, US); Pike Co., Holmesville, *Wheeler* (MO); Stone Co., 8 mi. s. of Wiggins, *Webster & Wilbur 3440* (MICH); Wayne Co., 6 mi. nw. of Ala.-Miss. state line, *Sargent*, 18 June 1950 (OKL, NCS). MISSOURI: Butler Co., 12 mi. n. of Poplar Bluff *Steyermark 11593*, (MO). ARKANSAS: Faulkner Co., Conway, *Haas 1629* (US); Drew Co., Ladelle, *Demaree 22321* (MO, OKLA); Lonoke Co., Grand Prairie, *Demaree 22333* (MO, NY, OKL, OKLA); Prairie Co., DeValls Bluff, *Demaree 22176* (MO); Pulaski Co., near Little Rock, *Carpenter*, June 1938 (UARK). LOUISIANA: Calcasieu Parish, Lake Charles, *Daves*, Aug. 1888 (F); Grant Parish, 4 mi. s. of Pollock, *Webster & Wilbur 3257* (MICH); Orleans Parish, New Orleans, *Drummond 224* (GH, K); Rapides Parish, 12 mi. se. of Hineston, *Webster & Wilbur 3275* (MICH); St. Tammany Parish, vicinity of Covington, *Arsène 11741* (US); Tangipahoa Parish, 6 mi. e. and 1 mi. n. of Hammond, *Nease*, 1945 (OKL); Vernon Parish, 2 mi. w. of Leander, *Webster & Wilbur 3228* (MICH); Washington Parish, Bogalusa, *Cocks*, 5 June 1917 (NO).

(*To be continued*)

Ilex glabra and a New Station for Kalmia latifolia in New Hampshire.—The Inkberry, *Ilex glabra* (L.) Gray, has never been validly reported to occur naturally in New Hampshire. However, it has long been known to be present in Maine on Isle au Haut as well as in Nova Scotia.

The frequency of stations for it in Essex County south of the Merrimack River, suggests that one might expect to find it in similar habitats along the coast in Rockingham County, New Hampshire.

In October 1950 some fragments of Inkberry were mailed to me from Seabrook accompanied by a brief discussion of the plants' whereabouts, the inference being that the station was within the boundaries of New Hampshire.

Not until 1954, was it convenient to arrange a visit to the Ilex-colony. But in March of that year, though temporarily viewed with some quite undeserved suspicion as a vandal, I was permitted to see the somewhat straggling and recently molested colony, and was even encouraged to bring away a small living plant. The herbarium specimen which unfortunately is meagre, though quite adequate for verification, is deposited in the University of New Hampshire Herbarium. The colony definitely is in New Hampshire, but rather less than a half mile from Massachusetts.

It will be interesting to watch the progress of this colony. Recent growth of shading *Pinus Strobus* in the immediate vicinity suggests vegetational changes perhaps detrimental to the plant's growth. Possibly in earlier times the colony was more vigorous and extensive and what we have now is a mere remnant of a much larger stand. Out of respect for the wishes of the owners in the matter, more precise information concerning the plant's whereabouts will not now be published.

Kalmia latifolia L. is one of numerous species which have mostly disjunct ranges in New Hampshire. Reaching the northeastern limit of its range in south-central and southeastern Maine, Mountain-laurel becomes increasingly more frequent as one approaches its more or less continuous area beginning in New Hampshire, west of the Merrimack River and including those upland townships which are adjacent to Massachusetts or which lie not many miles to the north. Unlike many other species of southern distribution, *Kalmia latifolia* does not extend northward appreciably in the Connecticut Valley. Fernald[1] summarizing botanical studies made in western Cheshire County during three summers, reported it from only one station. He described it as "Forming an extensive thicket by the Ashuelot River, Gilsum," while H. G. Jesup[2] mentioned only the well known Squam Lake Station. *Kalmia latifolia* is a normal constituent of the acid upland forests of southwestern New Hampshire becoming only occasional in the different type of forest of the Connecticut Valley. To the east of the Merrimack River, Mountain-laurel again is very localized in the dominant White Pine Region of southeastern New Hampshire. Specimens are represented in herbaria from favorable sites in southeastern New Hampshire where locally the plant is luxuriant, in the townships of Pelham, Windham, Sandown and Barrington. Doubtless it occurs elsewhere in this region but to most persons living there, *Kalmia latifolia* is either totally unknown as a native or is exceedingly rare.

Farther northward in New Hampshire as in Maine the plant becomes less frequent. Reports from creditable observers have reached me of colonies in New Durham and Effingham. These I have not visited, but an herbarium specimen from Chase Hill in Albany, confirms the existence of a vigorous colony there with which I am familiar.

In central New Hampshire, there is the isolated colony near Squam Lake in Holderness, evident from the highway and familiar to all. This I had always believed to be the most outlying stand in this part of New Hampshire. But in mid-July 1954, in company with Mr. Radcliffe Pike, I visited Peaked Hill Pond, in Thornton, Grafton County, to investigate a report of "Rhododendron" in the vicinity. A half-acre of "Rhododendron" near the southern shore turned out to be two or more acres of Mountain-laurel. The colony occurs in deciduous woods, with a scattered admixture of large hemlocks and is somewhat away from the water on the southern and southeastern sides of the pond. The growth of laurel is noticeably dwarf, most of the plants not exceeding 3 or 4 feet in height, in marked

[1] Rhodora, 3: 235, September 1901.

[2] A catalogue of the Flowering Plants and Higher Cryptogams found within about thirty miles of Hanover, New Hampshire, 26 (1891).

contrast to some of the colonies in southeastern New Hampshire which contain plants averaging much higher than a man's height. Here at nearly 1200 feet altitude in an area exposed to winds from the north the necessity for protection by deep snow in severe winter weather may account in some way for the low stature of the plants. Peaked Hill Pond is rather less than 30 miles northeast of Hanover and not more than 15 miles, as the crow flies, from the area of *Kalmia latifolia* at Squam Lake. Specimens from Thornton are deposited in the Herbaria of the University of New Hampshire and the New England Botanical Club.—A. R. Hodgdon, University of New Hampshire.

A New Variety of Solidago ulmifolia.—*Solidago ulmifolia* Muhl., var. **palmeri** Cronq. var. nov. Caulibus pilis patentibus obtectis.

Type: *Palmer 24111*, shaded sandstone slopes, north side, near top of Magazine Mt., Logan Co., Arkansas, October 14, 1923; deposited at the New York Botanical Garden. Additional specimens: Arkansas: Garland Co., *Palmer 29092, 29194; Demaree 11001, 20498, 20512, 21836.* Logan Co.: *Palmer 24180; Demaree 8072.* Perry Co.,: *Demaree 20145.* Pope Co.: *Demaree 19876.* Yell Co.: *Demaree 15942.* Alabama: County undetermined: *Buckley s.n.*, October, 1838, without further data; *Biltmore Herb. 15003*, Avondale.

The var. *ulmifolia*, with the stems essentially glabrous below the inflorescence, is largely replaced in the Ouachita region of Arkansas by the var. *palmeri*. The existence of two specimens of var. *palmeri* from Alabama in the herbarium of the New York Botanical Garden indicates that the hairy-stemmed phase of the species is not purely local, however, and the limits of its range remain to be determined.

Several of the specimens (including the type) here cited as *S. ulmifolia* var. *palmeri* were annotated by K. K. Mackenzie with an apparently unpublished binomial using the epithet *palmeri* in conjunction with the genus *Solidago*. The treatment of the new variety was inadvertently omitted by me from an earlier paper dealing with eastern American goldenrods, with the result that the name as used on page 428 of volume 3 of Gleason's Illustrated Flora is technically a nomen nudum.—Arthur Cronquist, The New York Botanical Garden.

Volume 56, no. 672, including pages 261–286, was issued 10 January 1955,

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club. by

REED CLARK ROLLINS, Editor-in-Chief

Vol. 57 February, 1955 No. 674

CONTENTS:

The New England Botanical Club, Inc.

8 and 10 West King St., Lancaster, Pa.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—**A monthly journal of botany, devoted primarily to the flora of the Gray's Manual Range and regions floristically related. Price, $4.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) of not more than 24 pages and with 1 plate, 40 cents, numbers of more than 24 pages or with more than 1 plate mostly at higher prices (see 3rd cover-page). Back volumes can be supplied at $4.00. Some single numbers from these volumes can be supplied only at advanced prices (see 3rd cover-page). Somewhat reduced rates for complete sets can be obtained on application to Dr. Hill. Notes and short scientific papers, relating directly or indirectly to the plants of North America, will be considered for publication to the extent that the limited space of the journal permits. Illustrations can be used only if the cost of engraver's blocks is met through the author or his institution. Forms may be closed five weeks in advance of publication. Authors (of more than two pages of print) will receive 15 copies of the issue in which their contributions appear, if they request them when returning proof. Extracted reprints, if ordered in advance, will be furnished at cost.**

**Address manuscripts and proofs to Reed C. Rollins,
Gray Herbarium, 22 Divinity Ave., Cambridge 38, Mass.**

**Subscriptions (making *all remittances* payable to RHODORA) to
Dr. A. F. Hill, 8 W. King St., Lancaster, Pa., or, preferably, Botanical Museum, Oxford St., Cambridge 38, Mass.**

Entered as second-class matter March 9, 1929, at the post office at Lancaster, Pa., under the Act of March 3, 1879.

Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 57 February, 1955 No. 674

STUDIES IN THE HIPPOCASTANACEAE, I. VARIATION WITHIN THE MATURE FRUIT OF AESCULUS

JAMES W. HARDIN[1]

A WIDE variation in fruit size and shape is readily noticeable from observations of an *Aesculus* tree or shrub in late summer (Fig. 1). Upon closer examination it becomes apparent that this variation is due in part to the number of maturing seeds in the ovary.

The ovary is typically 3-locular and 3-carpellate with two ovules in each locule. These ovules are oriented differently, the lower descending with a dorsal raphe, and the upper horizontal or more often ascending with a ventral raphe. Each fruit, therefore, is potentially six-seeded.

The literature is not clear in regard to the number of seeds usually found in the mature fruit. Gray (1849) stated that the locules are one seeded by the abortion of one ovule in each, and by suppression the fruit is often 1- to 2-celled and 1- to 2-seeded. Pax (1895) said that the mature fruit is mostly 1- seldom 2-locular with one seed. Rendle (1925) also stated that only one seed per fruit develops due to the crushing of two out of three cells by the considerable growth of the one ovule. Chapman (1897) on the other hand described the fruit as being 1- to 3-seeded. The more recent literature presents the same information: Fernald (1950)—3-seeded or usually by abortion 2- or 1-locular and 2- or 1-seeded; Lawrence (1951)—usually 1-locular and 1-seeded; Gleason (1952)—seeds by

[1] My sincere thanks go to Professor Rogers McVaugh, University of Michigan, for his helpful suggestions during the preparation of the manuscript.

abortion only one and subglobose, or 2 and semiglobose, or rarely 3 with flattened sides. Summarizing this information then, one might expect to find usually one, or possibly up to three, seeds per fruit.

Since there seems to be as much variation in the literature as in the fruit, and more than three seeds per capsule are often found, it was thought necessary to make some actual counts in conjunction with a much broader study of the entire genus.

Collections of fruit from six species were made during the summer of 1954 and studied from the point of view of the number of mature seeds, the position of these seeds within the capsule and the number of locules present. The result of this analysis is presented here.

Each fruit was examined and the number of mature seeds and their position recorded. In Table 1, "top" and "bottom" refer to the ascending and descending ovules respectively. The fifteen position-combinations were determined from the abortive ovules more easily than from the mature ones since the former more nearly retain their original position after the great enlargement of the seeds. More combinations could be recognized if, e.g. with 3 and 4 seeds, it were determined whether one or both ovules mature within the same locule. This information was kept only for 2-seeded combinations—both seeds in the same or different locules. Also given in Table 1 is the number of fruits found with a particular combination and the percentage based on the total fruits examined for each species.

From three trees of *A. hippocastanum* L. growing on the University of Michigan Campus and from two trees along a highway in Franklin County, Ohio, a total of 107 fruits was collected and examined. Table 1 indicates that the 1-seeded fruit was the most common type and that the ratio of "top" to "bottom" was essentially 1:1. In the 2-seeded type the most frequent combination was the 1 — 1 diff., meaning one ascending and one descending seed but in different locules.

An analysis was made of 153 fruits of *A. glabra* Willd. which were collected from a small population in Washtenaw County, Michigan. The 1-seeded capsule was again found to be the most common (Table 1) and maturation of ovules occurred in essentially the same numbers for ascending and descending.

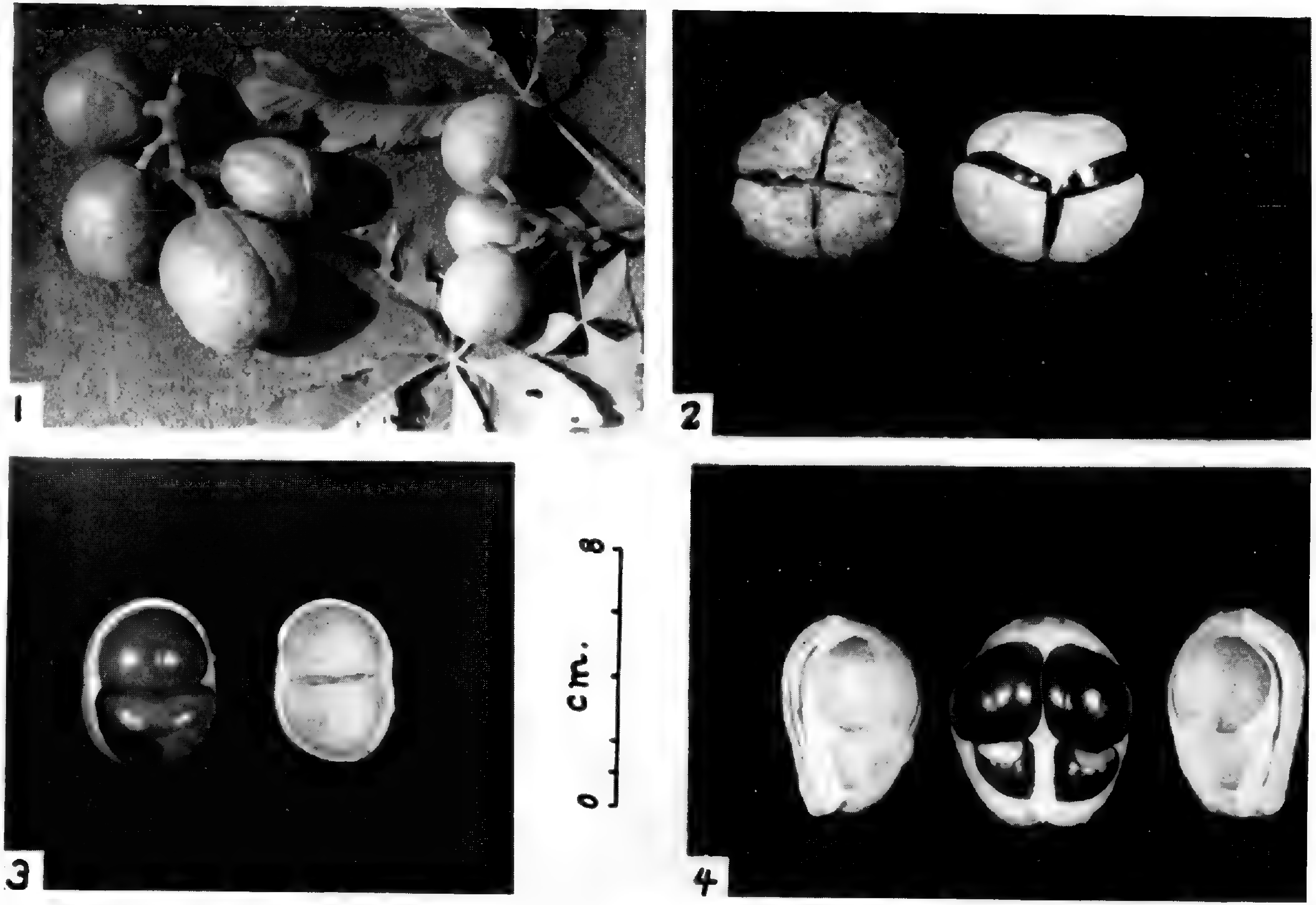


PLATE 1205. FIG. 1, Variation in size and shape of *Aesculus octandra* fruit. FIG. 2, Anomalous 4-locular capsule (left) and typical 3-locular capsule (right) of *A. hippocastanum*. FIG. 3, Anomalous 2-locular, 2-seeded and bivalved capsule of *A. sylvatica*. FIG. 4, Fruit of *A. octandra* showing suppression of lower two ovules. Scale applies only to Figures 2, 3 and 4.

Table 1. Number and Position of Mature Seeds in Capsules of Six Aesculus Species

Number seeds in capsule	*Position-combination*	*Hippocastanum*		*Glabra*		*Octandra*		*Sylvatica*		*Parviflora*		*Discolor*		*Genus*
		Number	%	*Number*	%	*Number*	%	*Number*	%	*Number*	%	*Number*	%	%
1	top	45	81.3	35	49.0	15	56.3	31	44.8	13	100			56.7
	bottom	42		40		16		34		15				
2	2 top	5	16.8	12	35.3	5	32.7	10	28.3				56.3	27.8
	2 bottom	2		11		2		9						
	1 top, 1 bottom different	7		8		5		15				9		
	1 top, 1 bottom same	4		23		6		7						
3	2 top, 1 bottom	2		10		4		13						
	1 top, 2 bottom		1.9	8	13.1	1	9.1	10	20.0			4	25.0	11.9
	3 top			2				2						
	3 bottom							4						
4	3 top, 1 bottom													
	1 top, 3 bottom			1	1.3		1.9	1	4.8				18.7	2.6
	2 top, 2 bottom			1		1		6				3		
5	3 top, 2 bottom							2						
	2 top, 3 bottom			1	0.65			1	2.1					0.8
6	3 top, 3 bottom			1	0.65									0.2

Aside from percentages which differ between *A. hippocastanum* and *A. glabra*, the most obvious difference is the occurrence in *A. glabra* of fruit with four, five and six mature seeds. Only one fruit each of the 5- and 6-seeded type was found, but it is significant that this condition does occur, even though seemingly rare for the species as well as the entire genus.

Fifty five capsules of *A. octandra* Marsh., from a population in Haywood County, North Carolina, were studied. Over half were of the 1-seeded type, although 2-, 3- and 4-seeded forms were found in decreasing frequencies.

A total of 145 capsules of *A. sylvatica* Bartr. were examined from two populations, one from Clarke County, Georgia and the other introduced from Georgia and now growing at the University of Michigan Botanical Garden. Again there was a high percentage of 1-seeded fruits, but also relatively high percentages of 2- and 3-seeded forms were found.

A very small and probably clonal population of *A. parviflora* Walt. was visited in Early County, Georgia during June 1954. Mature fruits were not available, but a population sample of partially mature fruits was collected. Analysis of these showed only the one-seeded type. This lack of variation is of interest since the population is probably one clone which occupies an area of nearly 400 square feet and includes approximately 75 trees.

Sixteen capsules were kindly sent from a small population of what is tentatively considered *A. discolor* Pursh growing near Old Sutherland Springs, Wilson County, Texas. It was unusual to find no 1-seeded fruits among this collection. Over half were of the 2-seeded type and the rest 3- and 4-seeded.

Considering all six of these species together, percentages are given (Table 1) for the genus based upon the random samples totaling 504 capsules. The emphasis which previous authors have placed upon the 1-seeded type is not justified on the basis of these figures which show that this form is present in barely more than one half of the total. Over one quarter of all fruit was of the 2-seeded form and just under one eighth had three seeds. The most significant deviation from the literature is the nearly 4% of the total which contained four to six seeds.

Correction should be made of the error found in the literature regarding the interpretation of the number of locules present in the mature fruit. Regardless of the number of seeds maturing, and the crushing of the locules by the excessive growth of the seeds, each of the locules remains at least partially distinct with its abortive ovules in their original position. The typical fruit then, is always 3-locular regardless of whether 1-seeded or 2- to 6-seeded.

Exceptions to this 3-locular condition were found in two of the species. Four-carpellate, 4-locular and in maturity 4-valved fruits of *A. hippocastanum* were found among the collections (Fig. 2). Also 2-locular and 2-valved fruits of *A. sylvatica* were found (Fig. 3). Of the 107 capsules of *A. hippocastanum* examined, thirteen of them, or 12%, were 4-locular. The majority of these were of the 1-seeded type, only a few having 2 seeds. Each of the four locules was distinct at maturity and each contained the expected two ovules. Only two capsules of *A. sylvatica* out of the 145 examined were 2-locular. One of these was 1-seeded and the other 2-seeded. The expected total of four ovules was present in both cases. The anomalous condition of 2 or 4 locules is rare, or at least infrequent in *A. hippocastanum.* Just what evolutionary significance these conditions have, if any, is not yet known.

At the outset of this study, the question arose as to whether only the ascending or descending ovules matured, or if both, in what proportions. The answer is shown in Table 1. A 1:1 ratio was found in the 1-seeded forms. In the 2-seeded and 3-seeded capsules only slightly more of the ascending ovules matured. These ratios show that the position of the maturing ovule in respect to ascending or descending is entirely random, and abortion is not due to a morphological degeneration of a portion of the ovary or placenta.

The cause of abortion in the majority of ovules is not known. According to Gray (1849) and Rendle (1925) the pressure from the maturing ovules is the important factor. If this were true, one would expect to find some degree of enlargement in all six ovules. Fig. 4 illustrated one of the few cases seen where pressure was effective in retarding the growth of ovules. In this case the lower two ovules did enlarge greatly until presumably stopped by pressure from the top. The smaller two were not true abortives since they expanded to full size after the capsule was opened. In practically every other case, the abortive ovules were 1–4 mm. in diameter—the size being nearly constant within a single capsule. Even when one mature seed was found in a locule, the second and abortive ovule in that locule showed no signs of being crowded. The "pressure" theory then, does not seem to be the answer in the majority of cases.

Incomplete fertilization could possibly be the determining factor. If this were true, then the unfertilized ovules would not ordinarily enlarge, which is found to be the case in these capsules. This incomplete fertilization could arise because of an incomplete pollination, or more probably caused by some morphological, physiological or genetic sterility factor. The answer to this question involves a major research problem in itself.

The phylogenetic significance of seed number in the genus *Aesculus* is not completely understood at this point. If one extreme in number (1-seeded or 6-seeded) is more primitive than the other in terms of evolution of the family, genus or species, the interpretation may be made only after a more complete study of the related taxa within the Sapindales.

DEPARTMENT OF BOTANY, UNIVERSITY OF MICHIGAN.

Literature Cited

Chapman, A. W. 1897. Flora of the Southern United States. Ed. 3. Amer. Book Co., N. Y.

Fernald, M. L. 1950. Gray's Manual of Botany. Ed. 8. Amer. Book Co., N. Y.

Gleason, H. A. 1952. The New Britton and Brown Illustrated Flora of the northeastern United States and adjacent Canada. Vol. II. Lancaster Press, Pa.

Gray, Asa. 1849. The genera of the plants of the United States. Vol. II. George Putnam, N. Y.

Lawrence, G. H. M. 1951. Taxonomy of Vascular Plants. Macmillan Co., N. Y.

Pax, F. 1895. Hippocastanaceae. In Engler and Prantl, Natürl. Pflanzenfam. III (5): 273–276.

Rendle, A. B. 1925. The Classification of Flowering Plants. Vol. II. Cambridge.

A REVISION OF THE NORTH AMERICAN GENUS SABATIA (GENTIANACEAE)

ROBERT L. WILBUR

(*Continued from page 33*)

C. Subsection CAMPESTRES Blake, RHODORA **17:** 56. 1915.

Neurola Raf., New Fl. **4**: 92. 1838.

Annuals, branches typically alternate, at least above. Basal rosette never present. Leaves either thin and membranous or thick and succulent, margins not scarious. Calyx-tube conspicuously ribbed or costate by the prominent development of the fused lateral traces and bearing a thin membranous wing. TYPE SPECIES: *Sabatia campestris* Nutt.

This subsection contains but two species which are obviously closely related to one another and which are strongly and uniquely distinguished from the other groups by the prominently developed calycine costae. In addition, the typically alternate branching pattern sets this small species-group apart from subsection *Angulares*, to which it is probably most closely related. Also, the *Angulares* possess a very well-developed basal rosette at some stage in their life-cycle although it is not always persistent at time of flowering; the *Campestres* are never rosulate. An additional indication, besides the aspect of the plants, the texture of the leaves, and perhaps the habit, of the relationship of this group to the opposite-branched *Angulares* is the pronounced quadrate stems in the species of both subsections (at least above) which are margined along the angles by a thin, hyaline membrane.

The distribution of the *Campestres* is almost entirely west of the Mississippi River where the subsection occupies an extensive area. *S. campestris* accounts for the bulk of the subsectional range. *Sabatia arenicola* is very obviously related to *S. campestris* and is believed to have been derived from that species or from its precursor. *S. arenicola* is at present known only from the Quaternary littoral deposits along the beaches from Louisiana to southern Tamaulipas.

KEY TO THE SPECIES OF SUBSECTION CAMPESTRES

A. Leaves and calycine lobes thin and membranous, neither succulent nor heavily cutinized; leaves broadest near the base, usually strongly clasping the stem, the midvein at least prominently elevated beneath; calyx-lobes usually 2–6 times longer than the calyx-tube, generally 4–8 times longer than broad; corolla-lobes typically equaling or exceeding the calyx-lobes,

usually longer than 1 cm. and wider than 7 mm.; stigmatic lobes over 5 mm. long; anthers longer than 2 mm.; widespread in prairies and fields from Texas to Mississippi and north to Illinois and Kansas.
6. *S. campestris.*

A. Leaves and calycine lobes thick and succulent, heavily cutinized; leaves broadest above the base, tapering somewhat to the sessile, nonclasping base, venation obscure and flush with the surface; calyx-lobes usually less than twice the length of the calyx-tube, generally less than 4 times as long as broad; corolla-lobes usually equaled or exceeded by the calyx-lobes, the corolla-lobes usually less than 1 cm. long and narrower than 7 mm.; stigmatic lobes less than 5 mm. long; anthers shorter than 2 mm.; restricted to the strand and dunes from Louisiana southward into Mexico.
7. *S. arenicola.*

6. **Sabatia campestris** Nutt., Trans. Am. Phil. Soc. n. s. **5:** 197. 1835. *S. nervosa* Raf., New Fl. **4:** 92. 1838. *Neurola arkanzica* Raf., l. c., an alternate name. *Sabbatia formosa* Buckl., Proc. Acad. Phila. **1862:** 7. 1863. *S. campestris* f. *albiflora* Moore, Proc. Ark. Acad. Sci. **1:** 26. 1941.

Erect annual (6–)15–30(–40) cm. high; stems 1–3 mm. wide, strongly quadrate throughout, the corners winged by a thin hyaline membrane, 0.1–0.2 mm. high. Branches usually few or absent from the lower half of the stem, but when present sometimes opposite, typically alternate throughout, usually widely divergent, often forming angles of 60–90 degrees with stem, giving plant a loose, strikingly divaricate or even geniculate aspect or, more rarely, forming a fuller, more compact, corymbiform crown, or in unfavorable situations sometimes unbranched. Root system of few to several fibrous roots or of a slender, wiry tap-root usually 5–10 cm. long bearing several slender laterals. Leaves thin, membranous, neither succulent nor heavily cutinized, primary venation apparent even in living material and at least the midrib noticeably elevated on the lower surface, conspicuously 3–5-nerved in dried specimens. Lowermost leaves rarely conspicuously different in either texture or shape from those at the middle or upper nodes, except usually somewhat smaller in size, rarely persistent at anthesis; or very rarely quite different in being broadly elliptic to oblong, tapering to the base and up to 8 cm. long, above narrowly lanceolate to broadly so, or ovate-lanceolate, rarely somewhat oblong or even ovate, typically broadest at or very near the base, generally broadly clasping, usually those at the lower nodes obtuse while the upper are acute, the tip callose-mucronulate, (0.8–)1.5–3.0(–4.0) cm. long, (0.3–)0.8–1.5(–2.0) cm. wide, usually about (1–)1.5–2(–3) times as long as broad. Internodes (1–)2–5(–10) cm. long, usually about 1.5–4 times the length of the leaves. Inflorescence usually of loosely-arranged, divergent, reduced, 1–2-flowered cymules forming a more or less open corymbose cluster. Peduncles (or pedicels) wiry, rigid, pentagonal, (1–)2–5(–10) cm. long, bearing fine hyaline membranous wings at the angles. Calyx-tube broadly campanulate, usually about 1–1.5 times as long as broad, (3–)4–6(–8) mm. long; strongly pentagonal with 5 thin, membranous costae or ribs elevated about 1 mm. with fine hyaline margins. The intercostal tube very thin, membranous, translucent, appearing green due to ovary within. Calyx-lobes thin, membranous, not heavily cutinized, strongly spreading at anthesis, (1.5–)2–4(–6) times longer than the tube, acute, apiculate, linear, (0.4–) 1.0–2.2(–3.2) cm. long, usually 4–8 times longer than broad, strongly resembling the leaves in texture. Corolla-tube usually 1–2 mm. longer than the calyx-tube, colorless except for the extension of the yellow "star" patches in the uppermost portion. Corolla-lobes typically equaling or exceeding the calyx-lobes, occasionally shorter, ascendent to rather strongly spreading, oblong, elliptical, or most commonly broadly obovate or spatulate, acute to obtuse, (1.0–)1.3–2.0(–2.3) cm. long, (0.4–)0.6–1.3 (–1.5) cm. wide, rose to pale pink or rarely white with a 3–4 mm. by 1–1.5 mm. greenish-yellow patch at the base of the lobe, bordered by a white area and sometimes by a more densely roseate region. Anthers bright yellow, narrowly linear, 2.5–5(–6) mm. long; filaments white to pale yellow, slender, 3–6 mm. long. Style slender, white to pale yellowish, 3–4 mm. long; stigmatic branches greenish at first, turning yellow at maturity, 5–8 mm. long. Capsules 5–9 mm. long, either equaling and included within the calyx-tube or exserted about 2–4 mm. TYPE LOCALITY: "in the open prairies of Arkansas and Red River." Type: Nuttall's collection, presumably in the Herbarium of the Philadelphia Academy of Science, but not seen. DISTRIBUTION: Fields and prairies from Illinois to Kansas south throughout most of the eastern half of Texas and eastward to Mississippi. Very rarely introduced farther east. Map 6.

This species is easily recognized by its prominently ribbed calyx-tube together with its thin, membranous leaves.

Nuttall's type, or authentic material known to have been in his possession when the original description was made, has not been seen by me but his diagnosis is so ample as to leave no doubt as to the plant he had at hand. As yet but four species of the genus are known from Arkansas and of these Nuttall's excellent description fits but one. The original collection is stated to have been made "in the open prairies of Arkansas and Red River."

If one were to accept the date of publication that appeared with the works of Nuttall and Rafinesque describing this species, a different conclusion than that adopted here would be reached as to which name has priority. Nuttall's "Collections towards a Flora of the Territory of Arkansas" appeared in Vol. 5 of the "Transactions of the American Philosophical Society." It has therefore been dated as 1837, the year that that volume was apparently completed. Foster (RHODORA **46:** 156–157. 1944.) has pointed out that that date is certainly later than the publication and distribution of Nuttall's contribution.

W. J. Hooker was familiar with Nuttall's account and cited it and descriptions provided in it on several occasions. The original diagnosis of *S. campestris* was quoted by Hooker (Comp. Bot. Mag. **1:** 171. 1836.) and its place of publication cited to the page. Since Sprague (Kew Bull. **1933:** 362–364.) has provided very precise dates for the publication of the various parts of Hooker's "Companion to the Botanical Magazine," it is certain that the whole of Nuttall's Flora, and not just the first twenty-one pages, as implied by Foster, was published and had reached England some time prior to the publication of Vol. 1, No. 6, of the Companion, which appeared January 1, 1836. The four parts or volumes of Rafinesque's New Flora were issued, not in 1836 as stated on the title page, but at various dates between very late in 1836 and late in 1838. This has been demonstrated rather conclusively by Barnhart (Torreya **7:** 177–181. 1907.). The names of *Sabatia* appeared in the part which appeared in 1838.

The Rafinesquian names here considered as synonymous with *S. campestris* were all published in one paragraph and were intended for the same entity. His account is quoted in full as it seems the surest way to prove the identity of the plant described by him and also to explain his peculiar nomenclature.

975. Sabbatia ? nervosa Raf. ramose pauciflore, branches anceps, leaves ovate lanceolate trinerve acute, peduncles axil. and terminal, calix base campanulate 5 gone, segments linear elongate nervose, corolla as long as calix, segments broad obovate, trinerve at base—anonymous sp. of Nuttal, which deserves perhaps to be a genus *Neurola* Raf. by calix 5 gone corolla nerved, stamens rolled up but not twisted, style declinate and with linear stigmas as in *Sabbatia*. From Arkansas, 8 inches high, leaves small remote semi-uncial, flowers large over uncial incarnate ? *Neurola arkanzica* will be a better name.

This description, which alone is rather convincing, coupled with the information that the specimen was one of Nuttall's collections from Arkansas leaves no doubt as to the identity of the plant. Nuttall found but two species on that journey, *S. campestris* and the well-known *S. angularis.* Rafinesque (Aut. Bot. p. 55. 1840.) was still uncertain as to the proper rank to bestow upon this species for he referred to it as "*Sabbatia nervosa* or *Neurola arkanzica* . . . fine subg. perhaps a Genus . . ."

The final proposition of specific rank made for this species was that of Buckley. The specimen upon which this was based has not been seen by me but again the description is such that determination is certain. The original publication reports it to have been collected in Llano Co., Texas, from whence numerous specimens of *S. campestris* have been examined. That is the only species of the genus known from Central Texas. Buckley's proposal was promptly relegated to synonymy by Gray (Proc. Acad. Nat. Sci. Phil. 1862: 166. 1863.) whose regret as to the "hundred worse than useless synonyms" published with *S. formosa*, especially after the caustic criticism strongly reminiscent of an even later Fisher Professor of Natural History, was doubtless shared by Buckley.

Merrill (RHODORA **50:** 127. 1948.) equates *S. concinna* Wood with *S. campestris* rather than with *S. brachiata* to which Gray long before had reduced it and to which Wood himself later considered it synonymous. The evidence that it is anything but *S. brachiata* is not convincing and the name is discussed more fully under that species.

REPRESENTATIVE SPECIMENS:—ILLINOIS: DuPage Co., Hinsdale, *Smith 497* (F). MISSISSIPPI: Covington Co., about 13 mi. nw. of Hattiesburg, *Webster & Wilbur 3359* (MICH). MISSOURI: Christian Co., 2 mi. s. of Saunderds, *Steyermark 23232* (F, MO, NY, TENN, WIS); Jasper Co., near Asbury, *Palmer 34661* (MO, NY). ARKANSAS: Benton Co., 9 mi. ne. of Springdale, *Moore 350339* TYPE of *S. campestris* f. *albiflora* Moore (UARK); Bradley Co., Warren, *Demaree 19268* (MO, NY, OKLA). LOUISIANA: Calcasieu Parish, vicinity of Lake Charles, *Allison 279* (NY, US); Winn Parish, 10 mi. w. of Winnfield, *Webster & Wilbur 3261* (MICH). KANSAS: Bourbon Co., 4 mi. w. of Fort Scott, *Horr E165* (DUKE, FLAS, NCS, OKL, OKLA, PENN, SMU, US); Cherokee Co., Baxter Springs, *Oyster 5445* (F, MO, NY); Montgomery Co., 5 mi. ne. of Caney, *Rydberg & Imler 408* (KSC, MO, NY, US). OKLAHOMA: Cleveland Co., Norman, *Demaree 13112* (GH, MO, NY, OKL, US); Comanche Co., near Cache, *Stevens 1328* (GH, MO, NY, OKL, OKLA, US); Creek Co., 7 mi. n. of Sapulpa, *Ownbey 1606* (GH, MICH, MO, NY, OKL, PENN, TEX, US); Johnston Co., near Mannsville, *Griffith 3474* (GH, MO, NY). TEXAS: Brazoria Co., Columbia, *Bush 76* (GH, MO, NY, US); Calhoun Co., Port Lavaca, *Tharp*, 22 May 1930 (DUKE, KSC, MO, MT, OKLA, TAES, TEX, WVA); Frio Co., near Moore, *Palmer 33868* (GH, MO, NY, US); Harris Co., Houston, *Hall 508* (BRU, F, GH, NY); Llano Co., Enchanted Rock, *Tharp*, 11 June 1930 (GH, MO, NY, SMU, TAES); Parker Co., Weatherford, *Tracy 8045* (CU, F, GH, MO, NY, TEX, US); Rockwall Co., ca. 30 mi. e. of Dallas, *Webster & Wilbur 2960* (MICH); Travis Co., Austin, *Tharp*, 16 May 1939 (MICH, MO, NA, NY, SMU, TEX).

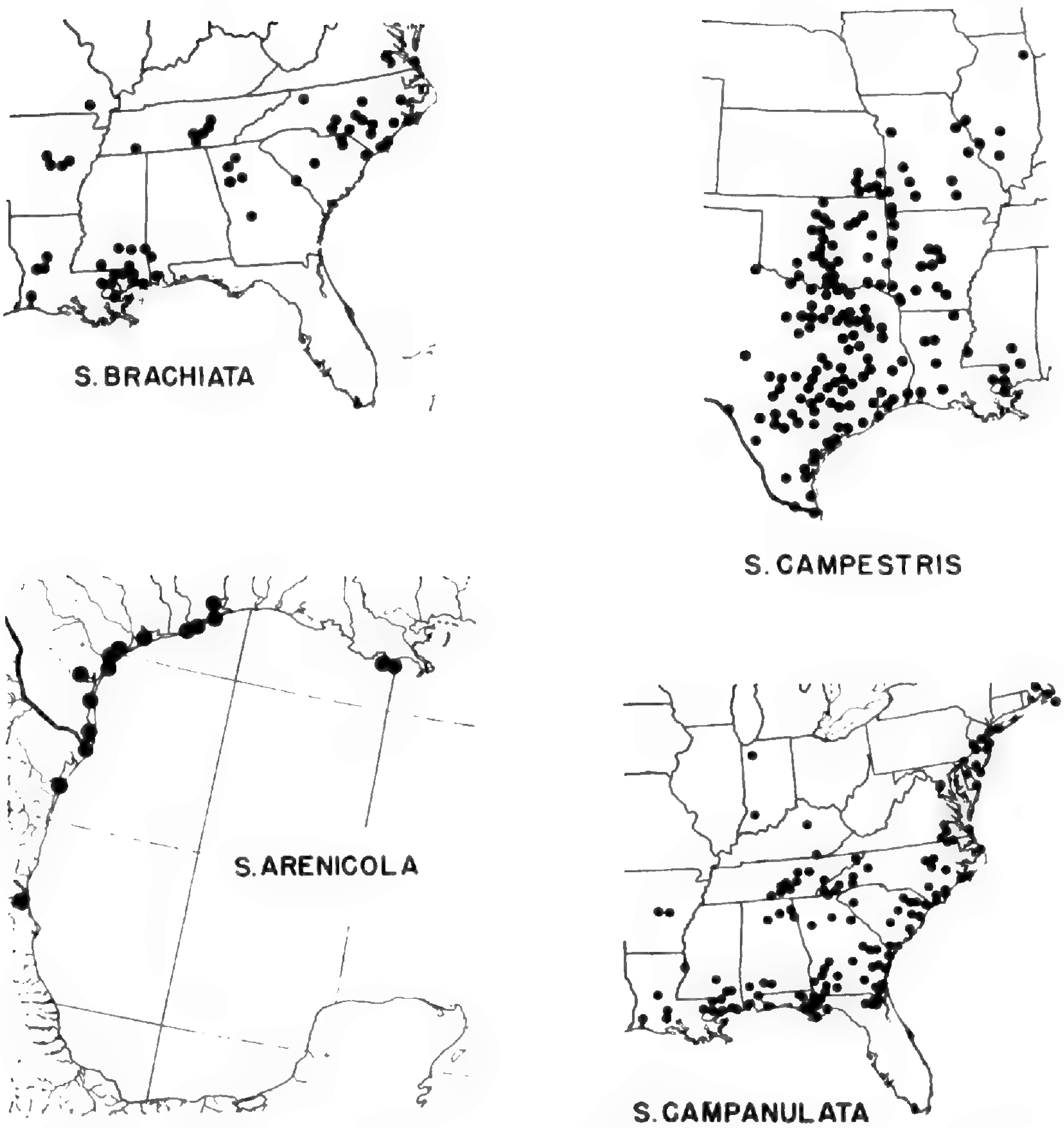
7. **Sabatia arenicola** Greenm., Proc. Am. Acad. **34**: 569. 1899. *S. carnosa* Small, Fl. SE. U. S. 927. 1903.

Erect annual (3–)10–20(–32 or up to 45 in greenhouse-grown plants) cm. high; stems rigid, 1–3 mm. in diameter, succulent when young but becoming less so with maturity, more or less terete in the lowermost internodes but soon becoming strongly quadrate above and the corners winged by a fine, hyaline membrane about 0.1–0.3 mm. high that is barely discernable in dried material. Branches most commonly arising from near the base and then often opposite but becoming alternate above, or in more loosely developed plants absent from the lower half of the plant and alternate throughout, strongly ascendent or at first widely divergent (up to 60 degrees) and, in plants grown under the normal highly exposed environmental conditions, typically presenting an almost globose form or a compact corymbiform to convex crown. Root-system most commonly a strongly developed tap-root or almost as commonly with several almost equally developed fibrous roots; these 4–20 cm. long and bearing few to several slender laterals. Leaves thick, widely spreading, strikingly succulent, shiny, heavily cutinized, venation almost completely obscured in living material, not at all elevated on either surface, appearing 3–5 nerved in dried specimens, the lowermost narrowly spatulate to somewhat elliptic, strongly tapering to the almost petiolate base, above becoming elliptical to ovate-lanceolate or rarely somewhat oblong, usually broadest one-fourth to one-third the length from the base or even near the middle, and somewhat tapering to the sessile, non-clasping base, (0.7–)1.2–1.8(–2.7) cm. long, (2.0–)5.0–8.0 (–13.0) mm. wide, usually about 1.5–4 times as long as broad, obtuse to acute with a minute, non-chlorophyllous callosity forming a mucronulate tip. Internodes (0.3–)1.0–2.0(–8.0) cm. long, usually 0.5–2 times the length of the leaves but in more loosely developed plants not uncommonly up to 4 or more times as long as the leaves. Inflorescence of corymbosely to pyramidally arranged cymules compactly clustered or borne loosely in plants grown under less rigorously exposed conditions. Cymules 1–2-flowered. Pedicels often somewhat succulent, rigid, pentagonal, bearing 5 fine, hyaline, membranous wings, 0.5–3(–7) cm. long. Calyx-tube broadly campanulate to urceolate, usually about twice as long as broad, (0.3–)1.0–2.0(–8.0) mm. long, becoming broadly turbinate in fruit, strongly pentagonal due to thick, somewhat succulent, costae or ribs about 0.5–0.7 mm. high, the internal portion of which is chlorophyllous, the outer finely hyaline margined. Intercostal tube very thinly membranous, colorless but translucent, thus appearing green due to the ovary within. Calyx-lobes thick, succulent, heavily cutinized, erect in bud but becoming strongly spreading at anthesis, (0.5–)1–1.5(–3) times longer than the tube, (0.3–)0.5–1.2(–2.0) cm. long, oblong to most commonly linear-lanceolate, usually about 3 times as long as broad, acute, minutely hyalinely callose-tipped, becoming prominently nerved when dried, in general very similar to leaves in texture. Corolla-tube exceeding calyx-tube as well as the ovary by about 1–2 mm., lower portion colorless, the upper colored by extension of the yellow patches at lobal bases. Corolla-lobes more or less equaling or somewhat shorter than the calyx-lobes, or rarely longer, ascendent to strongly spreading, broadly spatulate, obovate, or oblong, obtuse, (0.5–)0.7–1.0(–1.3) cm. long, 3–7.5 mm. wide, deeply roseate or pure white, both forms with a 2–3 mm. long, 1.5 mm. wide basal, oblong, yellow patch, which in roseate forms is often bordered by deeper shade of red. Anthers bright-yellow, oblong, 1.5–2 mm. long; filaments white to pale-yellow, slender, 2–4 mm. long. Style slender, colorless to pale greenish-yellow, 2–3.5 mm. long, stigmatic branches green to greenish-yellow, 2.5–4 mm. long. Capsule 5–9 mm. long, equaling and included within the calyx-tube or exserted by 1–3 mm. TYPE LOCALITY: "on damp sands of seacoast near Tampico, State of Tamaulipas, Mexico." TYPE: *Pringle 6808* (GH!). DISTRIBUTION: Beaches and dunes from Louisiana southward to at least the southern part of the State of Tamaulipas, Mexico. Map 7.

The pronounced succulence of this species is perhaps its most striking characteristic and that by which it is most readily distinguished from the closely related but perfectly distinct *S. campestris.*

Many of the differences noted between the two species of subsection *Campestres* are such that one might expect them to be merely response of a highly plastic organism to an environmental extreme. Succulence and diminution of the various organs and structures and the assumption of an almost globose, compact form are features that logically would be expected among the littoral members of a species of wide environmental variation. *Sabatia arenicola,* found along the strand and dunes from Louisiana to at least Tampico in Mexico, possesses such characteristics and accordingly suspicion is raised as to its status.

The few specimens of *S. campestris* observed in the field in almost similar situations, although stunted or dwarfed, failed to show the peculiarities characteristic of the littoral species. Furthermore, herbarium specimens of plants that were undoubtedly *S. campestris,* as indicated by their morphological characters, were collected, according to their accompanying labels, from what was approximately the environment of *S. arenicola.* In addition, numerous plants of *S. arenicola* grown in the greenhouse from seeds collected at various stations along the Texas coast retained the pronounced succulent nature so characteristic of the littoral species. The greenhouse-grown plants were larger, more elongate, and much more diffuse than the majority of specimens of *S. arenicola* seen by me either in the field or in the herbarium but are approached to some extent by those growing in nature in the more sheltered areas. The principal distinguishing characters mentioned in the key remain constant and the plants of the two species grown side by side are readily separable.



Maps 5–8. Map 5, upper left; map 6, upper right; map 7, lower left; map 8, lower right.

Two specimens were annotated by Small as *S. carnosa*. These are the only representatives of the littoral species that were available to him at New York prior to 1903 when his Flora was published. None of the specimens on either of the sheets is as much as 3 dm. tall, the maximum height mentioned in the original description. However, it is likely that these were the only examples seen by him before publication; they were certainly the only two annotated by him as that species and one of them should be chosen as the type of the name. The only collection of the two that matches the statement "often branched at the base" is that of A. Schott taken on the beach at Brazos

Santiago near the mouth of the Rio Grande on the expedition led by Major Emory to survey the Mexican boundary. The other specimen annotated as *S. carnosa* by Small is one of Drummond's but no other information, other than that it was from Texas, is presented on the accompanying label. However, the great similarity in aspect and in state of preservation strongly suggests that it is a duplicate of these specimens seen at both the Gray Herbarium and Kew which bear Drummond's collection number "59" and which came from the "Rio Brassos" (Rio Brazos) Texas. The New York specimen may well be taken as the lectotype of *S. carnosa.* These specimens, the basis of Small's *S. carnosa,* can in no way be distinguished from Greenman's *S. arenicola* which has four years priority.

This species and *S. campestris* are usually readily separable if the specimens are adequate. A few collections have been seen, however, that indicate that hybridization may be taking place between them in the region where they come into contact. Careful observation in the field should do much toward settling this suspicion.

REPRESENTATIVE SPECIMENS:—LOUISIANA: Jefferson Parish, Grand Isle, *Cangemi & Andrus,* 13 June 1931 (NY); Terrebonne Parish, Timbalier Island, *Tharp,* 29 July 1929 (MO, TEX). TEXAS: Aransas Co., n. of Rockport, *Whitehouse 18232* (SMU); Brazoria Co., Rio Brazos, *Drummond 59* (GH, K, NY); Calhoun Co., beach near Port O'Connor, *Webster & Wilbur 3134* (MICH); Cameron Co., beach at Brazos Santiago, *Schott 27* (F, NY), about 3 mi. w. of Boca Chica, *Lundell 8635* (GH, MICH, NY, SMU); Galveston Co., beach on Galveston Island, *Webster & Wilbur 3153* (MICH); Harris Co., Morgan's Point, *Palmer 11966* (MO, US); Kennedy Co., El Toro Island, *Tharp 49218* (TEX); Kleberg Co., Kingsville, *Sinclair,* 1940 (TEX); Matagorda Co., beach beyond Sargent, *Webster & Wilbur 3152* (MICH); Nueces Co., north end of Padre Island, *Webster & Wilbur 3092* (MICH); San Patricio Co., 10 mi. s. of Aransas Pass, *Whitehouse 18213* (SMU).

MEXICO: TAMAULIPAS: Washington Beach, *Runyon 461* (GH, NY, US); San Jose, *LaSueur 349* (TEX); vicinity of LaBarra, 8 km. e. of Tampico, *Palmer 297* (F, GH, US); Tampico, *Pringle 6808* (BRU, F, GH, NY, UC, US).

D. Subsection CAMPANULATAE Blake, RHODORA **17:** 56. 1915.

Annuals or perennials with either slender tap-root, several fibrous roots, or an erect, branched, perennating caudex. Branches typically alternate. Corolla 5-parted, rose, pink, or white. Calyx smooth or finely ribbed, not wing-costate. TYPE SPECIES: *Sabatia campanulata* (L.) Torr.

The species forming this subsection are not of uniform habit of growth as three of the species are annuals, while one, the type, is a perennial with a subterranean system unique in the genus. This is the only species-group showing diversity in life-form. The branching pattern in this group is typically alternate, but this character is highly variable, as it is throughout most of the genus. This subsection is not set off by one strong characteristic or even by a series of lesser ones. Segregation of the annuals, leaving *S. campanulata* to form a monotypic subsection characterized by its shortly branched, erect, caespitose caudices, would result in two subsections, each certainly more homogeneous than the present one. For the moment at least, I am hesitant about erecting additional subgeneric units as their utility is defeated when they become so numerous as to be composed of only one or two species. The genus is already, for one so small, burdened with a large number of subgeneric units.

Key to the Species of Subsection Campanulatae

A. Caespitose perennial from branched, erect caudex; calyx-lobes usually more or less equaling the corolla in length.........8. *S. campanulata.*

A. Annuals with either a tap-root or several fibrous roots; calyx-lobes usually less than three-fourths the length of the corolla.

B. Calyx lobes linear to almost filiform, usually more than 8 mm. long; corolla usually roseate, rarely white; style 2 mm. or more in length; branches usually not numerous, mostly restricted to the upper half of the stem; nodes along the main axis not numerous, usually less than 15; root-system typically of several, almost equal, fibrous roots.

C. Leaves drying thin and smooth, the uppermost equaling or exceeding the stem in diameter; corolla-lobes usually less than 1.5 cm. long; calyx-tube usually turbinate or narrowly campanulate; known from Mexico, Cuba, the Bahamas, Florida west to Louisiana and north to southern Massachusetts.......................9. *S. stellaris.*

C. Leaves drying thick and very noticeably rugose; above typically less than the stem in diameter; corolla-lobes usually longer than 1.5 cm.; calyx-tube usually broadly campanulate; known only from Cuba and peninsular Florida..................10. *S. grandiflora.*

B. Calyx-lobes setaceous or subulate, less than 8 mm. long; corolla white; style 1 mm. long or less; branches usually numerous and typically arising from throughout the length of the stem; nodes very numerous and typically more than 20 along the main axis; root-system of one prominently developed, wiry tap-root with several slender laterals. 11. *S. brevifolia.*

8. **Sabatia campanulata** (L.) Torr., Fl. N. & Mid. U. S. 217. 1824. *Chironia campanulata* L., Sp. Pl. **1:** 190. 1753. *C. gracilis* Michx., Fl. Bor. Am. **1:** 146. 1803. *C. campanulata* β *gracilis* (Michx.) Pers., Syn. Pl. **1:** 282. 1805. *Sabbatia gracilis* (Michx.) Salisb., Parad. Lond. t. 32. 1806. *S. campanulata* f. *albina* Fern., Rhodora **18:** 151. 1916. *S. Tracyi* Gandoger, Bull. Soc. Bot. Fr. **65:** 61. 1918. *S. campanulata* var. *gracilis* (Michx.) Fern., Rhodora **39:** 444. 1937.

Caespitose perennial from an erect, short, much-branched, underground caudex 1–4 cm. long. Stems few to numerous, erect, (15–)30–60(–90) cm. high, 1–3 mm. in diameter, terete but often strongly ridge-angled from fine elevated internodal lines, becoming hollow below. Branches typically alternate throughout, or occasionally those at lower nodes opposite, rarely opposite even above; usually restricted to the upper half of the stem but occasionally arising from throughout the length, strongly divergent forming an angle with the stem of 50–80 degrees or, especially in the northern portion of its range, strongly ascendent forming angle of about 20–40 degrees; few to numerous, slender, bearing but few nodes (more common in the northern portion of the range) or several. Root-system of few to many, slender, but apparently succulent, roots descending from the caudex, about 5–10 cm. long and 1 mm. thick bearing few to several very slender, fibrous laterals. Leaves ascendent to very commonly (especially the upper) strongly spreading, midvein noticeably elevated beneath, venation otherwise obscure, margins somewhat thickened and slightly revolute, drying thick, somewhat chartaceous, smooth or slightly rugose, obtuse to acute, broadly sessile or somewhat tapering in broader leaves to the base, the lowermost rarely ovate; the lower cauline (1–)1.5–3(–4) cm. long, (1–)2–7(–12) mm. wide, usually 5–12 times as long as broad, narrowly lanceolate, oblong, or linear gradually reduced above to very narrowly linear or even filiform; those of the branches narrowly linear to filiform. Internodes usually 1–2 times the length of the leaves. Flowers apparently solitary, borne on alternate, or rarely opposite, ascendent to widely divergent, slender branches bearing 1 to several nodes, or in more obvious cymules which are often reduced. Pedicels (2–)4–7(–9) cm. long, slender, wiry, slightly angled. Calyx-tube shallowly turbinate or more rarely somewhat campanulate, smooth or nearly so, not conspicuously nerved, scarious, usually about as broad as long, (1–)1.5–2.5(–3) mm. long. Calyx-lobes linear to very narrowly so or very commonly acicular or setaceous, erect to more commonly widely spreading, (6–)7–17(–23) mm. long, typically less than 0.5 mm. wide but occasionally as wide as 1 or even 2 mm., usually 5–15 times as long as the calyx-tube, generally nearly equaling the corolla in length, or but several millimeters shorter, rarely exceeding it. Corolla-tube cylindrical, about 2–3 times as long as the calyx-tube or exceeding it about 2–3 mm., colorless to white or pale greenish-yellow, (2–)3–5(–6) mm. long. Corolla-lobes wide-spreading, oblanceolate, oblong, or elliptic, acute to obtuse, (0.6–)0.9–1.8(–2.4) cm. long, (3–)4–7(–9) mm. wide, usually about 2–4 times as long as wide, rose, pink, or rarely white with an usually unlobed yellow area at base of lobe 2–3 mm. long, often bordered by a dull red irregular line. Anthers slender, bright yellow, (2–)3–4(–5) mm. long; filaments pale yellow, slender, 2–4 mm. long, usually shorter than the anthers. Style 2–5 mm. long, usually shorter than its branches, green to greenish-yellow; stigmatic lobes 3–7 mm. long, pale-green turning yellowish (with pollen?) at maturity. Ovary pale-green, slightly exserted from the corolla-tube. Capsule cylindrical, 5–7 mm. long, 2.5–4 mm. in diameter, usually 1.5–2 times as long as wide. TYPE LOCALITY: "in Canada." This plant is not known from farther north than Massachusetts. TYPE: *Kalm* (Photograph of the

Type in the Linnaean Herbarium seen in the collection of the Gray Herbarium). DISTRIBUTION: Peaty bogs and savannas along the Coastal Plain from Massachusetts south to northern Florida and westward to Louisiana and Arkansas; also found in the southern Appalachians and locally in Kentucky and Illinois. Map 8.

Fernald recognized two populations within this species. The supposed differences as defined by him are presented below.

campanulata	*gracilis*
Primary cauline leaves oblong-linear to lanceolate.	Lower cauline leaves linear, the upper ones very narrowly so.
Pedicels naked or only slightly bracted.	Pedicels mostly leafy-bracted.
The linear calyx-segments (except in in small secondary flowers) 1–2 cm. long.	The linear-acicular calyx-segments 6–14 mm. long.
The corolla-segments 1–1.7 cm. long.	The corolla-segments 6–14 mm. long.
Branches erect or strongly ascendent.	Branches more divergent.
Upland and Piedmont region, Ga., and Ala., n. to Va., and Ind., and on or near Coastal Plain to se. Mass.	On the Coastal Plain from Florida to Louisiana and se. Va.

Many of the specimens studied could be assigned to one or the other group with a fair degree of assurance by applying these criteria. Yet there are a number of puzzling collections which aroused a strong suspicion as to one's ability to determine "correctly" a large series of specimens if one were unaware of their geographic origin. For example, Deam (1940) considered the material from southwestern Indiana to be a representative of the typically Coastal Plain population while Fernald (1950) mentioned Indiana only in the range of the *campanulata*-group.

Fernald (RHODORA **34:** 27. 1932.) originally had considered the plants found along the southern Coastal Plain to be "a rather well defined species" although admitting that ". . . it may be better to treat it as a southern Coastal Plain variety . . ." After encountering specimens in southeastern Virginia that possessed some of the supposed distinguishing characteristics of both varieties, Fernald (Rhodora **39:** 444. 1937.) concluded that ". . . *S. gracilis* should be treated as a geographical variety." Those intermediate specimens combined the presumably characteristic narrow leaves and calyx-segments of the southern Coastal Plain population with the longer lobes of both calyx and corolla of the more northern collections. Since numerous large-flowered specimens had been observed throughout the supposed range of the *gracilis*-population, the several hundred available measurements were tallied for comparison and are presented below. The specimens from southeastern Virginia which Fernald considered atypical as they showed features of both populations were not included.

	Length of Calyx-Lobes		Length of Corolla-Lobes	
mm.	*No. of lobes gracilis-range*	*No. of lobes campanulata-range*	*No. of lobes gracilis-range*	*No. of lobes campanulata-range*
6	6	0	1	0
7	23	5	4	0
8	30	6	4	1
9	42	18	16	7
10	40	22	34	16
11	50	31	44	38
12	60	42	63	38
13	45	36	52	43
14	45	20	36	38
15	27	19	32	19
16	19	11	17	7
17	10	19	15	0
18	7	9	10	0
19	1	5	4	2
20	4	2	2	0
21	2	1	0	1
22	0	1	0	0
23	0	1	0	0
24	0	0	0	1

These hundreds of measurements indicate that, although the smallest flowers were found on the specimens from the *gracilis*-range and the largest from the range of the more northerly population, no reliance can be placed upon the length of either the calyx- or corolla-segments as a distinguishing characteristic between the two supposed varieties. These measurements show that the range of flower-size of the plants from the Coastal Plain is considerably greater than that known to Fernald and for diagnostic purposes the range of the length of the lobes of either floral series is so broadly overlapping as to be unworkable.

Nor am I able to detect any consistent differences in the shape of the calyx-lobes between those specimens of the Coastal Plain south of Virginia and those from the Appalachian region and the Costal Plain north of Virginia. Numerous specimens from Florida and the other states of the supposed range of *gracilis* have linear calyx-lobes presumably characteristic of the northern variety.

By "pedicels" Fernald apparently meant lateral branches bearing flowers. These branches in the Massachusetts material, with which Fernald had field experience, are typically short and rather strongly ascendent and their one or two nodes bear bracts that are foliose in comparison to the narrowly linear to even filiform bracts of the typical southern coastal material. A tendency for opposite branching in the upper part of the stem is also more pronounced, especially in more robust specimens, and then the unreduced cymose pattern of inflorescence is somewhat more apparent. These rather striking characteristics found with considerable constancy in the few New England stations are far less apparent in the specimens seen from the more southern part of the range of the supposed typical variety. Numerous specimens from the mountainous regions of Georgia, Alabama, the Carolinas, Tennessee and Kentucky, as well as Deam's Indiana station, possess elongate, widely divergent branches with several to numerous nodes bearing narrowly linear to even filiform bracts. The extremes of leaf-type from the two ranges are often most striking and clear-cut but many specimens within the range attributed to one of the varieties would be assigned to the other upon the application of this criterion. These considerations have convinced me that it would be difficult to recognize varieties in this species in spite of some rather strong tendencies which are somewhat geographically segregated and whose extremes are of rather striking difference in aspect.

Gandoger based the description of *S. tracyi* upon the specimen in his herbarium of *Tracy 6468* collected at Biloxi, Mississippi. I have not seen his type but four specimens of the same collection number are located at the Gray Herbarium (2 sheets), New York Botanical Garden, and the National Herbarium. They are presumably isotypes. Gandoger described his specimen as an annual and this would relate or equate *S. tracyi* with *S. stellaris*, the only annual of subsection *Campanulatae* known to the state. The presumed isotypes, however, are perennials with narrowly oblong-linear to linear leaves gradually reduced above and on the branches to filiform bracts; their branches, which are alternate, are elongate, bear numerous nodes, and are very strongly divergent. There is still a trace of rose-pink color on the corolla-lobes of at least three of the sheets seen although even on those sheets most of the flowers appear yellowish-white. Gandoger's species was described as having white flowers which together with the more slender leaves and mucronate sepals supposedly distinguished it from *S. gracilis*. *S. tracyi* is synonymous with *S. campanulata*, or, if one prefers to recognize what now seems to me to be a variation too weak to maintain, to *S. campanulata* var. *gracilis* (Michx.) Fern. It may be matched by a majority of the specimens collected along the Gulf and Southern Atlantic Coastal Plain.

REPRESENTATIVE SPECIMENS:—MASSACHUSETTS: Barnstable Co., Barnstable, *Fernald & Svenson*, PL. EX. GRAYANAE 479 (in many herbaria); Nantucket Co., Almanac Pond, *Williams*, 30 July 1911 (GH); Plymouth Co., Pembroke, *Foster*, 10 Sept. 1884 (GH). NEW YORK: Nassau Co., East Rockaway, *Bicknell 7089* (NY); Suffolk Co., Oakdale, *Ferguson 7775* (NY). NEW JERSEY: Ocean Co., e. of Silverton, *Fogg 4908* (GH, NY, PENN, TENN). PENNSYLVANIA: Bucks Co., Tullytown, *MacElwee*, 28 July 1894 (GH, NY). DELAWARE: Kent Co., Felton, *Canby*, July 1878 (US). MARYLAND: County unknown, Delaware Beach, *Hood 2370* (FLAS). DISTRICT OF COLUMBIA: Virginia Highlands, *Griggs*, 17 July 1923 (US). VIRGINIA: Greensville Co., ne. of Gaskins, *Fernald & Long 13421* (GH, MO, TENN, US); Sussex Co., about 4 mi. nw. of Homesville, *Fernald & Long 6351* (GH, NY, PENN). NORTH CAROLINA: Columbus Co., 2 mi. w. of Freeman, *Wilbur 2882* (MICH); Henderson Co., 1 mi. s. of East Flat Rock, *Oosting 1790* (DUKE); Northampton Co., near Margarettsville, *Heller 1160* (CU, F, GH, KSC, MO, MT, NY, PENN, US). SOUTH CAROLINA: Anderson Co., Belton, *Smith*, 23 July 1881 (GH, US); Georgetown Co., 12 mi. n. of Georgetown, *Godfrey & Tryon 66* (DUKE, F, GH, MICH, NY, PENN, TENN, US). GEORGIA: Bartow Co., 4.5 mi. s. 16° east of Allatoona Dam, *Duncan 8521* (FLAS, GA, MO, SMU, TENN, US); Thomas Co., about 1 mi. n. of Coolidge, *Duncan 8466* (FLAS, GA, MO, TENN). FLORIDA: Bradford Co., near Lawtey, *Murrill 528* (DUKE, MO, US); Holmes Co., Bonifay, *Curtiss 6481* (GH, MO, NY, SMU, US); Washington Co., 8 mi. s. of Chipley, *Webster & Wilbur 3615* (MICH). INDIANA: Daviess Co., about 4 mi. n. of Washington, *Deam 52742* (F, GH, MO, NY); Jasper Co., about 3 mi. se. of Wheatfield, *EK*, 30 July 1940 (GH). KENTUCKY: Fayette Co., Lexington, *Short*, 1831 (NY); Whitley Co., n. Jellico, *Braun*, 21 July 1933 (GH, NY). TENNESSEE: Coffee Co., n. of Manchester, *Svenson 9219* (DUKE, GH, MO, NA, NY, WIS, US); Franklin Co., near Tullahoma, *Sharp, Clebsch & Fairchild 9938* (DUKE, GA, NCU, OKLA, SMU, TENN, TEX, US). ALABAMA: Conecuh Co., about 9 mi. w. of Evergreen, *Webster & Wilbur 3514* (MICH); DeKalb Co., Lookout Mountain, *Biltmore Herb. 4510g* (US); Mobile Co., about 8 mi. sw. of Mobile, *Webster & Wilbur 3480* (MICH). MISSISSIPPI: Covington Co., 1.5 mi. se. of Mt. Olive, *Webster & Wilbur 3336* (MICH); Forest Co., 18 mi. nw. of Beaumont, *Webster & Wilbur 3424* (MICH); Jackson Co., Ocean Springs, *Pollard 1010* (CU, F, GH, MO, NY, US). ARKANSAS: Lonoke Co., Grand Prairie, *Demaree 22329* (MO); Pulaski Co., Little Rock, *Harvey*, July 1882 (UARK). LOUISIANA: Calcasieu Parish, Lake Charles, *Cocks*, Sept. 1906 (NO); Tangipahoa Parish, 3 mi. e. of Robert, *Correll 9307* (DUKE, MO, TEX).

9. **Sabatia stellaris** Pursh, Fl. Am. Sept. **1:** 137. 1814. *Chironia amoena* Raf., Med. Repos. II. 5: 359. 1808. not Salisb., Prodr. 137. 1796. *C. stellata* Muhl., Cat. Pl. Am. Sept. ed. 2, 23. 1818. *C. stellaris* [Pursh] Eaton, Man. ed. 2, 204. 1818. *Sabbatia maritima* Raf., Med. Fl. **2:** 77. 1830. *S. amoena* (Raf.) G. Don, Gen. Hist. **4:** 207. 1838. *S. stellaris β pumila* A. Gray ex Griseb., Prodr. **9:** 49. 1845. *Eustoma maculata* Benth., Pl. Hartw. 292. 1848. *Sabbatia gracilis β stellaris* [Pursh] Wood, Am. Bot. & Flor. 267. 1870, without basionym. *S. nana* Featherman, Rep. Bot. Surv. S. & Cent. La. 71. 1871. *S. maculata* (Benth.) Benth. ex. A. Gray, Proc. Am. Acad. **22:** 438. 1887. *S. Palmeri* A. Gray, Proc. Am. Acad. **22:** 438. 1887. *S. stellaris* f. *albiflora* Britton, Bull. Torrey Club **17:** 125. 1890. *S. simulata* Britton, Bull. N. Y. Bot. Gard. **3:** 448. 1905. *S. Purpusii* Brandegee, Univ. Calif. Pub. Bot. **4:** 275. 1912. *Sabatia amoena* f. *albiflora* (Britton) Fern., Rhodora **34:** 26. 1932. *Sabbatia campanulata* var. *amoena* (Raf.) Monachino, Torreya **41:** 99. 1941.

Erect annual (2–)15–50(–80) cm. high; stem 1–4 mm. in diameter, terete to strongly angled due to several somewhat irregularly disposed fine lines or ridges extending between nodes, pith parenchymatous in young living specimens but becoming hollow in older or dried specimens. Branches almost always alternate, very rarely one or so nodes with opposite branches, usually restricted to upper half or two-thirds of the stem but sometimes arising throughout the length and even from the base, typically strongly divergent, forming an angle of about 30–70(–85) degrees with the stem, few to numerous, slender, wiry, bearing few to numerous nodes. Root-system of several to numerous, usually slender, but occasionally thickened, fibrous roots 2–10 cm. long, 1–3 mm. in diameter or occasionally with one principal root and several laterals. Leaves ascendent, above often closely appressed to stem, succulent, thick, rubbery in texture, midvein conspicuous and elevated beneath, venation otherwise obscure; after drying leaves commonly darken, usually thinly membranous or occasionally the lowermost slightly rugose, the midvein alone usually prominent. Lower leaves broadly to narrowly elliptic, or even linear, rarely spatulate or obovate, acute to rarely obtuse, often apiculate, usually tapering to both ends, typically about 5–10 times as long as broad, (0.5–)1.5–3(–6) cm. long, (2–)3–8(–15) mm. wide. Upper leaves more narrowly elliptic to linear, the uppermost sometimes very narrowly so to even almost filiform, usually 7–15(–20) times as long as wide, 1–4 cm. long, (0.5–)1.5–3(–5) mm. wide, typically exceeding the diameter of the stem or at least equaling it. Internodes usually 1–2 times the length of the leaves. Flowers appearing solitary but usually arranged in very loose and reduced cymules and these sometimes aggregated in loose clusters. Pedicels slender, straight, ascendent to divergent, (1–)4–10(–15) cm. long, usually about 0.5 mm. in diameter. Calyx-tube turbinate, or occasionally even narrowly campanulate, usually rather gradually narrowing to the base, smooth or but very faintly nerved, thin, somewhat scarious, usually 1–2 times as long as broad, (1.5–)2–4(–6) mm.

long. Calyx-lobes narrowly linear to almost filiform, ascendent or more typically wide-spreading, (4–)6–15(–22) mm. long, typically less than 0.5 mm. but rarely as wide as 1 mm., usually 3–6 times as long as calyx-tube, in general considerably shorter than the corolla, rarely equaling or exceeding it, apparently slightly hyaline-scarious margined. Corolla-tube about 2–3 times as long as wide, usually exceeding calyx-tube by 1–3 mm., translucent but appearing greenish due to ovary, (3–)4–6(–8) mm. long. Corolla-lobes strongly spreading, elliptic, oblong, spatulate, or obovate, obtuse to somewhat acute, (0.5–)1–1.5(–2) cm. long, (2–)4–8(–10) mm. wide, rose, pink, or more rarely white, with a usually irregularly 3-lobed yellow area at the base often bordered by a distinct, bright or dark red line which in turn is sometimes bordered by a white area of variable width. Anthers linear, yellow, (2–)3–4(–5) mm. long; filaments pale yellow to greenish, (1.5–)2–3(–4) mm. long. Style 2–4 mm. long, usually about half the length of its branches; stigmatic lobes 3–8 mm. long. Capsule from almost globose to cylindrical, (4–)6–8(–14) mm. long, (3–)4–5(–6) mm. wide, usually 1.6–2 times as long as broad. TYPE LOCALITY: "in salt marshes: New York, New Jersey &c." DISTRIBUTION: Salt marshes and sandy (usually littoral) places from southern Massachusetts south along the coast and throughout much of Florida and west into Louisiana. Also known from the Bahamas, western Cuba and the central plateau of Mexico. Map 9.

Sabatia stellaris is the most variable species of the *Campanulatae* but within this wide range of diversity there appears to be no sharply differentiated population that might be more naturally treated as a subspecies or a variety. Rather, there is an almost imperceptible change and as a consequence specimens from the northern limits of the range are often strikingly different from those seen at the extreme southern portion of its distribution. Typically, plants collected in southern Florida will be taller, more profusely branched, often from near the base, and these branches will be much more elongate, wiry, and slender. The leaves, for the most part, will be narrowly linear and only the uppermost with indications of a more elliptical or spatulate nature. The northern material will be on the average smaller, less branched, and then the branching usually restricted to the upper portion of the stem; the branches usually short and bearing few nodes. Also the leaves in most cases will be linear only in the very upper portion of the stem and otherwise will often be broadly elliptical. The sum of these differences results in plants of very dissimilar appearance. However, examination of an ample series taken from throughout the range will convince one, I believe, that these differences are not sufficient for the recognition of subspecific categories. Rather these differences should in part be attributed to the great diversity in environment encountered through the range of more than twenty degrees of latitude and especially the difference in the length of the growing season between the Massachusetts coast and the shores of the Caribbean.

After initially attempting (1903) to distinguish between *S. campanulata* and *S. stellaris,* Small abandoned the effort and thereafter applied the former name to specimens of both species in the Southeast. The confusion between the two species is understandable due to the often misleading distinguishing criteria published in most works previous to the detection of the strikingly obvious differences by Bicknell (Bull. Torrey Club **42:** 30–32. 1915.) and especially by Fernald (Rhodora **18:** 145–147. 1916.). Thereafter there should have been little difficulty in distinguishing the two. However, most of the southern material of *S. stellaris* has passed as *S. campanulata* or the larger-flowered specimens as *S. grandiflora* due to the influence of Small's work. *Sabatia campanulata* is not known in peninsular Florida or from the West Indies.

Gleason's treatment (1952) illustrates the confusion that still exists in this species-group. He ascribes a salt or brackish marsh habitat to both *S. campanulata* and *S. stellaris* and includes the West Indies in the range of the former species rather than that of the latter. Furthermore he states that *S. stellaris* "and *S. campanulata* constitute the local extremes of a variable population which may represent only one species or as many as four. Even in our range numerous intermediate forms occur and their assignment to a species depends on the general prominence of characters of which the proportion of the petals is probably the most reliable. In the southeastern part of our range and in the southeastern states both species pass into forms with lvs. all linear (*S. gracilis* (Michx.) Salisb.)." The true picture is by no means as confusing or as complex as Gleason suggests. *Sabatia stellaris* and *S. campanulata* are separable by strong morphological features and the two species occupy mutually exclusive habitats.

It should be pointed out that while *S. stellaris* is rather closely confined to the littoral region in the northern part of its range, specimens from inland peninsular Florida are fairly numerous. In spite of the information available in the literature, *S. stellaris*, at least in the southern part of its range, is not restricted to a salt-marsh or littoral environment and in fact is at least more commonly collected in inland sandy areas.

Britton (Bull. N. Y. Bot. Gard. **3:** 448. 1905.) and later Britton & Millspaugh (1920) recognized two species as occurring in the Bahamas, *S. campanulata* and the supposedly endemic *S. simulata*. This latter species was to be distinguished from what has been called *S. campanulata* by its more slender habit and smaller white flowers. All the material seen from the Bahamas has proven to be annual and consequently the larger-flowered plant with the rose-pink corollas is definitely not *S. campanulata;* it is *S. stellaris*. There is no break in flower-size between the pink and white flowered specimens although the latter are on the average smaller. Several of the larger-flowered specimens (2.5 cm. or more in diameter) had been designated by Britton as *S. simulata* apparently on the basis of the flower color. The stigma of *S. simulata* was described as "spatulate" in contrast to the "oblong-linear" stigma of "*S. campanulata*." I was unable to discover any consistent difference between the stigmas of the specimens. There was the usual variation dependent upon age. *S. simulata* is, I believe, merely a white-flowered form of *S. stellaris* and is conspecific with the pink-flowered specimens of the Bahamas. These color-phases are indistinguishable from much of the material from southern Florida and, for the present at least, all had best be treated as but another trend in the variation apparent in this species throughout its extensive range.

One name deserving brief discussion is *S. nana* of Featherman, which is not listed in "Index Kewensis." The description is here quoted in full:

> Sabbatia Nana.—Stem simple, low, somewhat angled. Leaves small, sessile, the lower spatulate lanceolate, the upper linear lanceolate. Lobes of the corolla five to six, one third longer than the narrow linear calyx lobes. Root perpendicular, slender. Flowers rose-colored. Stem three to four inches high. Blooms in August.
>
> Habitat—Marshy soil of Grande Isle.

The diagnosis is certainly brief but the shape of the leaves, the "narrow linear" calyx-lobes two-thirds as long as the corolla, the habit and the habitat all together make it quite certain that *S. stellaris* was the plant being described. This Louisianan record is at or near the westernmost extremity of the species' present known range in the southeastern states.

Type-specimens of *S. maculata*, *S. palmeri*, and *S. purpusii* have all been examined and compared both with the few additional Mexican collections of the genus that have been made and specimens of the widespread species of eastern North America. Two of the species seemed very different from each other and at first I thought that I could easily distinguish them both from any others in the genus. *Sabatia palmeri*, on the other hand, very quickly seemed to be indistinguishable from *S. maculata*. After examining more material, especially from Florida, it became obvious that any of the Mexican specimens could be matched or very nearly matched by a considerable number of plants of *S. stellaris*. I am certain that I could not distinguish a large unlabeled series of specimens made in Florida and another large series made in Mexico. Therefore, all three names are here treated as synonyms of *S. stellaris*, a wide-ranging, variable species.

The blackened patches at the base of the corolla-lobes of the type of *S. maculata* are very striking and the epithet chosen by Bentham points out this feature. However, the dark black color can almost certainly be attributed to discoloration upon drying and has been noted in many specimens found as far north as New Jersey. The type itself seems indistinguishable from many specimens from Florida of which *Cuthbert 1525* (FLAS) from Manatee Co. is a good example. The type of *S. palmeri* is very similar in appearance to that of *S. maculata*.

S. purpusii is indistinguishable from many of the wiry Floridian specimens. For example, Pennell's collection (*18048*) from the state of San Luis Potosí seems remarkably similar to the collection of Hood *3565* (FLAS) among others from western peninsular Florida. In the Mexican specimens a tendency was noted for the calyx-tube to be more cylindrical with sides more parallel rather than strongly tapering and whose length is typically in the upper range of that of the specimens from the eastern United States. Also, the few capsules seen in the Mexican specimens of the *purpusii*-aspect appeared to be more slender and longer than those of most of the specimens seen from the principal area of distribution of the species.

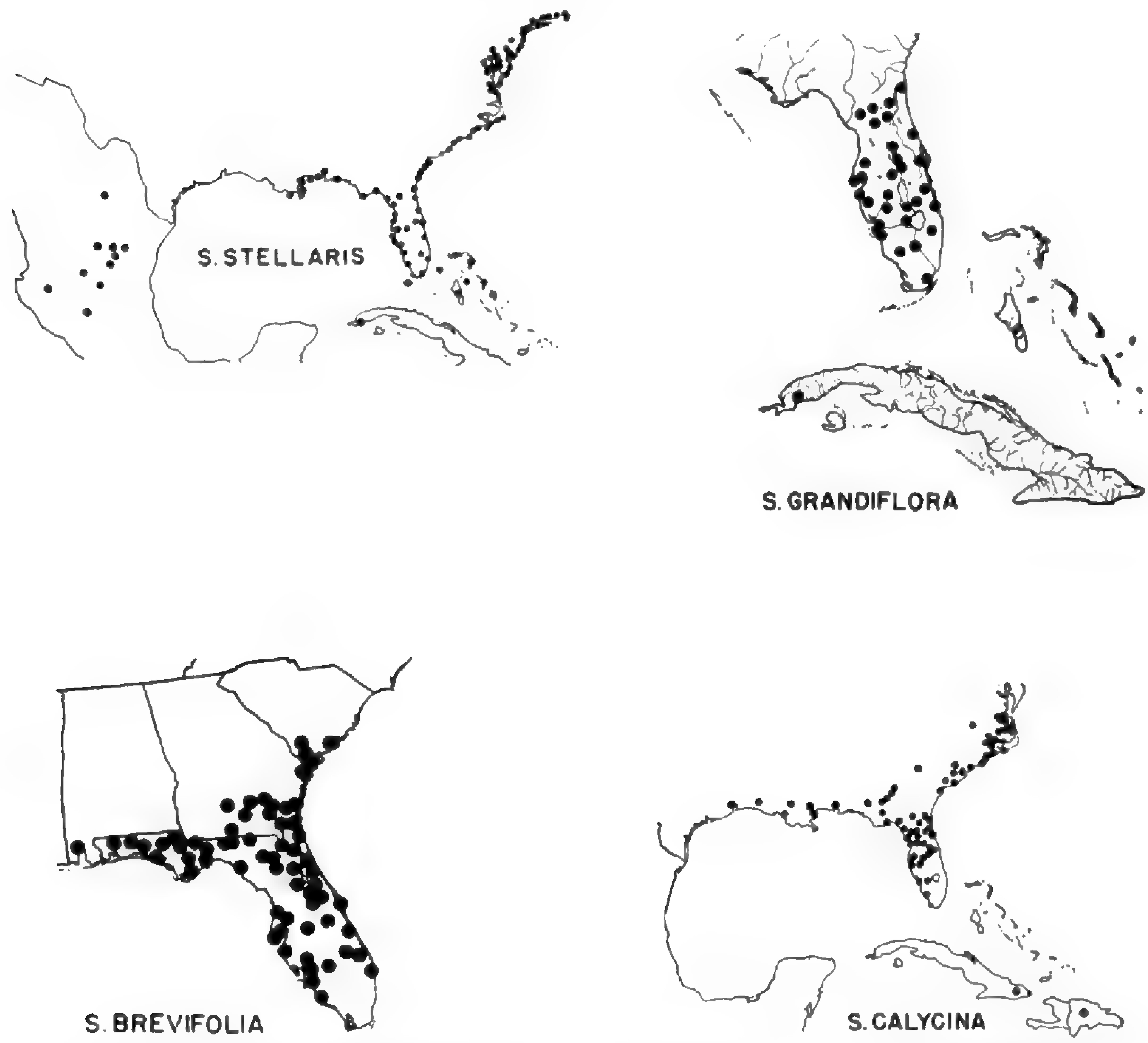
The disjunct distribution of this species is somewhat perplexing. Fernald (RHODORA **18:** 146. 1916.) stated that the range of *S. stellaris* was from "Massachusetts to eastern Mexico" and at that time he considered the plants called by some *S. purpusii* as part of the wide ranging species as is shown by his annotation labels. In the most recent edition of Gray's Manual the western limit of the range was stated to be Louisiana. The apparent absence of this species from the Texas coast and its eventual reappearance in eastern Mexico far south of the border and, most surprisingly of all, in the central plateau of that country is not easily explained. It was with considerable reluctance that attempts to distinguish these species were abandoned but there seemed to be no alternative. The absence of the plant from Texas is in particular inexplicable as there seem to be enormous stretches of territory offering an environment apparently similar to that in which it is found so abundantly in the Atlantic and Gulf Coastal Plain.

REPRESENTATIVE SPECIMENS:—MASSACHUSETTS: Bristol Co., Dartmouth, *Hervey* (GH); Dukes Co., Tisbury, *Cushman*, July 1911 (WIS). RHODE ISLAND: Washington Co., Westerly, *Weatherby 3311* (NCS). CONNECTICUT: Fairfield Co., Stratford, *Eames*, 16 Aug. 1895 (NCU, NY, US). NEW YORK: Kings Co., Barren Island, *Svenson 8242* (GA, GH, MO, PENN, TENN); Richmond Co., vicinity of New Dorp, *Small*, 2 Aug. 1890 (F, GH, MO, NA, NY, US, YU); Suffolk Co., mouth of Wading River, *Muenscher & Curtis 6420* (CU, GH, MT, NY, US). NEW JERSEY: Cape May Co., Cold Spring, *Pennell 2179* (GH, MO, US); Salem Co., about 4 mi. s. of Canton, *Fogg 6054* (GH, PENN, TENN). DELAWARE: Sussex Co., 2 mi. s. of Rehoboth, *Larsen 989* (GA, PENN, US). MARYLAND: Caroline Co., between Choptank River and Bethlehem, *Killip 7278* (GH, US). VIRGINIA: Princess Anne Co., along Back Bay, *Fernald & Long 11113* (DUKE, GH, MO, NY, US); Surry Co., Hog Island, *Fernald & Long 12774* (GA, GH, MO, US). NORTH CAROLINA: Brunswick Co., near Southport, *Biltmore Herb. 3304a* (GH, MO, NCU, NY, US); New Hanover Co., Fort Fisher, *Godfrey 4726* (DUKE, GH, NCU, NY, US). SOUTH CAROLINA: Georgetown Co., Pawleys Island, *Godfrey & Tryon 306* (DUKE, F, GH, MO, NY, PENN, TENN, US); Horry Co., about 2 mi. sw. of Ocean Drive, *Wilbur 2901* (MICH). GEORGIA: Chatham Co., Tybee Island, *Harper 924* (GH, MO, NY, US); Glynn Co., Sea Island, *Cronquist 5356* (FLAS, GA, GH, NO, SMU, US). FLORIDA: Brevard Co., Titusville, *Nash 2303* (F, FLAS, GH, K, MICH, MO, US); Lee Co., vicinity of Fort Myer, *Standley 12* (F, GH, MO, NY, US); Levy Co., 1 mi. se. of Chiefland, *Webster & Wilbur 3639* (MICH); Monroe Co., Big Pine Key, *Small 8148* (DUKE, GH, NCU, NY, PENN, WVA); Orange Co., about 2 mi. e. of Fort Christmas, *Moldenke 210* (DUKE, MO, NY, PENN, US); Sarasota Co., Longboat Key, *Tracy 6808* (F, MO, NY, US). ALABAMA: Mobile Co., saline marshes, *Mohr*, Aug. 1892 (NY). MISSISSIPPI: Harrison Co., Cat Island, *Tracy, Earle & Seymour 101* (CU, GH, MO, NCU, WIS). LOUISIANA: Plaquemines Parish, Breton Island, *Tracy & Lloyd 343* (CU, F, GH, MO, NY, US). BAHAMA ISLANDS: Abaco Is., *Brace 1793* (NY); Andros Is., *Brace 7116* (F, NY, US); Cat Is., *Britton & Millspaugh 5780*

(F, NY); East Bimini, *Howard 10274* (SMU, US); Eleuthera Is., *Britton 6427* (F, GH, NY, US); Great Bahama Is., *Brace 3518* (F, NY, US); New Providence Is., *Britton 58* [TYPE of *S. simulata* Britt.] (NY); *Curtiss 200* (F, GH, MO, NY, US). CUBA: Without more exact locality but very likely from Pinar del Rio, *Wright 412* [sheets sometimes mixed with *S. grandiflora*] (BRU, GH, NY, US). This is the same number but from a different collecting trip as the type of *S. gracilis* var. *cubensis* Griseb. (= *S. calycina*). MEXICO: Coahuila: Cuatro Cienagas, *Marsh 2068* (F). Michoacán: 60–70 mi. e. of Lake Pátzcuaro in bog 4 mi. w. of Hidalgo, *Hitchcock & Stanford 7196* (GH, UC). Jalisco: Lagos de Moreno, *Hartweg 1615* [TYPE of *Eustoma maculata* Benth.] (K); Rio Blanco, *Palmer 668* [TYPE of *S. palmeri* Gray] (GH). Querétaro: Querétaro, *Arsèen 10281* (US). San Luis Potosí: Media Luna near Rio Verde, *Palmer 80* (F, GH, MO, NY, UC, US) and *Palmer 80½* (GH, MO, NY, US); Minas de San Rafael, *Purpus 5345* [TYPE of *S. purpusii* Brandegee at UC] (F, GH, MO, NY, UC); Hacienda de Angostura, *Pringle 3810* (BRU, F, GH, MICH, MO, NY, UC, US); Las Tablas, *Pennell 18048* (US). Tamaulipas: Jaumave, *Rozynski 377* (F).

10. **Sabatia grandiflora** (A. Gray) Small, Fl. SE. U. S. 928. 1903. *Sabbatia gracilis* var. *grandiflora* A. Gray, Syn. Fl. N. Am. **2:** 115. 1878. *Sabatia campanulata* var. *grandiflora* (A. Gray) Blake, Rhodora **17:** 52. 1915. *Sabbatia Alainii* Marie-Victorin, Contr. Inst. Bot. Univ. Montreal No. 63: 73. 1948.

Erect annual (15–)40–90(–110) cm. high; stem (1–)2–5(–7) mm. in diameter, terete, although in dried specimens with several fine lines running between the nodes. Branches, rarely absent, almost entirely restricted to the upper third or half of the stem and almost invariably alternate, typically strongly divergent, forming angles of about 50–70 degrees, stiffly geniculate, bearing but few nodes. Plant appearing virgate from elongate, rigid internodes. Root-system of several to numerous fibrous roots 3–8 cm. long, 1–3 mm. in diameter. Leaves erect, at least above closely appressed against the stem, succulent, drying thick, rigid, rugose-roughened, venation obscure in both living and dried material; the lower spatulate, elliptic, oblong-linear or even linear, obtuse to acute, (1–)2–4(–5) cm. long, (2–)4–7(–10) mm. wide, typically about 5–10 times longer than wide, usually several times exceeding the typically short, 0.5–3 cm. long internodes; gradually to abruptly reduced above to very narrowly linear or even filiform, the width noticeably less than the diameter of the stem, (1–)3–5(–12) cm. long, (0.5–)1–2(–3) mm. wide, generally 20–60 times as long as wide, hyaline or callose-apiculate. Internodes above typically greatly elongate, often 2–5 times as long as the leaves. Inflorescence of (1–)2–3(–4) or rarely more flowers in reduced cymules; the flowers borne on slender, but rigid, elongate, terete pedicels (2–)4–8 (–12) cm. long and about 0.5 mm. in diameter; the flowers thus appearing solitary. Calyx-tube campanulate, usually broadly so, the sides more or less parallel, abruptly contracting to base or but gradually tapering in the lower half, typically 1–1.5(–2) times as long as broad, 2–4(–6) mm. long, generally very smooth or but very finely lined, the wall thin and somewhat hyaline-scarious especially with age. Calyx-lobes erect to spreading, very narrowly linear or filiform, (0.6–)1–2(–3) cm. long, usually



Maps 9–12. Map 9, upper left; map 10, upper right; map 11, lower left; map 12, lower right.

about 3–6 times as long as the tube, typically less than three-fourths as long as the corolla, rarely equaling or exceeding it, the tip callose-apiculate. Corolla-tube cylindrical, (3–)5–7(–8) mm. long, exceeding calyx-tube by about 2–4 mm., usually 1.5–2 times as long as wide, apparently colorless. Corolla-lobes strongly spreading, oblanceolate, obovate, broadly spatulate, oblong, or elliptic, usually obtuse or more rarely acute, (1.3–)1.8–2.5(–3) cm. long, (5–)7–12(–15) mm. wide, deep rose to pale-pink or white, with oblong basal yellow area 2–4 mm. long, rather irregularly lobed or toothed, and in the roseate forms usually bordered by an intense red line or area. Anthers linear, dark yellow, (3–)5–7(–8) mm. long; filaments yellow, slender, 2–4 mm. long. Style 2–5 mm. long; stigmatie lobes (4–)6–8(–9) mm. long. Capsule usually narrowly cylindrical, (6–)8–10(–15) mm. long, 4–5(–7) mm. wide, generally 2–3 times as long as broad. TYPE LOCALITY: "Coast of E. Florida." Lectotype: *Palmer 430* (GH!) from "Indian River." DISTRIBUTION: Everglades, pinelands and sandy places in peninsular Florida and western Cuba. Map 10.

In spite of the numerous striking characters which distinguish this species from any other, too much reliance has been placed upon floral size as the criterion for the recognition of *S. grandiflora*. As a consequence one finds under this name in most herbaria a miscellaneous assemblage of large-flowered specimens belonging to subsection *Campanulatae*. Small never pointed out the distinctive characteristics of *S. grandiflora* and a considerable number of the specimens labeled or annotated by him are merely large-flowered *S. stellaris*. The identity of these incorrectly determined specimens is shown by the smooth, thin texture of the dried leaves which above, although narrowly linear, are typically as broad or broader than the diameter of the stem. Also these large-flowered specimens of *S. stellaris*, which have been so often mistaken for *S. grandiflora*, are generally more profusely branched, especially below the middle of the stem. *S. grandiflora* may be readily distinguished from *S. stellaris* by its thick rugose-roughened or wrinkled leaves which above are almost filiform and less in width than the diameter of the stem. Furthermore, it is typically a larger and coarser plant with branching more or less restricted to the upper third or half of the stem. Another fairly reliable feature that may be utilized in recognizing *S. grandiflora* is that its calyx-tube is most often broadly campanulate, while that of *S. stellaris* is more typically narrowly turbinate. That much-relied-upon character, the length of the corolla-lobes, is at best a subsidiary one because of the considerable overlap in the size of flowers between the two species.

In spite of the inferences that might be derived from the synonymy, the relationship of *S. grandiflora* is closer to *S. stellaris* than to *S. campanulata* (= *S. gracilis*). Numerous differences might be listed to distinguish *S. grandiflora* from *S. campanulata* with which it was originally and even later considered to be a variety. However, the most obvious and perhaps most fundamental is that the latter is a caespitose perennial while *S. grandiflora*, like *S. stellaris*, is an annual. The perennial species is not known in peninsular Florida. *S. stellaris* has been collected throughout the state, while in Florida, *S. grandiflora* is almost entirely restricted to the peninsular portion. Judging from the number of mixed sheets of *S. stellaris* and *S. grandiflora*, there is considerable overlap in range of habitat between these two species if their environmental tolerances in Florida are not exactly the same.

In the United States other than in Florida, *S. grandiflora* is represented only from Louisiana by a specimen attributed to Josiah Hale deposited in the Gray Herbarium. This collection is *S. grandiflora* but more recent collections from Louisiana seen in the herbaria under this name have always proven to be large-flowered specimens of *S. stellaris*. Confusion in labeling should be considered a strong possibility for this specimen reputedly from Louisiana.

After the short original diagnosis, Gray presented the collections known to him in the following manner: "coast of E. Florida, Leavenworth, Buckley, Palmer & c.". Theirs are the only specimens available to him now preserved in either the Gray Herbarium or that of the New York Botanical Garden; who the other collectors were is unknown to me. Palmer's collection, made in 1874, is definite and all four sheets at the three different herbaria bear the information "Indian River, East Florida" as well as the number "430." These specimens are also equal to or better than the others and, in spite of being collected after a varietal status had been decided upon (with another epithet) based on the other collections, Palmer's collection (no. 430) at the Gray Herbarium is here designated the lectotype.

The recently proposed *S. alainii* from Cuba here is considered to be but a synonym of *S. grandiflora*; its distinctness has certainly not as yet been demonstrated. The original description of this supposedly distinct Cuban entity was accompanied by the following discussion in reference to its relationship with *S. grandiflora*. "Cette espèce se rapproche du *Sabbatia grandiflora* par sa grande corolle, ses curtes feuilles, l'absence d'oeil jaune, sa capsule plus petite." The meaning of this is not altogether clear. It would seem as though a word or so had been omitted in printing and that the first two characters mentioned were meant as features shared in common by *S. grandiflora* and the newly proposed species and that the second two phrases were supposed distinctions. The stated absence of the yellow eye in the throat of the corolla-tube and at the base of the lobes of *S. alainii* is not borne out by examination of either the type material, distributed isotypes or information ("white with light yellow eye") provided on the label of *Britton et al. 7166* which was collected in the same region. The few capsules available were smaller but did not appear to have fully developed. The Cuban representatives of this group are, I believe, indistinguishable from those of Florida.

REPRESENTATIVE SPECIMENS:—FLORIDA: Alachua Co., Earlton Beach, *Loucks*, 5 Sept. 1927 (FLAS); Brevard Co., between Cocoa and Lake Poinsett, *Rhoads*, 23 May 1937 (FLAS); Broward Co., Ft. Lauderdale, *Small & Wilson 1785* (NY); Charlotte Co., without exact locality, *Frye*, 17 May 1946 (FLAS); Clay Co., Keystone Heights, *West*, 29 June 1930 (FLAS); Collier Co., 2 mi. s. of Immokalee, *Sheehan* 28 Feb. 1919 (NY); Dade Co., w. of Camp Jackson, *Small & Wilson 1991* (NY); DeSoto Co., Lacy, *West*, 23 Sept. 1938 (FLAS); Duval Co., without exact locality, *Fredholm 5* (GH); Glades Co., Lakeport, *Lovett 264* (DUKE); Hardee Co., Limestone, *Kirk*, 1 July 1942 (FLAS); Hendry Co., se. corner of county, *Davis*, 13 Sept. 1947 (FLAS); Hernando Co., without exact locality, *Hitchcock 1283* (F, MO); Highlands Co., near Brighton, *McFarlin 10913* (GH, PENN); Hillsborough Co., Tampa, *Garber*, May 1876 (BRU, F, NY, US, YU); Indian River Co., near Felsmere, *Small 8917* (NY); Lake Co., Eustis, *Nash 763* (CU, F, GH, MICH, MO, NY, US); Lee Co., about 8 mi. se. of Fort Myers, *Standley 446* (F, GH, MO, MT, US); Levy Co., Bronson, *Watson & Murrill*, 18 June 1939 (FLAS); Manatee Co., near Palma Sola Bay, *Cuthbert*, 23 June 1916 (FLAS); Marion Co., Lake Kerr, *West & Arnold*, 21 July 1935 (FLAS) Martin Co., Stuart, *Atwood* 1917 (CU); Okeechobee Co., n. of Fort Drum, *West*, 22 Apr. 1946 (FLAS); Orange Co., near Oakland, *Curtiss 6624* (CU, GH, MO, NY, US); Osceola Co., Kissimmee, *Singletary 136* (DUKE, NCU); Palm Beach Co., along the Palm Beach Canal, *Small 8280* (FLAS, NY, TENN); Pasco Co., near Zephyrhills, *Hood 3483* (FLAS); Pinellas Co., near St. Petersburg, *Deam 1901* (MICH); Polk Co., n. of Davenport, *Hood 3546* (FLAS); Putnam Co., Welaka, *DeVall*, 23 June 1939 (FLAS); Sarasota Co., Myakka River State Park about 18 mi. se. of Sarasota, *Wilbur & Webster 2502* (MICH); Volusia Co., near Ariel, *Moldenke 180a* (NY, PENN); County unknown, Indian River, *Palmer 430* [LECTOTYPE of *S. gracilis* var. *grandiflora*] (F, GH, NY). CUBA:—Pinar Del Rio: au bord des lagunes de Santa Maria, San Luis, *Marie-Victorin & Alain 369* [TYPE of *S. Alainii*] (GH, MT); Borders of Laguna Santa Maria, *Britton, Britton & Gager 7166* (NY, US). Province not stated, *Wright 412* [sheets sometimes mixed with *S. stellaris*] (BRU, NY, US).

11. **Sabatia brevifolia** Raf., Atl. Journ. **1**: 147. 1832. *S. Elliotii* [*Elliottii*] Steud., Nom. Bot. Ed. 2. **2**: 489. 1841. *S. paniculata* β *Elliottii* [Steud.] Wood, Am. Bot. & Flor. 266. 1870, without basionym.

Erect annual (15–)30–60(–70) cm. high; stem (1–)2–3(–4) mm. in diameter, terete, but usually finely ridged or lined by slight elevations extending between the nodes, pith hollow, at least below. Branches typically alternate, always so above, but in robust, profusely branched plants occasionally with few to several branches of the main stem and even near base of principal branches opposite; in large well-developed plants usually branching throughout the length of the stem, in smaller plants often restricted to the upper half of the stem, strongly ascendent to more commonly widely divergent, usually forming an angle with the stem of (20–)40–60(–80) degrees, slender, very wiry, usually bearing numerous nodes, the internodes not elongate; the aspect of the plant strikingly wiry-virgate. Root-system a pronounced slender or occasionally thickened tap-root 2–8 cm. long, (1–)2–3(–4.5) mm. in diameter, bearing few to several very slender laterals. Leaves ascendent and apparently appressed on the main stem and the more or less vertical branches but on strongly divergent branches usually strikingly upwardly secund and often appearing falcate, midvein alone easily detected and that elevated beneath, apex very minutely apiculate, the lowermost somewhat obovate, oblanceolate, oblong, elliptic, or linear, (0.5–)1–2(–3) cm. long, (1–)2–5(–7) mm. wide, typically obtuse or sometimes acute, usually tapering to the sessile base, generally 3–6 times as long as wide; those from about the middle of the stem narrowly oblong or more commonly linear, 1.5–2.5 cm. long, 1–3 mm. wide, acute; the upper cauline leaves and those of the branches narrowly linear to filiform or even subulate, gradually reduced to about 3–5 mm. long and less than 0.5 mm. wide, and almost invariably less than 2 mm. wide or twice the diameter of the stem but often the same width, usually 10–25 times as long as broad. Internodes usually 1–2 times the length of the leaves, occasionally greater or sometimes, especially near the base, less. Flowers appearing solitary but arranged in reduced often 1–2-flowered usually secund cymules on the upper side of the divaricate branches. Pedicels very slender, wiry, erect (1–)2–4(–5) cm. long. Calyx-tube turbinate, sides sloping to the base, smooth or more commonly noticeably finely nerved, internerval wall thin, often scarious, about 1–2 times as long as broad, (1–)1.5–2.5(–3) mm. long. Calyx-lobes setaceous or subulate, ascendent to wide spreading, (3–)4–7(–8) mm. long, tapering from about 0.5–1 mm. base, usually 2–4 times as long as the calyx-tube, usually not exceeding half the length of the corolla. Upper half of corolla-tube usually cylindrical, tapering below middle to the base, about 1.5–2 times as long as wide, usually 1–2 mm. longer than the calyx-tube or about 2 times as long, (2.5–)3.5–4.5(–5) mm. long. Corolla-lobes spreading, elliptic, oblong, oblanceolate, or broadly spatulate, (0.6–)0.9–1.3(–1.8) cm. long, (2–)3–5(–7) mm. wide, usually obtuse but not uncommonly somewhat acute, white with a greenish-yellow to yellow patch at base of lobe. Anthers linear, yellow, (2–)3–5(–6) mm. long; filaments greenish-yellow to pale yellow, 1–2 mm. long. Style 1 mm. long or less; stigmatic lobes 3–5 mm. long. Capsule cylindrical, 3–6 mm. long, 2–4 mm. wide. TYPE LOCALITY: Florida. Type: unknown. Described by Rafinesque along with thirty other species from Florida "seen in gardens and herbals." DISTRIBUTION: Pinelands and savannas from southeastern South Carolina along the Coastal Plain throughout most of Florida and west at least to Alabama. Map 11.

This species was described originally by Elliott with the acknowledged aid of Baldwin but the name applied to it was *Sabbatia paniculata.* This erroneous nomenclature was generally employed even after it was understood to be a mistake. Chapman (1860) was persuaded by Gray to take up the substitute name first proposed by Steudel nearly twenty years before. Elliott's application of Michaux's epithet which initiated the confusion is curious in view of his understanding of the subject as shown by the following quotation:

Though the description of Michaux applies more peculiarly to the *S. corymbosa*, yet as this species was certainly included, and is the only one to which the term *paniculata* is certainly applicable, I have referred to him here.

This change in concept of the species passing as *S. paniculata* was pointed out by Grisebach (1839) but he chose to continue the use of the name in the sense of Elliott. Steudel simply substituted the epithet *elliottii* (as *Elliotii*) citing in synonymy "*S. paniculata* Ell. (non Pursh)." The original spelling of the name need not be retained in a case such as this as it was clearly an unintentional orthographic error. Steudel, in listing Stephen Elliott's name, spelled the name, "Elliot." It seems hardly possible that anyone would carry the prerogative of modifying a name when latinizing it to a bibliographic listing; the change must have been unintentional. Wood's solution to the confusion that had enveloped the nomenclature of the white-flowered sabatias was to reduce *S. elliottii* to varietal status of *S. paniculata*. This indicated no more than a vague bibliographic rather than biological familiarity with the plants.

Nine years before Steudel's publication of *S. elliottii*, Rafinesque in a paper describing over thirty species from Florida belonging to various genera "seen in gardens and herbals" published *S. brevifolia*, the original description of which is here quoted in full:

8. Sabbatia brevifolia Raf. Stem dichotomus filiform leaves short subulate acute, flowers terminal white, calyx shorter than corolla setaceous, segments of corolla obovate. Near to S. brachiata and stellaris.

This description, although very brief, seems very apt in pointing out the stronger features that characterize the species that has long been called *S. elliottii*. Even in the absence of an authentic specimen I feel no hesitation in taking up Rafinesque's name other than that caused by the regret of seeing a well-established name replaced by one long-forgotten. It would be difficult to present a better description in so few words of the plant first characterized by Elliott than Rafinesque's attempt. Every descriptive phrase fits Elliott's plant very well.

REPRESENTATIVE SPECIMENS:—NORTH CAROLINA: without locality, *Delile* (NY). Since this species is not otherwise known north of Charlestown, S. C., its presence in North Carolina seems most doubtful. SOUTH CAROLINA: Beaufort Co., Bluffton, *Mellichamp*, 1886 (F, MO, NY, US); Charleston Co., Adams Run, *Godfrey & Tryon 1544* (DUKE, F, GH, MICH, MO, NY, PENN, TENN, US); Hampton Co., about 4 mi. se. of Hampton, *Wilbur & Webster 2825* (MICH); Jasper Co., Ridgeland, *Mohr*, Nov. 1893 (MO, NY, US). GEORGIA: Camden Co., w. of St. Marys, *Small, DeWinkeler & Small 10545* (DUKE, WVA); Charlton Co., Okefenokee Swamp between Chesser Island and Camp Cornelia, *Thorne & Ford 2064* (CU, GA); Coffee Co., without exact locality, *Harper 681* (NY, US); Pierce Co., 3 mi. n. of Blackshear, *Thorne & Norris 6202* (CU, GA); Ware Co., 5 mi. se. of Waycross, *Wilbur & Webster 2731* (MICH). FLORIDA: Brevard Co., Merritts Island, *Curtiss 2227* (F, GH, MO, NY, US); Clay Co., about 2 mi. n. of Orange Park, *Moldenke 162* (DUKE, MO, NY, PENN, US); DeSoto Co., 4 mi. w. of Arcadia, *Webster 4224* (MICH); Duval Co., near Jacksonville, *Curtiss 5114* (CU, F, GH, NCS, NY, US); Franklin Co., Apalachicola, *Biltmore Distrib. Chapman Herb. 903b* (GH, MO, NCS, NCU, NY, PENN, US); Hernando Co., between Brookside and Bayport, *Jones 43* (CU, US); Hillsborough Co., Tampa, *Nash 2422* (F, GH, MICH, MO, MT, NY, US); Indian River Co., near Felsmere, *Small 8902* (FLAS, GH, NY, US); Jackson Co., 4 mi. e. of Marianna, *Wiegand & Manning 2559* (CU, GH); Lake Co., near Cassia, *Hood*, 1 Sept. 1911 (FLAS, GH); Lee Co., s. of Fort Myers, *Moldenke 909* (DUKE, MO, NY, PENN, US); Liberty Co., near Roy, *Wiegand & Manning 2558* (CU, GH); Manatee Co., Bradenton, *Tracy 7080* (CU, F, FLAS, GH, NY, PENN, TAES, US); Orange Co., about 2.5 mi. ne. of Apopka, *Wilbur & Webster 2650* (MICH); Palm Beach Co., Earman, *Randolph 26* (CU, GH); Pinellas Co., about 4 mi. w. of St. Petersburg, *Deam 2840* (MICH, US); Putnam Co., 10 mi. se. of Interlochen, *Fox 5700* (MICH, NCS); Seminole Co., Lake Monroe, *Garber*, Mar. 1896 (BRU, F, US, YU); Volusia Co., Beresford, *Hood*, 21 Sept. 1910 (FLAS, MO). ALABAMA: Mobile Co., between Theodore and Hollander's Island, *Pennell 4512* (NY, PENN). LOUISIANA: without locality data, *Featherman* (MO). This species should not be included in the flora of the state without a better substantiated record. It seems likely that there is confusion in labeling in regard to this collection.

(to be concluded)

EPIFAGUS VIRGINIANA.—On the northern exposure of a deciduous woods, consisting chiefly of oaks and beeches, there is at Swarthmore, Delaware County, Pa., a large colony of *Epifagus* which is butter-yellow in color. Nearby a number of hemlocks are growing, but this plant is not found under these, but confines itself to the deciduous trees. A year ago I counted 300 of this yellow *Epifagus* without materially changing my position, and this year ('54) I counted 175 plants along a wood's lane within the space of 100 feet. A fair estimate of the plants on this northern hillside would be more than 1000.

The plant resembles the species closely except for color. If any difference is to be noted I think the yellow form tends to be more bushy and is perhaps more fleshy. However, there are numbers of single-stemmed plants scattered about. Some of these are pure yellow, but others show touches of reddish brown on the stem scales.

The usual color-formof *E. virginiana* does not appear within the area occupied by the main growth of the yellows, but as the yellows diminish along the edges the usual form appears. The whole area is about an acre in extent.

The concentration of the yellow forms on this hillside suggests a common origin for them, but does not explain the absence of the usual form. So many plants of this one color within the limited area indicated with the usual form of the species on the periphery offers a nice problem of distribution and might provide an interesting population study for the appropriate person.—Samuel C. Palmer, swarthmore, pa.

Calycera balsamitaefolia in the United States.—Recently there were found in the Herbarium of the Chicago Natural History Museum two sheets of *Calycera balsamitaefolia* (Juss.) Rich., of the family Calyceraceae. They were included in the J. T. Rothrock collection, when that herbarium was purchased by the Chicago Natural History Museum in 1909. Both sheets were collected on ballast at Kaighns Point (spelled Kaigns on the label) in New Jersey. This station is near Camden opposite Philadelphia. One sheet has the label of "Herbarium of Isaac Burk, Philadelphia; Pa.", the other sheet accompanied by a label of the "Herbarium of University of Pennsylvania." No date is indicated on either label.

It is of interest to note this collection, because the species is a native of Chile, and is not mentioned in either the eighth edition of Gray's Manual, Gleason's New Britton & Brown, or any of the floras of New Jersey and Pennsylvania. Probably collected at the station given above in the latter decades of the nineteenth century or at the beginning of the twentieth century, the species apparently has never been re-collected either at the Kaighns Point station or elsewhere. Botanists from the vicinity of Philadelphia and New York should give special attention to ballast sites similar to the one where *Calycera* was found.—Julian A. Steyermark and Floyd A. Swink, chicago natural history museum and college of pharmacy, university of illinois.

Volume 57, no. 673, including pages 1–36, was issued 28 February, 1955.

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Vol. 57 March, 1955 No. 675

CONTENTS:

The New England Botanical Club, Inc.

8 and 10 West King St., Lancaster, Pa.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of the Gray's Manual Range and regions floristically related. Price, $4.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) of not more than 24 pages and with 1 plate, 40 cents, numbers of more than 24 pages or with more than 1 plate mostly at higher prices (see 3rd cover-page). Back volumes can be supplied at $4.00. Some single numbers from these volumes can be supplied only at advanced prices (see 3rd cover-page). Somewhat reduced rates for complete sets can be obtained on application to Dr. Hill. Notes and short scientific papers, relating directly or indirectly to the plants of North America, will be considered for publication to the extent that the limited space of the journal permits. Illustrations can be used only if the cost of engraver's blocks is met through the author or his institution. Forms may be closed five weeks in advance of publication. Extracted reprints, if ordered in advance, will be furnished at cost.

Address manuscripts and proofs to Reed C. Rollins,
Gray Herbarium, 22 Divinity Ave., Cambridge 38, Mass.

Subscriptions (making *all remittances* payable to RHODORA) to

Dr. A. F. Hill, 8 W. King St., Lancaster, Pa., or, preferably, Botanical Museum, Oxford St., Cambridge 38, Mass.

Entered as second-class matter March 9, 1929, at the post office at Lancaster, Pa., under the Act of March 3, 1879.

Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 57 | March, 1955 | No. 675

A NOTE ON THE NAME CALAMINTHA

GORDON P. DEWOLF, JR.

THE genus *Satureja,* L. as interpreted in the 8th edition of "Gray's Manual of Botany" includes plants that have been included in four genera: SATUREJA (*S. hortensis* L.); CALAMINTHA (*S. Calamintha,* (L.) Scheele = *C. officinalis* Moench; *S. glabella* (Michx.) Briq. = *C. glabella* (Michx.) Benth.; *S. arkansana* (Nutt.) Briq. = *C. glabella* (Michx.) Benth., var. *angustifolia* (Torr.) DeWolf [*Satureja glabella* (Michx.) Briq., var. *angustifolia* (Torr.) Svenson]; ACINOS (*S. Acinos* (L.) Scheele = *A. arvensis* (Lam.) Dandy; and CLINOPODIUM (*S. vulgare* (L.) Fritsch = *C. vulgare* L.).

Study of material of species of this group known to be in cultivation has convinced me that these four taxa are not congeneric, and that current European practice of recognizing them as distinct genera should be followed. A fuller discussion of the taxonomic aspects of the problem has been published elsewhere (Baileya 2(4): 142–150. 1954 [Jan., 1955]). Here I should like to discuss a purely nomenclatural problem.

In the 52nd volume of Fedde's "Repertorium specierum novarum regni vegetabilis," Heft 2, pp. 144–161, 1943, there appears the second of a series of articles by Erwin Janchen entitled "Zur Nomenclature der Gattungsnamen." My attention was drawn to this paper by the inclusion in the 1952 edition of the "International Code of Botanical Nomenclature," p. 131, of the name *Calamintha,* Lamarck as a *nomen conservandum propositum,* the respective *nomen propositum rejiciendum* being *Clinopodium,* Linnaeus. It seems to me that certain data have been overlooked in the framing of this proposal, and hence, further, and perhaps fuller, discussion is in order.

In the 1943 paper, p. 156, no. 7305, Janchen refers to a paper by Janchen and Neumayer, entitled "Beiträge zur Benennung, Bewertung und Verbreitung der Farn- und Blütenpflanzen Deutschlands" in the "Oesterreichische Botanische Zeitschrift," volume 91, 1942, pp. 209–298, in particular to p. 274. At this place the identity of *Calamintha*, Moench (1794) [non Lamarck! 1778] and *Clinopodium*, Linnaeus is asserted, and their distinctness from *Satureja*, Linnaeus is affirmed. Further, Janchen and Neumayer stated: ". . . Mit Rücksicht auf die Artenanzahl ist *Calamintha* gegenüber dem älteren Gattungsnamen *Clinopodium* auf der Ausnahmsliste zu schützen . . ." They also refer to a paper in the "Acta Horti Gotoburgensis," volume 13, 1939, pp. 335–380, in particular p. 349, in which essentially the same thought is expressed by Handel-Mazzetti.

Objections to this proposal arise on two points:

1. *Calamintha*, Lamarck (1778) is a later homonym of *Calamintha*, Miller (1754) *Calamintha*, Trew (1754) and *Calamintha*, Adanson (1763) (and/or Scopoli, 1772), and is synonymous with *Calamintha*, Miller and *Calamintha*, Trew.
2. *Calamintha*, whether of Miller, Trew, Adanson, Scopoli, Lamarck, or Moench, did not contain any species then ascribed to *Clinopodium*. The two taxa were not confused until 1891 when O. Kuntze reduced *Calamintha*, Moench emend. Bentham to *Clinopodium*, Linnaeus emend. O. Kuntze.

Reference to Pfeiffer's "Nomenclator Botanicus," volume 1, part 1, of 1873 indicates that *Calamintha* was first used as a post-Linnaean name by Adanson, in the "Families des Plantes" of 1763, volume 2, p. 192, for the Linnaean genus *Glechoma*. This same usage was maintained by Scopoli in the first volume of the second edition of the "Flora Carniolica" (1772), at p. 423, where synonymy and a good description of the single species [*Glechoma hederacea*] are given. The next entry should be to the usage of Lamarck in the second volume of the first edition of the "Flore Francoise," 1778, p. 393, no. 432. Pfeiffer missed this, however, so the next actual entry is to Moench's "Methodus Plantas . . ." of 1794.

A note about *Calamintha*, Moench is perhaps in order. In 1794 the "Methodus Plantas Horti Botanici et Agri Marburgensis, a Staminum Situ Describendi" of Konrad Moench was published. In this work, at least so far as the labiates are concerned, very good generic and specific diagnoses are given. It was used by Bentham during the preparation of his "Labiatarum, Genera et Species," of 1832–36, and, in particular, Bentham accepted Moench's circumscription of *Calamintha* over that of Lamarck. As published by Moench, three species were accepted: *C. grandiflora,* (L.) Moench; *C. officinalis,* Moench; and *C. trichotoma,* Moench = *C. Nepeta,* (L.) Savi.

Meanwhile, *Clinopodium* had received a very uniform treatment. In 1753 Linnaeus included three species in his genus, viz., *Clinopodium vulgare; C. incanum* = *Pycnanthemum incanum,* (L.) Michx., fide Bentham, "Labiatarum . . ." p. 327; and *C. rugosum* = *Hyptis capitata,* Jacquin (ex Jamaica) and *H. radiata,* Willdenow (ex Carolina), fide Bentham, "Labiatarum . . ." pp. 104 and 108. Of these three species, *Clinopodium vulgare* has been consistently retained in the genus since its publication, and its immediate relatives have been placed with it.

In 1754 Philip Miller published a three volume, octavo, abridgement of the last folio edition (? 6th, 1752) of "The Gardeners Dictionary." In this work binomial nomenclature was not used, but the generic descriptions are well drawn[1]. We are, therefore, faced with the necessity of considering Miller's genera. We find that Miller defined a genus he called "*Calamintha.*" The generic circumscription is tolerably specific, and, of the six taxa listed, the first three are the same as those accepted by Moench. They are: *Calamintha vulgaris, vel officinarum Germanicae,* of Caspar Bauhin = *C. officinalis,* Moench; *Calamintha pulegii odore, foliis latioribus,* of Paul Hermann = *C. Nepeta,* (L.) Savi; and the *Calamintha magno flore,* of Caspar Bauhin = *C. grandiflora,* (L.) Moench.

When I discussed the taxonomic aspects of this problem in Baileya (l.c.) the name *Calamintha* was ascribed to Philip Miller. This occurred because of ignorance of the fact that also in 1754 Christopher Jacob Trew, in his Nuremburg edition of Elizabeth Blackwell's "A Curious Herbal," which is usually referred to as the "Herbarium Blackwellianum," had used the name *Calamintha.* Trew validated his name by reference to the generic descriptions of pre-Linnaean authors, including Ray and Tourne-

[1] After Tournefort, *fide* G. C. Druce in Rpt. Botanical Exchange Club of the British Isles 3: 426–428. 1913.

fort. Further he gave two excellent plates: no. 166, *Calamintha montana* = *C. officinalis,* Moench and no. 167, *Calamintha officinalis* = *C. Nepeta,* (L.) Savi.

In the past there has been a good deal of discussion as to the advisability of rejecting all names published in works dated after 1753 which do not use binomial nomenclature. As late as 1935 a formal proposal[2] was made to the 6th International Botanical Congress that such be done, and a list of proscribed works be made. This seems, however, to have met with no success.[3] We are left, then, with the tacit understanding that generic names, so long as validly and legitimately published after 1753, may be taken up even from works not using binomial nomenclature.

In the present case we are concerned with homonymous and/or synonymous names, published in the same year, but in unknown sequence. It behooves us, then, to take up for purposes of nomenclature, the most adequately circumscribed of the two names. Miller provides a generic description in English, and cited, with description, also in English, six species. Trew gave no generic description as such, but validated his name implicitly by reference to previously effectively published generic descriptions, especially those of Ray and Tournefort. Trew also gave two excellent plates of the two species which he accepted and full specific descriptions in Latin and German. Therefore, for purposes of citation I am accepting *Calamintha,* Trew.

Lamarck's circumscription of *Calamintha* on the other hand, is not good, nor does he refer to descriptions by previous authors. The genus may be identified with certainty only by recourse to the included species. Of these, the first two, *C. alpina* and *C. arvensis,* are now placed in *Acinos; C. cretica* is referred to *Micromeria;* and only the last two, *C. parviflora* and *C. montana* are now retained, under earlier names, in *Calamintha* (*C. Nepeta,* (L.) Savi and *C. officinalis,* respectively, fide Bentham "Labiatarum . . ." p. 387–388).

Until the publication of O. Kuntze (Revisio Generum Plantarum, volume 2, pp. 513–516) in 1891, there was little confusion of the two taxa which may be distinguished taxonomically as follows:

[2] Wilmott, A. J.—Kew Bull. *1935* 66.
[3] Little, E. L.—Madrono *7:* 240–242, 1944.

Calamintha	*Clinopodium*
Calyx tubular, straight. Verticellasters on relatively long pedicels, sub-secund.	Calyx tubular, curved. Verticellasters sessile or nearly so.

After the genera were firmly established, with good circumscriptions, by Moench in 1794, in the "Methodus Plantas . . .," they were generally treated as taxa of correlative rank. Bentham treated them as sections of *Melissa*, L. in the "Labiatarum . . ." of 1832–36, and as sections of *Calamintha*, Moench emend. Bentham in the 12th volume of de Candolle's "Prodromus Systematis Naturalis . . ." of 1848. Briquet, in IV Teil, 3 Abteilung, a, of" Die natürlichen Pflanzenfamilien" of 1897, treated them as sections of *Satureja*, L. Neither Bentham nor Briquet considered them synonymous, as did O. Kuntze and Janchen and Neumayer.

Two facts emerge from this discussion. In the first place, *Calamintha* and *Clinopodium*, as originally proposed, and as generally used to 1891, apparently had no species in common. There was, and is today, controversy over the rank of the taxa, but not over their identity or composition. In the second place, the proposal by Janchen is to conserve a poorly circumscribed later name over an adequately circumscribed Linnaean name. Further, the name proposed for conservation is both a later homonym and synonym of earlier names, facts not mentioned by the propositor.

The "International Code of Botanical Nomenclature" (1952), at Article 24, stated: ". . . These names [for conservation] are preferably such as have come into general use in the fifty years following their publication, or which have been used in monographs and important floristic works up to the year 1890 . . ." Up to the year 1890 both *Calamintha*, Moench (non Lamarck) and *Clinopodium*, Linnaeus were in general use for the respective taxa concerned. There was no confusion between them.

Finally, if *Clinopodium*, Linnaeus is declared a *nomen rejiciendum*, those who desire to recognize the taxon which has borne that name as a genus will be faced with the necessity of publishing a new name for it.

For these reasons it is recommended that the proposal for the conservation of the name *Calamintha*, Lamarck, and the rejection of the name *Clinopodium*, Linnaeus not receive favorable action.—BAILEY HORTORIUM, CORNELL UNIVERSITY, ITHACA.

A REVISION OF THE NORTH AMERICAN GENUS SABATIA (GENTIANACEAE)

Robert L. Wilbur

(*Continued from page 71*)

E. Subsection Dodecandrae subsect. nov.[5]

Subg. *Plurimaria* Raf., Med. Fl. **2:** 76. 1830, in part, not *Plurimaria* Raf. (as genus), Fl. Tell. **3:** 31. 1837.

Pleienta Raf., Fl. Tell. **3:** 30. 1837, in part, an illegitimate name since its type, designated by Rafinesque, is the same as that of *Sabatia*.

Sect. *Pleienta* (Raf.) Blake, Rhodora **17:** 56. 1915, an illegitimate name.

Dodecandrae Small, Man. SE. Fl. 1049. 1933, a category of undesignated status.

Rhizomatose perennials with at least the secondary and very often the primary branches alternate. Strongly pronounced tendency towards plurimerous flowers ranging from 5–12(–14)-parted. Flowers typically large and pedicels usually longer than 1 cm. TYPE SPECIES: *Sabatia dodecandra* (L.) BSP.

This subsection contains but four species which, except for one species, are restricted to the Coastal Plain of the United States. *S. calycina* occurs in addition on at least two islands of the West Indies.

S. calycina, I feel certain, has very little in common with the species of subsection *Campanulatae* with which it has been formerly associated. Its proper relationship is more aptly shown by grouping it with the rhizomatose, pluripetalous species of the *dodecandra*-alliance. The strongly pronounced tendency for this species to possess flower-parts more numerous than five, the large, often foliose calyx-lobes, the often conspicuous, elongate rhizome, the broad leaves and the broadly campanulate calyx-tube are features of all or most of the *dodecandra*-group

[5] Subsectio Dodecandrae. Perennes rhizomatibus praeditae. Rami secondarii et interdum primarii alterni. Flores saepe plurimeres, inter 5-partiti et 14-partiti, plerumque in specie una 5–6-partiti, in speciebus aliis ca. 9- partiti, typice grandes, pedicellis quam 1 cm. longioribus. Species typica, Sabatia dodecandra (L.) BSP. (Chironia dodecandra L.)

and are present in none of the species with which it has formerly been allied. I do not feel that the *Dodecandrae* are so much more strongly differentiated than the other subsections as to warrant sectional rank which Blake accorded to them.

Key to the Species of Subsection Dodecandrae

A Calyx- and corolla-lobes 5–6-parted or rarely up to 7; corolla-lobes (0.6–) 0.7–1.3(–1.5) cm. long; cauline leaves spatulate, tapering into a much-narrowed, sometimes almost petiolate base............12. *S. calycina.*

A. Calyx- and corolla-lobes 7–13-parted, usually 9–12 in number, corolla-lobes (1.2–)1.6–2.4(–3.5) cm. long; cauline leaves elliptic, lanceolate, or linear, the median and upper at least not strongly tapering into an almost petiolate base.

B. Upper cauline leaves less than the diameter of the stem or but little wider, very narrowly linear, contrasting strongly with the broadly spatulate, rosulate, basal leaves; leaves thick and succulent, often drying somewhat rugose; the larger roots succulent; calyx-lobes strongly subulate, often succulent and even semicircular in cross-section......................................15. *S. bartramii.*

B. Upper cauline leaves considerably wider than the diameter of the stem, lanceolate, elliptic, or linear; basal leaves often absent, when present linear to lanceolate, and not strongly contrasting with the lower cauline leaves; leaves drying smooth and usually thin in texture; roots fibrous, non-succulent; calyx-lobes linear, thin and flattened in cross-section.

C. Calyx-lobes hyaline-margined; plants strongly stoloniferous; primary branches very often opposite; terminal flower short-pedicellate, usually considerably exceeded by the first internode of the lateral branches arising at the same node............14. *S. kennedyana.*

C. Calyx-lobes not hyaline-margined; stolons usually lacking, if present neither numerous nor strongly developed; primary branches usually alternate; terminal flower typically long-pedicellate, usually about equaling or exceeding the first internode of lateral branch arising at the same node...........................13. *S. dodecandra.*

12. **Sabatia calycina** (Lam.) A. Heller, Bull. Torr. Bot. Club **21:** 24. 1894. *Gentiana calycina* Lam., Encyc. **2:** 638. 1788. *Chironia dichotoma* Walt., Fl. Car. 93. 1788. *C. calycosa* Michx., Fl. Bor.-Am. **1:** 147. 1803. *Sabbatia calycosa* (Michx.) Pursh ex Sims, Curtis's Bot. Mag. *pl. 1600.* 1813. *S. gracilis* var. *cubensis* Griseb., Mem. Am. Acad. **11:** 521. 1862. *S. dichotoma* (Walt.) Trelease ex Branner & Coville, Ann. Rept. Geol. Surv. Ark. 1888. **4:** 204. 1891. *Sabbatia cubensis* (Griseb.) Urb. Symb. Ant. **8:** 536. 1921.

Perennial herb (although flowering the first year) (8–)15–40(–50) cm. high, with a slender to thick rhizome (1–)2–4(–10) cm. long, 1–3 mm. in diameter. Stems usually solitary, or sometimes several and clustered, erect, rigid, smooth above or but very slightly ridged, hollow at least below, (1–)2–3(–4.5) mm. in diameter, branching usually restricted to the upper half or third of the stem but may arise from nearly throughout the entire length. Branches generally alternate but commonly opposite even above along the main stem, ascendent or more typically divaricate, further branching also strongly divergent, thus the plant typically presents a strikingly geniculate aspect, branching usually restricted to the second or third order, usually less than 20 cm. long, bearing but few nodes. Root-system of several to numerous slender, fibrous roots arising from the rhizome or from the base of the stem. Leaves thin, drying very thinly membranous and hence venation conspicuous although only the midvein even slightly elevated beneath. Basal rosette lacking and the lower cauline leaves not conspicuously differentiated in shape from the median or upper leaves and usually the reduction in size is gradual and slight. Leaves ascending or more often strongly spreading, elliptical to broadly spatulate, mostly obtuse but still commonly acute, tapering into a conspicuous, much-narrowed or even petiolate base, (1.5–)2.5–6(–10) cm. long, (4–)10–18(–20) mm. wide. Inflorescence of usually reduced, 1–2-flowered cymules; the flowers appearing loosely arranged and even solitary. Pedicels slender, rigid, inconspicuously 5–7-angled, (1–)3–5(–6) cm. long. Calyx-tube thin, smooth or with veins but very slightly elevated, somewhat scarious or translucent, shallowly crateriform to broadly campanulate, (1.5–)2–4(–5) mm. long. Calyx-lobes oblanceolate to spatulate, or rarely linear, often of unequal size, usually foliaceous, apparently enlarging after pollination, acute to obtuse, thin, membranous, (8–)10–25(–32) mm. long, (1–)1.5–6(–8) mm. wide. Corolla-tube cylindrical, (3–)4–5(–6) mm. long, 2–3 times as long as the calyx-tube, colorless or white to pale pink. Corolla-lobes equaling the calyx-lobes in number, typically 5–6-parted, but occasionally as many as 7, often exceeded in length by the calyx-lobes which are sometimes as much as twice as long, but not uncommonly equaling or even exceeding the calyx-lobes by 1–2 mm., oblong to oblong-spatulate, oblanceolate or elliptic, obtuse or acute, (6–)7–13(–15) mm. long, (2–)3–5(–6) mm. wide, white or more commonly pale rose to pink gradually giving way to white in the area above the triangular, pointed yellow patch at the base of the lobe. Filaments pale yellow, 2–3 mm. long; anthers bright yellow, slender 2.5–3.5 mm. long. Style 1–2 mm. long; stigmatic branches 4–6 mm. long. Capsule almost globose or very broadly cylindrical, 6–10 mm. high, 5–8 mm. in diameter.

Type locality: "Cette plante croît á la Louisiane." Type: the original description states that its author saw it in the herbarium of Jussieu. A photograph in the Gray Herbarium, reputedly of the type, was of a specimen in Lamarck's herbarium.

DISTRIBUTION. Ditches, riverbanks and swampy hardwoods from southeastern Virginia south along the Coastal Plain throughout most of Florida and westward into eastern Texas. Also known from eastern Cuba and the central Cordillera of Hispaniola. Map 12.

In the West Indies this species has been called most often *S. gracilis* var. *cubensis* or *S. cubensis*. However in spite of the geographical isolation and the difference in physiographic provinces, there has not been pointed out previously, nor have I been able to detect from herbarium specimens, any character that distinguishes the West Indian specimens from those from the south Atlantic and Gulf Coastal Plain. The original publication of the insular representatives in a varietal status with the very different *S. gracilis,* which is but a later synonym of *S. campanulata,* by Grisebach, is especially surprising in view of that author's monographic treatment of the family. Grisebach's varietal name was first treated as a synonym by Gray in the Synoptical Flora and this still seems to be the only defensible stand to take in view of the lack of any known morphological differences. Urban did not discuss the evidence, if any, that caused him to decide upon specific status.

Lamarck's publication doubtless has priority over that of Walter as the portion of the former's work in which *Gentiana calycina* appears is usually dated as April, 1788. Fraser, who carried Walter's Flora back with him and arranged for its publication at his own expense, stated (1789, p. 5) that "after having resided in South Carolina and Georgia nineteen months, I returned to England in the month of March 1788. . . ." This would seem to make certain that it was at least several months after the appearance of Lamarck's name before Walter's Flora could have been published.

REPRESENTATIVE SPECIMENS:—VIRGINIA: Isle of Wight Co., Zuni, *Fernald & Long 6349* (GH, PENN); Nansemond Co., near Suffolk, *Kearney 1726* (US); Southampton Co., about Franklin, *Heller 1114* (GH, MO, NY, PENN, US); Sussex Co., west of Lumberton, *Fernald & Long 14386* (GH, MO, TENN). NORTH CAROLINA: Brunswick Co., just w. of Wilmington, *Wilbur 2894* (MICH); Chowan Co., 1.5 mi. e. of Edenton, *Randolph 659* (CU, GH); New Hanover Co., near Wilmington, *Biltmore Herb. 3306c* (NY, US); Onslow Co., 4.5 mi. s. of Jacksonville, *Fox & Boyce 3718* (MICH, NCS); Pender Co., n. of Castle Hayne, *Fox & Boyce 3773* (MICH, NCS); Pitt Co., w. of Grimesland, *Wiegand & Manning 2560* (CU, GH). SOUTH CAROLINA: Berkeley Co., 10 mi. ne. of Moncks Corner, *Godfrey & Tryon 872* (GH, NY, US); Dorchester Co., along the Ashley River, *Correll 5378* (DUKE, NA); Georgetown Co., 1.5 mi. w. of Andrews, *Godfrey & Tryon 555* (DUKE, F, MO, NY, TENN, US); Horry Co., Myrtle Beach, *Coker,* 29 July 1946 (NCU, NY); Williamsburg Co., s. of Kingstree, *Wiegand & Manning 2562* (CU, GH). GEORGIA: Baker Co., in western portion of county, *Eyles 7185* (DUKE, GH); Dougherty Co., vicinity of Albany, *Pollard & Maxon 532* (NY, US); Early Co., about 4 mi. se. of Blakely, *Harper 1910* (F, GH, MO, NY, US). FLORIDA: Alachua Co., River Sink, *Murrill,* 21 May 1939 (MO, US); Columbia Co., without exact locality, *Hitchcock,* 1898 (F, MO); Duval Co., near Jacksonville, *Curtiss 4373* (F, MO, NY, US); Lake Co., Eustis, *Nash 2063* (GH, MICH, MO, MT, NY, US); Levy Co., Rosewood, *Garber,* June 1886 (BRU, F, NY, US, YU); Orange Co., 7 mi. se. of Fort Christmas, *O'Neill* 25 June 1925 (FLAS, US); St. Johns Co., near Tocoi, *Curtiss 2230* (CU, F, FLAS, GH, MO, NY, SMU, US, YU). ALABAMA: Mobile Co., Magazine Point, *Dougan*, 19 June 1914 (MO). LOUISIANA: Calcasieu Parish, vicinity of Lake Charles, *Allison 324* (NY, US); East Baton Rouge Parish, near Baton Rouge, *Joor*, 22 May 1874 (F); Orleans Parish, New Orleans, *Drummond 222* (GH, K). TEXAS: Harris Co., Houston, *Hall 510* (BRU, F, GH, MO, NY, US). CUBA:—Oriente Province: Monte Verde, *Shafer 8719* (NY, US); in Cuba Orientali, *Wright 412*, 1856–57 (TYPE-NUMBER of *S. gracilis* var. *cubensis*) (F, GH, MO, NY). DOMINICAN REPUBLIC: Cordillera Central, Prov. de la Vega, Constanza, in Cienaga de los Hoyos, c. 1200 m., *Ekman 13919* (GH, MO, NY, US); prope Farabocoa, c. 550 m., *Fuertes*, June 1912 (GH); prope Constanza, *Türckheim 3368* (GH, MO, NY, US); Cordillera Central, Prov. de Azua, Valle del Yanque, *Ekman 13700* (NY).

13. **Sabatia dodecandra** (L.) BSP., Prel. Cat. N. Y. 36. 1888.

Perennial herb (10–)30–70(–100) cm. high, with a slender to robust, often somewhat branched rhizome 4–10(–15) cm. long, 2–4 mm. in diameter. Stems solitary or several arising in a cluster, erect, terete and smooth or somewhat angular and slightly ridged, hollow, (1–)2–3(–4) mm. in diameter. Branches usually restricted to the upper third or half of the stem, typically alternate, or more rarely, on unusually robust plants, the primary sometimes opposite; ascendent to strongly spreading, forming an angle of from 30–70 degrees with the stem, 5–15(–20) cm. long, rigid. Root-system of slender, definitely non-fleshy, wiry roots 5–10 cm. long and generally considerably less than 1 mm. in diameter. Commonly, especially in the south, with one to few, slender, superficial rhizomes, or more rarely stolons, 2–10 cm. long, 1–2 mm. in diameter bearing small rosettes of few to numerous, thin, slender, oblanceolate, obtuse to acute leaves 1.5–4 cm. long. Basal rosettes absent from the base of the aerial stem, the lower cauline leaves neither densely clustered nor strongly contrasted in either size or shape with those borne several nodes higher up on the stem. Cauline leaves spreading to ascendent, non-succulent, in texture drying from thin and membranous to even somewhat thick and chartaceous, smooth, not rugose, with 1–2 pairs of usually inconspicuous veins paralleling the midvein which is typically elevated beneath; leaves only gradually reduced above, in length ranging from twice exceeded by the internodes to 3–4 (or more) times surpassed by them, lanceolate, linear, elliptic, or oblong, acute to obtuse, clasping to merely sessile, (1.5–)2.5–4(–7) cm. long, (4–)5–12(–20) mm. wide; the lowermost sometimes narrowly spatulate with long tapering almost petiolate base. Inflorescence almost invariably of 1–several, reduced, 1–2-flowered cymules but rarely complete with three flowers; the flowers loosely arranged and thus appearing solitary on erect, rigid, slightly angled pedicels (1–)3–6(–11) cm. long and about 1 mm. in diameter. Calyx-tube crateriform, somewhat turbinate or campanulate, with nerves typically somewhat elevated, (1.5–)2–3(–4) mm. long, usually green but sometimes straw-colored. Calyx-lobes thin, flat, drying smooth, linear, narrowly oblanceolate or even spatulate, ranging from rather inconspicuous to large and somewhat foliaceous, acute, (0.4–) 0.8–1.8(–2) cm. long, one-fifth as long to slightly exceeding the corolla in length, 1–2.5 mm. wide. Corolla-tube (4–)5–7(–8) mm. long, usually 2–4 times the length of the calyx-tube. Corolla-lobes (7–)9–12(–13) in number, elliptic, oblanceolate, or oblong, acute to obtuse, (1.2–)1.6–2.4(–3) cm. long, (3–)5–8(–10) mm. wide, usually not overlapping each other when fully expanded, deep rose-purple, rose-pink, pink, or more rarely white, with oblong to somewhat triangular yellow patch at base of lobe, the patch sharply 3-lobed or even irregularly toothed, usually bordered by thin red line except in albinos. Anthers bright yellow, slender, 3–5 mm. long; filaments yellow, slender, 3–5 mm. long. Stigmatic lobes slender, 5–9 mm. long; style 3–5 mm. long. Capsule cylindrical, 6–10 mm. high, 4–6 mm. in diameter.

Some indication of the considerable variation within this species may be deduced from the fact that in the past fifty years three species have been segregated from it. The variation is such, that with but a few sheets upon which to base their conclusions, it is not surprising that the various authors have been convinced of the distinctness of the entities that they were publishing. The several hundred specimens of this species examined by me from nearly one hundred stations extending from Connecticut to Louisiana are quite diverse and at the same time it is all but impossible to define any of the various tendencies that have attracted the interest of botanists in the past.

After the belated recognition of the specific status of the entity formerly called *S. decandra* in 1900, the next species to be segregated from the all-inclusive *S. dodecandra* (= *S. chloroides*) was *S. foliosa* Fern. in 1902. What eventually became a syntype of this species was sent to the Gray Herbarium by the collector, A. H. Curtiss, who afterwards distributed the duplicates as *S. chloroides* according to the determination of Fernald. The latter became more impressed with the features of the southern plant after observing similar variation in specimens collected by J. Donnell Smith in South Carolina. He described it as a species especially emphasizing the (1) more stoloniferous habit, (2) leaves equaling the internodes, (3) foliaceous calyx-lobes. The calyx-lobes in both the numerous duplicates collected by Curtiss and those of Smith are certainly large, ranging in size from one-half or more commonly three-quarters as long as the corolla-lobes or in a few instances even exceeding them. This character has proven most variable and the variation is so great within the same colony and even on the same plant that it is of but little diagnostic importance. For example, the variation of large series of specimens collected (*Webster & Wilbur 3583*) along the eastern bank of the Blackwater River just across from Milton, Florida, the locality from which one of the syntypes was collected, ranges rather uniformly between having calyx-lobes one-fifth to about three-quarters as long as the corolla-lobes.

Small (1903) proposed another species based largely upon two collections from central Georgia which he called *S. harperi*, in honor of the original collector. The supposed distinguishing characters were calyx-lobes less than half the length of the corolla and supposed features of the leaf which are in reality highly variable. Small restricted the range of *S. foliosa* to Florida and Alabama which excluded one of the syntypes. *S. harperi* was said to range from South Carolina to Florida and west to Louisiana. In the previous month Harper, in his account (Bull. Torrey Club **30**: 338–339. 1903) of these same collections, referred to them as *S. foliosa* upon the authority of Fernald who had examined them. Harper pointed out at that time that "the two species (i.e., *S. foliosa* and *S. dodecandra*) are very closely related differing perhaps in habitat as much as in any other way" in that "*S. dodecandra* seems to be mostly a maritime plant, while the usual home of *S. foliosa* is in creek and river swamps." Fernald had informed Harper also that *S. dodecandra* was not represented in the Gray Herbarium from south of North Carolina and this restricted range was presented in the Seventh Edition of Gray's Manual.

Blake (1915) concluded that *S. foliosa* and *S. harperi* were conspecific. At the same time he proposed a new species, *S. obtusata*, from central Georgia. The distinctive features were said to be oblong leaves with rounded apices and non-clasping bases which nearly equaled the internodes. He emphasized that *S. foliosa* (including *S. harperi*) had "considerably longer calyx-lobes" and the sketch accompanying the description of *S. obtusata* showing part of the type indicates that the calyx-lobes extend barely one-third the length of the corolla. None of the supposed differences pointed out by Blake is distinctive, as they are but minor variations which are well within the range of variability of the southern population. Several of these features appear within the individual sheets taken from one stand. The diagnostic importance of clasping versus sessile leaves has been overemphasized in the past. Robustly developed plants throughout the range of the species may possess clasping or semi-clasping leaves.

In the last edition of Gray's Manual (1950), the range and habitat of *S. dodecandra* was stated as "saline, brackish or rarely fresh marshes and meadows, Fla. to La., n. on or near Coastal Plain to s. Ct." However, of all the many sheets that Fernald annotated, mostly in 1916, there is only one from south of North Carolina that he considered at that earlier date to be *S. dodecandra* and that, a very fragmentary specimen of Buckley from Alabama, seems quite inadequate for satisfactory determination. In spite of a return to the extensive range for *S. dodecandra* by Fernald, it is not certainly to be inferred that he had necessarily abandoned any attempt to distinguish the entities since fresh-water habitats are implied by Fernald to be the exception for the species which is anything but the case in the South.

I am convinced that it is impossible to recognize *S. dodecandra, S. foliosa, S. harperi,* and *S. obtusata* as four distinct entities regardlesss of rank. In general, the material examined from stations ranging from Connecticut to just north of Charleston, South Carolina, is characterized by having the internodes from half-again to twice or more as long as the leaves and this variety seems for the most part to be rather closely restricted to brackish habitats or at least seldom gets very far from the coast. The variety that occurs from South Carolina to Florida and westward to Louisiana is characterized by having shorter internodes which rarely exceed one and a half times the length of the leaves and more often than not are equaled or exceeded by them. Its habitat is inland along river banks and borders of ditches and streams. Most of the specimens examined have been easily separable by this morphological criterion and by several additional tendencies that are little more tangible than the "certain indescribable grace" of E. L. Greene. Rather unsatisfactory specimens were seen from St. Vincent Island and Tampa Bay, Florida, which have been tentatively determined as *S. dodecandra*, the only specimens so identified by me from south of South Carolina. From the southeastern corner of this last-mentioned state three collections are available and they, too, leave considerable to be desired in the matter of providing an ample basis for positive determination. There are few complete or even modern collections known from Alabama, none at all from Mississippi, and but very few from Louisiana.

In spite of the obvious need for intensive fieldwork and an accumulation of numerous well-prepared collections from throughout the entire range of the species before this group will be satisfactorily understood, it is believed that the treatment suggested here will serve as a more natural and at the same time more useful arrangement until this necessary research is accomplished and may prove a better point of departure than previously has been available.

Key to the Varieties of S. dodecandra

Internodes usually exceeding the leaf in length, commonly 1.5 to 3 times longer than the leaf; stolons rarely present but if present then only weakly developed; plants usually of brackish habitats, coastal from Connecticut to South Carolina (and perhaps locally to Florida) 13a. *S. dodecandra* var. *dodecandra*.

Internodes usually equaled in length by the leaf or nearly so, commonly less than the leaf in length and very rarely exceeded by it as much as 1.5 times; stolons commonly present and often numerous and well developed; plants of river-banks, ditch and stream margins, inland from South Carolina to Louisiana............................13b. *S. dodecandra* var. *foliosa*.

13a. **Sabatia dodecandra** (L.) BSP., var. **dodecandra**

Chironia dodecandra L., Sp. Pl. 190. 1753. *Chlora dodecandra* (L.) L., Syst. Nat. ed. 12. **2:** 267. 1767. *Chironia chloroides* Michx., Fl. Bor. Am. **1:** 147. 1803. Illegitimate as it was merely a substitute name. *Sabbatia chloroides* (Michx.) Pursh, Fl. Am. Sept. **1:** 138. 1814. *S. dodecandra* (L.) BSP., Prel. Cat. N. Y. 36. 1888. *Pleienta leucantha* Raf., New Fl. **4:** 92. 1838. *P. dodecandra* (L.) Raf. ex B. D. Jackson, Ind. Kew. **2:** 561. 1894.

Rarely stoloniferous and stolons when present scarcely developed; internodes usually exceeding the leaf in length, commonly 1.5–3 times longer. type locality: "in Virginia." Type: *Clayton 120* (British Museum); Phototype seen in collection of Gray Herbarium. distribution: Salt or brackish marshes from Connecticut south along the coast into South Carolina and perhaps locally to Florida. Map 13.

representative specimens:—connecticut: Middlesex Co., Saybrook, *Thompson*, 20 Aug. 1891 (ny). new york: Rockland Co., Iona Island, *Muenscher & Curtis 5939* (cu); county unknown, Long Island, White Mills, *Poggenburg*, Aug. 1886 (GH). NEW JERSEY: Atlantic Co., Port Republic, *Long 10486* (GH); Bergen Co., Hackensack marshes, *Eaton*, Sept. 1860 (YU); Burlington Co., New Gretna, *Chrysler*, 30 Aug. 1926 (CU, RUT); Cape May Co., first of Fishing Creek Bogs, *Walker 1653* (NA, US); Hudson Co., Granton, *Sickle*, 1 Aug. 1894 (US); Monmouth Co., Avon-by-the-Sea, *Kaufman*, 25 Aug. 1904 (YU); Ocean Co., east of Silverton, *Long 38148* (PENN). DELAWARE: Sussex Co., s. of Rehoboth Beach, *Hood 2378* (FLAS). MARYLAND: Anne Arundel Co., Furnace Branch, *Plitt*, 5 Aug. 1902 (GH); Caroline Co., between Choptank River and Bethlehem, *Killip 7279* (US); Cecil Co., ca. 1.5 mi. s. of Elkton, *Long 57046* (GH); Charles Co., Stump Neck, *Turpin 474* (US); Harford Co., 0.25 mi. n. of Bush River Station, *Shull 344* (GH, MO, NY, US); St. Marys Co., St. Marys River 3.7 mi. from St. Mary, *Walker 3888* (US); Somerset Co., Kings Creek, *Holmes*, 24 July 1890 (US); Talbot Co., 5.5 mi. se. by s. of Easton, *Earle 3075* (PENN, WVA); Wicomico Co., Salisbury, *Smith 302* (MT, NY); Worchester Co., Stockton, *Rusby*, Aug. 1889 (NY). VIRGINIA: Fairfax Co., near mouth of Occoquan Creek, *Ulke*, 1 Aug. 1910 (US); James City Co., about 5 mi. from Toano, *Menzel 193* (GH); Nansemond Co., s. of Reid's Ferry, *Fernald & Long 13423* (GH, US); Norfolk Co., near Northwest, *Fernald & Long 13997* (GA, GH, MO); Princess Anne Co., Cape Henry, *Egler & Ryan 40–183* (NY). NORTH CAROLINA: Carteret Co., between Core Creek and Adam's Creek, *Hill 171* (DUKE); Chowan Co., near Edenton, *Godfrey 5346* (GH, US); Craven Co., 2 mi. sw. of James City, *Randolph 862* (CU, GH); Currituck Co., marsh at Sligo, *Godfrey 5279* (DUKE, GH, US); Dare Co., Kill Devil Hills, *Fox 144* (MICH, NCS); New Hanover Co., Carolina Beach, *Biltmore Herb. 3305c* (GH, MICH, MO, NCU, NY, PENN, US); Pasquotank Co., Elizabeth City, *Kearney 1996* (US); Tyrrell Co., Fort Landing, *Radford 4622* (NCU). SOUTH CAROLINA: Charleston Co., north of McClellanville, *Godfrey & Tryon 722* (DUKE, F, GH, MICH, MO, NY, PENN, TENN, US). FLORIDA: Franklin Co., St. Vincent Island, *McAtee 1835A* (US); Hillsborough Co., Tampa Bay, *Leavenworth* (GH, NY). The material upon which these Florida stations are reported is rather unsatisfactory for certain identification but they seem to belong to the otherwise more northern population.

13b. **Sabatia dodecandra** (L.) BSP., var. **foliosa** (Fern.) comb. nov.

Sabbatia foliosa Fern., Bot. Gaz. **33:** 155. 1902. *S. Harperi* Small, Fl. SE. U. S. 928. 1903. *Sabatia obtusata* Blake, RHODORA **17:** 54 *pl. 112.* 1915.

Commonly stoloniferous and the stolons often numerous and well-developed; internodes usually equaled or exceeded by the leaves, commonly the leaves as much as 1.5 times as long as the internodes. TYPE LOCALITY: "Muddy banks of the Blackwater River, near Milton, Florida." Syntype and lectotype: *Curtiss 5928* (GH). DISTRIBUTION: River banks, ditches and stream and pond margins inland from South Carolina southward into northern Florida and westward into Louisiana. Map 13.

REPRESENTATIVE SPECIMENS: SOUTH CAROLINA: Beaufort Co., Bluffton, *Mellichamp*, 1887 (US); Berkeley Co., 10 mi. ne. of Moncks Corner, *Godfrey & Tryon 876* (DUKE, F, GH, MO, NY, PENN, TENN, US); Charleston Co., 17 mi. w. of Charleston, *Duncan 5802* (GA); Colleton Co., Cottageville, *Hunt 1648* (CHARL, MICH,); Jasper Co., Ridgeland, *Mohr*, 14 Nov. 1893 (US); Marion Co., east of Nichols, *Wiegand & Manning 2561* (CU, GH); Orangeburg Co., North

Edisto River, *Smith*, 9 Aug. 1884 (F, GH, MO, US); Williamsburg Co., 6 mi. s. of Kingstree, *Godfrey & Tryon 369* (DUKE, F, GH, MICH, MO, NY, PENN, TENN, US). GEORGIA: Bullock Co., swamp of Big Lott's Creek, *Harper 964* [SYNTYPE of *S. harperi*] (GH, MO, NY, US); Candler Co., 6 mi. ne. of Metter, *Pyron & McVaugh 713* (GA, US); Charlton Co., Traders Hill, *Wright 878* (CU); Decatur Co., between Forest Falls and Bainbridge, *Harper 1196* [SYNTYPE of *S. harperi*] (GH, MO, NY, US); Dodge Co., between Copeland and Rhine, *Harper 1876* (F, GH, MO, NY, US); Early Co., about 2 mi. e. of Restler, *Harper 1912* (F, GH, MO, NY, US); Grady Co., about 4 mi. w. of Whigham, *Wise*, 30 June 1940 (FLAS); Jenkins Co., about 3 mi. w. of Millen, *Pyron & McVaugh 968* (GA, US); Laurens Co., 12 mi. s. of Wrightsville and 6 w. of Adrian, *Pyron & McVaugh 3056* (GA, NA); Long Co., 3 mi. sw. of Ludowici, *Wilbur & Webster 2756* (MICH); McIntosh Co., Darien, *Wiegand & Manning 2564* (CU); Mitchell Co., 12 mi. ne. of Camilla, *Thorne 5784* (CU); Montgomery Co., north of Mt. Vernon, *Harper 1866* (F, GH, MO, NY, US); Telfair Co., near Lumber City, *Biltmore Herb. 3305d* [TYPE-number of *S. obtusata*] (US). FLORIDA: Gadsen Co., sw. of Havana, *Small, Small & DeWinkeler 11387* (NY, US); Jefferson Co., 2 mi. nw. of Lamont, *Webster & Wilbur 3631* (MICH); Madison Co., 1 mi. w. of Greenville, *Wiegand & Manning 2565* (CU, GH); Nassau Co., Boulogne, *Hume & West*, 14 July 1933 (FLAS); Santa Rosa Co., near Milton, *Curtiss 5928* (CU, FLAS, GH-SYNTYPE of *S. foliosa*, KSC, MO, NCU, NY, SMU, US); Taylor Co., 14 mi. nw. of Perry, *Webster & Wilbur 3635* (MICH). ALABAMA: Mobile Co., Mobile, *Harvey* (US); Dallas Co., Selma, *Biltmore Herb. 3305a* (US); Washington Co., 2 mi. s. of Wagarville, *Webster & Wilbur 3496* (MICH). LOUISIANA: Calcasieu Parish, Lake Charles, *Tracy 3453* (F); St. Landry Parish, Opelousas, *Carpenter* (GH); St. Tammany Parish, vicinity of Covington, *Arsène 11706* (US).

14. **Sabatia kennedyana** Fern., Rhodora **18:** 150. fig. 98c. 1916. *S. Kennedyana*, f. *candida* Fern., Rhodora **18:** 151. 1916. *S. Kennedyana*, f. *encycla* Fern., Rhodora **24:** 180. 1922.

Perennial herb (15–)30–65(–80) cm. high, arising from slender, easily broken rhizome about 2–3 mm. in diameter and up to 12 cm. long. Stems usually solitary or occasionally 2 or more arising together, erect, stiffly rigid, terete, smooth, ridgeless throughout, hollow below, 2–4(–6) mm. in diameter. Branches typically restricted to the upper third or half of the stem, the primary, at least in well-developed plants, typically opposite, additional ramifications, when present, mostly alternate; usually rather strongly ascendent forming an angle of about 20–40(–50) degrees with the stem, generally 5–15(–30) cm. long, slender, rigid, further branching also typically stiffly geniculate. Root-system a dense mass of non-fleshy, very slender, white to straw-colored roots 5–10 cm. long, 1 mm. or less in diameter. Typically with few to several or occasionally with numerous slender, decumbent stolons initiated as superficial rhizomes 2–8(–12) cm. long, 1–2 mm. in diameter, bearing few to several slender roots and at the tip a rosette of numerous, ascendent to erect, usually very narrowly linear or oblanceolate leaves 10–15 times as long as broad, 2–6(–15) cm. long, 3–8(–15) mm. wide, acute to acuminate, strongly long-tapering to the nearly petiolate base. Leaves thin, non-succulent, drying brittle, smooth, thinly chartaceous in texture, venation obscure except for the midvein which is somewhat elevated beneath; the basal leaves, when present, and the lower cauline very similar in size and shape to those of the stolon-borne rosettes; the cauline strongly ascendent and only gradually reduced above, stems almost equally leafy throughout, typically lanceolate or narrowly linear, weakly clasping or sessile, acute to acuminate, slightly callose-tipped, (1.5–) 3–5(–10) cm. long, (2–)4–10(–16) mm. wide, usually about (5–)7–12(–15) times as long as wide, ranging from about (0.5–)2–4(–5) times as long as the internodes. Inflorescence composed of complete or reduced cymules; the terminal flower typically shortly pedicellate and usually greatly exceeded by the first node of the lateral branches. Flowers borne on erect, slender, smooth pedicels (0.5–)1–5(–7) cm. long and about 1 mm. in diameter. Calyx-tube crateriform or shallowly campanulate, thin, smooth or rarely with a few nerves slightly elevated, (2–)3–4(–4.5) mm. long, green to almost straw-colored. Calyx-lobes linear, (5–)6–10(–18) mm. long, 0.5–1.5 mm. wide, thin, very flat in cross-section, acute, slightly hyaline-margined, strongly ascendent, green. Corolla-tube cylindrical, 5–8 mm. long, 2–3 times as long or about 2–4 mm. longer than the calyx-tube, pale yellow without, darker within. Corolla-lobes (7–)9–12 in number, (12–)18–24(–26) mm. long, (4–)7–10(–13) mm. wide, obovate-spatulate, cuneate-obovate, or more nearly oblong, tapering gradually to broad 3–5 mm. base, broadly obtuse or rarely somewhat emarginate, usually overlapping, rose-pink, pink, or rarely white, with an often 3-pointed oblong yellow patch usually about 4–7 mm. long, except in white flowers this area bordered by a dull red to reddish-brown line. Filaments slender, pale yellow, (2–)4–6(–7) mm. long; anthers linear, slender, bright yellow, 3–6 mm. long; style 2–6 mm. long; stigmatic lobes slender, (4–)5–7(–9) mm. long. Ovary rather conspicuously half-exserted from the corolla-tube. Capsule broadly cylindrical, 7–11 mm. long, 4–7 mm. in diameter. TYPE LOCALITY: "shore of Wequawket Pond, Centreville, Barnstable Co., Massachusetts." TYPE: *E. F. Williams s.n.* (GH!). DISTRIBUTION: Sandy and peaty margins of ponds and streams in southern Nova Scotia, eastern Massachusetts, Rhode Island, southeastern North Carolina and northeastern South Carolina. Map 14.

S. kennedyana, recognized only in 1916 as being distinct from the widespread *S. dodecandra*, is a rather easily identifiable entity with as distinctive morphological features as any of the four species within the subsection. It is distinguishable by a combination of several strong tendencies rather than by one or even a few strong and constant features. These characters are: stems almost perfectly smooth and in well-developed specimens the primary branches typically opposite; the terminal flowers, usually short-pedicellate, typically being much exceeded by the first internode of the lateral branches; leaves thin, drying thinly chartaceous, brittle, smooth; corolla-lobes broadest near the tip, more or less obovate-spatulate, calyx-lobes linear and hyaline-margined, thin and flat in cross section; calyx-tube broad, thin, unribbed. Some of these characteristics are shared by other species but the combination is unique. In addition, the frequency of the stolon-borne rosettes and their development in size is much greater in this species than in any of the others within the subsection. Therefore, in spite of the late date of recognition of the distinctness of this species, it appears to be a strongly characterized biological entity and not merely the result of too diligent a study of too few specimens.

When originally described, the plant was known only from Rhode Island and Massachusetts. Four years later Fernald discovered it in Nova Scotia where it is apparently fairly common in Yarmouth County on the southern side of that peninsula. An even greater range extension for this species into southeastern North Carolina and northeastern South Carolina can now be reported. H. L. Blomquist, R. K. Godfrey and I made a large collection of what proves to be this species along the sandy bank of the Waccamaw River in Columbus County, North Carolina in the summer of 1951. After studying these specimens, it was then possible to recognize that a few other collections from the same general area which previously had been rather uncritically passed over as merely abnormal *S. dodecandra* were in reality this species which I had not expected to see from south of the fresh-water ponds of southern New England. Disjuncts between the eastern Carolinas or southeastern Virginia and Delaware, New Jersey or New England are numerous but examples matching that of *S. kennedyana* are certainly much less common. One species with a somewhat similar distribution as shown by existing records is *Scirpus longii* Fern. This sedge is at present known from one station in eastern North Carolina, again from New Jersey to Massachusetts, and finally reappears in western Nova Scotia. Fernald (Rhodora **45:** 55. 1943.) wrote that this species of *Scirpus* "has shown itself to be an old Coastal Plain type which, like so many other species, became isolated in Nova Scotia before the late Tertiary or early Pleistocene submergence of the continental shelf."

The possibility that the name *S. kennedyana* may be synonymous with *Chironia decandra* Walter is included in the discussion of *S. bartramii* and need not be repeated here. Walter's name had best be treated, it is believed, as a *nomen dubium.*

REPRESENTIVE SPECIMENS:—NOVA SCOTIA: Yarmouth Co., Gravelton, *Fernald & Long 22266* (F, GH, MO, NY, PENN, YU, US). MASSACHUSETTS: Barnstable Co., Harwich, *Fernald* PL. EX. GRAYANAE 387 (in many herbaria); Bristol Co., Dartmouth, *Sturtevant*, 26 July 1889 (CU, F, MO); Essex Co., Newburyport, *Chamberlain*, June 1899 (NY); Norfolk Co., Weymouth, *Seymour 4373* (DUKE, WIS); Plymouth Co., in inundatis ad Plymouth, *Oakes* (GH, NY, US, YU). RHODE ISLAND: Kent Co., Warwick, *Bailey*, 27 July 1883 (US); Washington Co., South Kingston, *Congdon* (MO, NY, YU). NORTH CAROLINA: Columbus Co., between Ash and Old Dock just west of the Waccamaw River, *Wilbur 2892* (MICH); New Hanover Co., Wilmington, *McCarthy*, 1885 (GH, NCU, US). SOUTH CAROLINA: Horry Co., near Ocean Drive, *Schallert*, 12 June 1933 (NY).

15. **Sabatia bartramii** sp. nov.[6] *Sabbatia chloroides* var. *coriacea* Ell., Sk. Bot. S. C. & Ga. 1: 286. 1817. Type (CHARL!). *S. chloroides* var. *flexuosa* Ell., l.c., excluding synonym. Type (CHARL!) ? *Sabbatia chloroides* var. *erecta* Ell., l.c. There is no specimen representing this variety in Elliott's herbarium. The original description is practically a translation of Walter's description of *Chironia decandra*, which is cited in synonymy. ? *Pleienta flexuosa* [Ell.] Raf., Fl. Tell. 3: 30. 1837, without basionym. ? *Sabbatia chloroides* β *stricta* Griseb., Gen. et. Sp. Gent. 125. 1839. The description is again almost word-for-word the same as that of *Chironia decandra* Walt., which Grisebach cited in synonymy. *Sabbatia dodecandra stricta* (Griseb.) Mohr, Bull. Torrey Club **24**: 26. 1897. *Sabbatia decandra* sensu Harper, Bull. Torrey Bot. Club **27**: 432. 1900.

Perennial herb (25–)50–80(–100) cm. high, arising from slender to thick rhizome 4–6 or more cm. long, 3–5 mm. in diameter. Stems almost invariably solitary, erect and rather rigid, terete, more or less smooth and ridgeless or but finely nerved, hollow, 2–5 mm. in diameter. Branches usually restricted to the upper third of the stem, typically alternate but occasionally opposite at one or two of the primary nodes; ascendent usually forming an angle with the stem of from 30–45 degrees, usually 10–20(–40) cm. long, typically unbranched and bearing but one flower, or if branched seldom with more than 2 flowers. Root-system of numerous clustered, fleshy roots 5–12 cm. long, 1–2 mm. in diameter bearing but few, slender, fibrous lateral roots. Leaf-texture thick, succulent, drying rather thickly chartaceous or rarely the lowermost becoming thinly membranous upon drying, venation obscure excepting the midvein which is often elevated beneath, the apices often callous-mucronate. Leaves

[6] Sabatia bartramii sp. nov. Perennes a rhizomatibus. Folia crassa, succulenta, saepissime siccitate plus minusve rugosa; radicalia rosulata, spathulata vel oblanceolata; caulina lanceolata vel linearia, ultima supreme plerumque angustiora quam caulis diametro. Flores plerumque 10–12 partiti, calycis lobis setaceis vel subulatis, succulentis, saepe semiteretibus. Specimen typicum in savanna prope Pensacolam, in Florida, legerunt Webster et Wilbur, sub numero 3577, et in Herb. Universitatis Michiganensis conservatum.

strongly dimorphic in appearance with an abrupt transition from the basal to the cauline; the basal strongly spreading, conspicuously rosulate, oblanceolate, somewhat oblong, or more typically broadly spatulate, strongly but gradually long-tapering to the almost petiolate base, obtuse or rarely acute, (2.5–)4–8.5(–13) cm. long, (4–)12–17(–22) mm. wide; cauline strongly ascendent and becoming even closely appressed, the lower lanceolate but gradually, or even abruptly, reduced to linear or even very narrowly linear above, where their width is often about equal to, or less than, the diameter of the stem, (1.5–)2.5–5(–6.5) cm. long, (1–)2–8(–15) mm. wide. Inflorescence of reduced cymules of commonly one and more rarely more than two flowers borne on slender, rigid, finely ridged pedicels (3–)4–8(–12) cm. long, terminal or arranged on usually undivided lateral branches of one or more rarely of several nodes. Calyx-tube ridgeless, crateriform to campanulate, usually broadly so, occasionally, especially in smaller flowers, somewhat turbinate, (2–) 3–4(–8) mm. long, usually straw-colored in strong contrast to the darkly chlorophyllose lobes. Calyx-lobes typically strongly subulate, (4–)8–12 (–20) mm. long, often rather succulent, usually drying somewhat rugose-thickened, ellipsoidal below to nearly round above in cross-section, often somewhat revolute, erect, strongly ascendent or but weakly spreading, dark green in color. Corolla-tube cylindrical, (5–)6–8(–9) mm. long, usually about 2–3 times as long as the calyx-tube, apparently pale-yellow externally and darker within. Corolla-lobes (8–)10–12(–13) in number, (16–)22–32(–35) mm. long, (5–)7–10(–12) mm. wide, obovate-spatulate or rarely oblong to elliptic, usually broadly obtuse, deep rose-magenta, rose-pink, rose, or rarely white, with an irregularly but slightly toothed, yellow, oblong patch at the base of the lobe 3–5 mm. long, usually bordered by a dark red line. Filaments slender, (3–)4–6(–7) mm. long, pale yellow; anthers linear, slender, golden-yellow, 5–7 mm. long. Style 4–6 mm. long; stigmatic lobes slender, 7–10 mm. long. Capsule ovoid, 6–8 mm. long, 4–6 mm. in diameter. TYPE LOCALITY: savanna about 9 miles west of Pensacola, Escambia Co., Florida. TYPE: *Webster & Wilbur 3577* (MICH). DISTRIBUTION: Savannas or low pine barrens from southern Georgia and Alabama to southeastern Mississippi and nearly throughout Florida except for the extreme southern tip. Map 15.

This very striking species is recognized at once by the strongly subulate calyx-lobes, which are thickened and semicircular in cross-section; the usually somewhat fleshy leaves; the obtuse, spatulate basal leaves contrasting strongly with the abruptly reduced cauline leaves, the uppermost of which are very narrowly linear being little, if any, broader than the diameter of the stem. These features are in very strong contrast with the thin, flat, linear to foliaceous calyx-lobes of the other southern species of the same area whose upper cauline leaves are always at least several times the diameter of the stem. Also the basal rosette of those species is either absent or little developed or, if present, the cauline leaves are only very gradually reduced. The rather high percentage of misidentifications of specimens of this species in the past, or the inclusion of material of other species under its name, has been due largely to the key-differences as presented by Small. The distinction first utilized by him was that of the length of the corolla-lobes. In this species, however, the length overlaps very considerably with the other species of the dodecandra-alliance commonly collected in the area. In the last mentioned work he added another key-distinction, that of the shape of the corolla-lobes, which also was poorly chosen, for that floral structure is also extremely variable.

S. decandra, the name that has designated this species for more than fifty years rests upon a binomial published in Walter's "Flora Caroliniana" (1788). Walter's Flora provides very brief diagnoses of the six species of what was then called *Chironia.* Linnean binomials were applied to three of the entities and new ones provided for the remaining species. The characterization of them all is so brief that one is able to place them no more than tentatively even if quite familiar with the genus. Blake stated (Rhodora **17:** 129. 1915.) that there are now but seven specimens of *Sabatia* in Walter's herbarium, located at the British Museum.

A print has been obtained from the Gray Herbarium of the page bearing all the specimens of *Sabatia* still in Walter's collection. Although the photographic print was not such that absolute determination of all seven existing specimens in the genus could be made, it was more than sufficient to prove conclusively that at present there is among the fragments no material representing the species that we have been calling *S. decandra.*

The seven fragments are tentatively identified from the photograph as follows: 3 specimens of *S. calycina* (Lam.) Heller (= *Chironia dichotoma* Walt.); 2 specimens of *S. difformis* (L.) Druce (= *Chironia lanceolata* Walt.); 1 specimen of *Sabatia dodecandra* var. *foliosa* (Fern.) Wilbur (called *Chironia dodecandra* L. in the Flora); and what appears to be a specimen of *S. stellaris* Pursh (probably passing in Walter's Flora as *Chironia campanulata* L., a species often confused with the annual even by present day authors).

In the absence of an authentic specimen of *Chironia decandra*, one must rely heavily upon the original description which is as follows:

> decandra 6. flor. decemfidis colore dodecandrae, foliis linearibus, caule rigido erecto.

This description, as Harper has admitted (Bull. Torrey Club **27**: 432. 1900.), is to say the least "rather brief." However, Harper concluded that since "there is no known plant in the southeastern states which answers it exactly, and as his name for the species is cited in synonymy by both Elliott and Grisebach, no hesitation is felt in taking it up here." I do not believe that Walter's description is sufficient to limit it to the species to which Harper applied it. The characterization of a 10-parted corolla colored like *S. dodecandra* with linear leaves and an erect, rigid stem fits *S. gentianoides* Ell. equally as well as *S. decandra* in the sense of Harper. There are occasionally encountered specimens of *S. dodecandra* that match the few features mentioned and certainly *S. kennedyana*, which formerly was not known from outside of Nova Scotia and southern New England but is now known to be part of the flora of southeastern North Carolina and northeastern South Carolina, might often be briefly described by those same few words.

The species to which Harper applied Walter's epithet is not as yet represented by a single herbarium specimen from South Carolina. In fact I have seen no specimens from north of the Ogeechee River in Georgia and only one specimen from north of the Altamaha River. Harper reports (Bull. Torrey Club **37**: 595. 1910.) having seen this species from a train window in Hampton County, South Carolina at two different locations. The nearest location represented by a herbarium specimen of the plant called *S. decandra* by recent authors is almost 150 miles from Walter's plantation and even Harper's sight records are nearly 100 miles from the area delimited by Walter.

The preface of "Flora Caroliniana" informs one that almost all of the species described were to be found within a radius of fifty miles of Walter's plantation on the banks of the Santee River near the town of St. Stephen. Fraser (1789) adds to our knowledge of the source of materials included in the Flora in the following manner:

> The botanical description of many of the plants which I found are contained in the Flora Caroliniana; with the author of which, the late Mr. Walter, I became acquainted soon after my arrival in Carolina. He had collected, when I went into that country, plants which afforded him six hundred and forty descriptions. I increased his work, by the specimens I produced to him, to one thousand and sixty; amongst which are upwards to *two hundred new species*, and *thirty new genera;* of all which, as well as the other plants in the Flora, I have now dried specimens in my possession, and many valuable living plants. Many of the most valuable specimens and living plants I collected are still remaining in my hands undescribed.

Fraser by his own account spent nineteen months on this trip and collected over thirty thousand specimens. During his travels he ranged "from the south boundaries of Georgia to the northward of Carolina." Upon these journeys he would have had ample opportunity to encounter the numerous species that have puzzled botanists in the past since those species at present are not known from Walter's neighborhood or even from South Carolina. Even so it would appear that most of Fraser's additions to the flora came from the limited area prescribed by Walter.

Lacking authentic material of *Chironia decandra* and in view of the extremely brief and inconclusive original description, it is now impossible to determine the identity of the name. The description is so generalized that it is equally applicable to at least two species known from the area from which most of the specimens in the Flora are stated to have been found.

For the reasons stated above I feel that the assignment of Walter's epithet to the pluripetalous southern perennial with subulate calyx-lobes is not justified by the available evidence. I am naming this plant *Sabatia bartramii.* William Bartram prepared an unmistakable sketch of the upper portion of this species which has recently been reproduced (Amer. Phil. Soc. Trans. **33:** Plate XXIV. 1943.). It is quite possible that the *nomen nudum* mentioned by Bartram in his "Travels" was this species. More than sixty miles south of the Altamaha River, according to his own estimate, he describes crossing a land of "high open forest of stately pines, flowering plains, and extensive green savannas, chequered with the incarnate *Chironia pulcherrima,* and *Asclepias fragrans* . . ."

REPRESENTATIVE SPECIMENS:—GEORGIA: Appling Co., near Baxley, *Biltmore Herb. 14965b* (US); Baker Co., near Bethany, *Eyles 7247* (CU, GH); Brantley Co., 3 mi. e. of Nahunta, *Wilbur & Webster 2746* (MICH); Bryan Co., about 2 mi. w. of Pembroke, *McKay*, 14 Aug. 1930 (MICH); Calhoun Co., 5 mi. e. of Arlington, *Thorne 5444* (CU, GA); Charlton Co., near Saddlebag Pond, *Wright 871* (CU); Clinch Co., 4 mi. e. of Homerville, *Eyles 6331* (GA); Cook Co., 0.5 mi. se. of Sparks, *Wilbur & Webster 2691* (MICH); Miller Co., in sw. corner of county just north of Donalsonville, *Duncan 6755* (MICH); Sumter Co., without exact locality, *Harper 461* (F, GH, MO, NY, US); Ware Co., 5 mi. se. of Waycross, *Wilbur & Webster 2737* (MICH). FLORIDA: Alachua Co., Waldo, *West*, 14 June 1927 (FLAS); Baker Co., 9 mi. s. of Macclenny, *West & Arnold*, 12 July 1946 (FLAS); Bay Co., 8 mi. n. of Lynn Haven, *Webster & Wilbur 3623* (MICH); Broward Co., Ft. Lauderdale, *Eaton 798* (F, GH); Clay Co., 2 mi. n. of Goldhead Branch State Park, *West & Arnold*, 15 July 1947 (FLAS); Collier Co., near Fort Shackleford, *Small 8340* (DUKE, GH, NY, TENN, US); Dade Co., Humbugus Prairie, *Small, Mosier, & Small 6885* (NY); DeSoto Co., without exact locality, *Schallert*, 29 July 1940 (UARK); Dixie Co., s. of Oldtown, *West & Arnold*, 11 Aug. 1937 (FLAS); Duval Co., Baldwin, *Nash 2250* (F, GH, MICH, MO, NY, US); Escambia Co., 9 mi. w. of Pensacola, *Webster & Wilbur 3577* (MICH); Flagler Co., near Andalusia, *Arnold*, 25 June 1942 (FLAS); Franklin Co., near Apalachicola, *Biltmore Distrib. Chapman Herb. 3305b* (GH, NY, US); Gulf Co., 7 mi. n. of Port St. Joe, *Small & West*, 8 Aug. 1935 (FLAS); Hardee Co., near Limestone, *Kirk*, 8 July 1942 (FLAS); Hernando Co., Bayport, *Jones 76* (CU, US); Lee Co., about 8 mi. se. of Fort Myers, *Standley 447* (F, GH, MO, US); Levy Co., 14 mi. se. of Chiefland, *Webster & Wilbur 3640* (MICH); Manatee Co., Manatee River, *Rugel 155* (MO, US); Nassau Co., 0.5 mi. s. of Callahan, *Wright 873a* (CU); Orange Co., without exact locality, *Fredholm 5374* (GH, US); Osceola Co., Kissimmee, *Eaton 1062* (F, GH); Palm Beach Co., 1 mi. n. of Lake Park, *Hannon*, 12 June 1948 (FLAS); Pasco Co., south of Denham, *Hood 3572* (FLAS); Polk Co., Polk City, *McFarlin 5979* (MICH, TEX); St. Johns Co., St. Augustine, *Garber*, July 1876 (US); Sarasota Co., Myakka, *Barrett 45* (US); Volusia Co., near Seville, *Curtiss 6843* (GH, KSC, MO, NA, NY, US); Wakulla Co., 1.5 mi. s. of Sopchoppy, *Webster & Wilbur 3629* (MICH); Washington Co., 4 mi. w. of Chipley, *Webster & Wilbur 3611* (MICH). ALABAMA: Baldwin Co., 1 mi. n. of Stapleton, *Webster & Wilbur 3522* (MICH); Mobile Co., Crichton, *Sawada*, 18 Aug. 1933 (NY); Monroe Co., Claiborne, *Blanton 53* (GH, MT, NO, NY, OKLA, US). MISSISSIPPI: Jackson Co., about 4 mi. e. of Moss Point, *Webster & Wilbur 3466* (MICH).

II. Section PSEUDOCHIRONIA Griseb., Gen. et Sp. Gent. 125. 1839.

Subg. *Plurimaria* Raf., Med. Fl. **2:** 76. 1830, in part, not *Plurimaria* Raf. (as genus), Fl. Tell. **3:** 31. 1837.

Pleienta Raf., Fl. Tell. **3:** 30. 1837, in part, an illegitimate name since its type is the same as that of *Sabatia*.

Lapithea Griseb., Prodr. **9:** 48. 1845.

Subg. *Pseudochironia* (Griseb.) Blake, RHODORA **17:** 56. 1915.

Annuals. Floral parts plurimerous, 7–12-parted. Flowers sessile or very nearly so and borne either solitarily or more typically in compact, capituliform cymules. Anthers about half-twisted laterally even prior to pollen-discharge and never becoming revolute. TYPE SPECIES: *Sabatia gentianoides* Ell.

The two species comprising this group are very strongly differentiated from the other eastern American species belonging to the subtribe *Erythraeinae* with strongly bilobed, linear stigmatic branches. Their distinctive features are such that Grisebach, after first placing the only species known to him in his section *Pseudochironia* coordinate with all the other species, finally six years later decided upon generic status calling it *Lapithea*. Bentham (1873) maintained this group as the genus *Lapithea* as did Gilg (1895). Small treated the group as of generic rank in all of his work. Blake (1915) discussed the differences and concluded that "the group is better treated as of subgeneric value." Subgeneric status still seems to express best the phylogeny and relationship of the group without belittling the distinctive features that so distinguish the two species from all others in the genus. The two groups of species are here considered to be of sectional rank.

The two species are both very easily distinguished from the species comprising the rest of the genus and also from each other. *S. capitata*, known only from the ancient Appalachian highlands, is believed to be more primitive than the Coastal Plain *S. gentianoides* which possesses greatly reduced and modified foliage in comparison to that of the supposedly more primitive species.

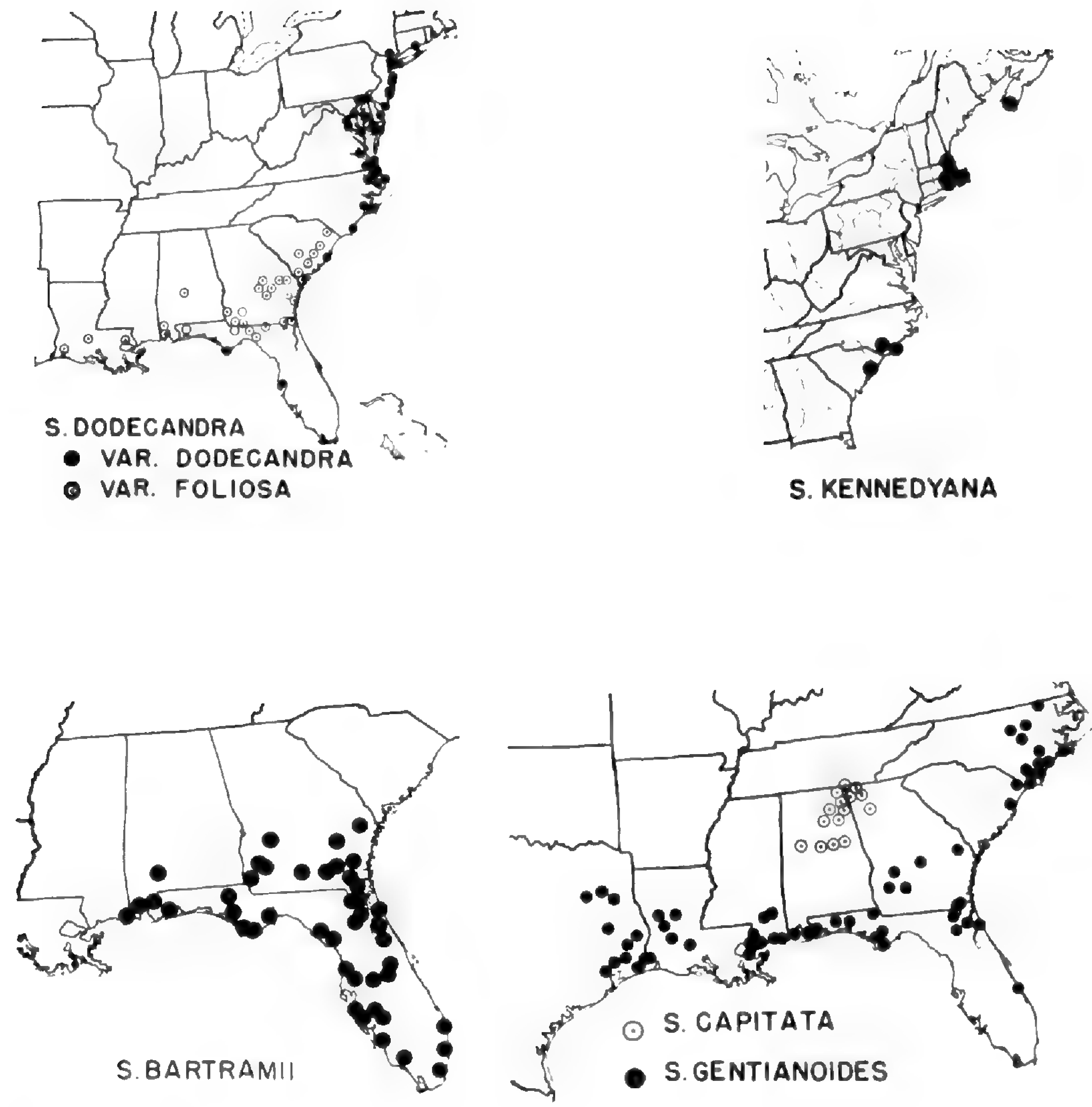
Key to the Species of Section Pseudochironia

A. Basal and cauline leaves not strongly contrasted in either size or shape; cauline leaves oblong, elliptic, or rarely weakly lanceolate, usually broader than 1 cm. and never less than 5 mm. wide, several to many times the diameter of the stem in width; calyx-lobes linear, their margins parallel for most of their length, erect .... 16. *S. capitata*.

A. Leaves strongly dimorphic, the basal strongly contrasting to those of the stem in both size and shape; cauline leaves very narrowly linear, less than 5 mm. wide, usually equaling or less than the diameter of the stem, 20–60 times longer than broad; calyx-lobes subulate, the tips often recurved or reflexed...................................... 17. *S. gentianoides*.

16. **Sabatia capitata** (Raf.) Blake, Rhodora **17:** 54. 1915. *Pleienta capitata* Raf., Fl. Tell. **3:** 30. 1837. *Sabbatia Boykinii* A. Gray in Chapm., Fl. S. U. S. 354. 1860. *S. gentianoides* β *Boykinii* (A. Gray) Wood, Am. Bot. & Flor. 266. 1870. *Lapithea Boykinii* (A. Gray) Small, Fl. SE. U. S. 929. 1903. *Lapithea capitata* (Raf.) Small, Man. SE. Fl. 1051. 1933.

Erect annual (15–)30–45(–70) cm. high; stem 1–4 mm. in diameter, rigid, hollow, more or less terete to slightly 4-angled, smooth or often, upon closer examination, with few, very slightly raised lines extending between the internodes. Branches usually present except in depauperate plants, either opposite or alternate but in well-developed plants probably more commonly opposite, often restricted to the upper third of the stem



Maps 13–16. Map 13, upper left; map 14, upper right; map 15, lower left; map 16, lower right.

but occasionally branching nearly to the base, varying greatly in length ranging from (1–)3–8(–30) cm. long, rather strongly ascendent forming an angle of about 20–40 degrees with the stem. Root-system of several to numerous fibrous roots usually about 3–8 cm. long, the larger of which are often somewhat woody and up to 2 mm. in diameter. Leaves weakly if at all dimorphic, the basal not strongly contrasting with the cauline in either shape or size, thin, not at all succulent, drying thin, smooth and brittly chartaceous, venation rather conspicuous with 3–5 nerves at least somewhat elevated beneath, the midvein especially so; the basal, when present and well-developed, obovate to broadly spatulate, sometimes rosulate, obtuse, tapering to the almost petiolate base, not strikingly contrasted to those above, 2.3–5 cm. long, 1–2 cm. wide, the cauline broadly, or more rarely narrowly, oblong, elliptic, or weakly lanceolate, usually about 2–4 times longer than broad, about 5–15 times as wide as the diameter of the stem, weakly ascending, strongly spreading or even somewhat reflexed, (2.5–)3.5–5(–6.5) cm. long, (7–)10–20(–25) mm.

wide, broadly obtuse or sometimes even acute, typically the base somewhat clasping. Inflorescence cymose, terminating the main stem or the lateral branches. Flowers sessile or very nearly so, borne singly or in few to several (2–5 or very rarely more)-flowered compact clusters. Each flower closely associated with 2 subtending oblong to elliptic bracts about 1–2 cm. long. Calyx-tube broadly campanulate, 3–6 mm. long, smooth, unnerved, membranous. Calyx-lobes linear, 4–10 mm. long, and about 1–2 mm. wide, erect or strongly ascendent, often strikingly unequal, 7–12 in number, about 1–2 times the length of the calyx-tube and about half the length of the corolla. Corolla-tube about 5–7 mm. long or about 1–2 mm. longer than the calyx-tube, probably pale greenish-yellow. Corolla-lobes about 12–25 mm. long, 5–13 mm. wide, elliptical, obovate or spatulate, acute to more typically rounded-obtuse, pale rose-pink, pink, or rarely white with an unlobed, pale yellow semicircle at the base about 1–2 mm. high. Filaments slender, (2–)3–4 mm. long; anthers stout, slightly twisted laterally even prior to pollen discharge, bright yellow, (2.5–)3–5(–6) mm. long. Style 3–5 mm. long; stigmatic branches spatulate, 6–9 mm. long. Capsule apparently ovoid. TYPE LOCALITY: "Unaka and Cherokis Mts." TYPE: unknown. DISTRIBUTION: Open hardwoods on hillsides and ridges in southwestern North Carolina (?), northeastern Georgia, southeastern Tennessee, and northeastern and central Alabama. Map 16.

This species, strikingly different from all others, has by far the most restricted range of any in the genus. It is also the only species which is completely limited to the southern Appalachian uplands, a biological reservoir from which spread much of the ancestral flora of eastern North America.

This species was first discovered in the Unaka and Cherokee Mountains along the southern portion of the boundary between North Carolina and Tennessee and was very fully described by Rafinesque in the "Flora Telluriana" (1837). However, like most of that author's work, it was apparently not given serious attention and the identity of his name was not made known for over seventy-five years. The species was first effectively brought to the attention of "reputable botanists" nearly twenty-five years after Rafinesque's description when it was published as *S. Boykinii* in Chapman's Flora (1860), and attributed to Gray. This was based upon material in Torrey's herbarium sent by Dr. Boykin from "middle Georgia." There it was seen by Gray and according to the annotation was apparently intended as a joint publication of Torrey and Gray. The remaining synonymy of this little collected species involves merely various combinations with either of these basionyms.

REPRESENTATIVE SPECIMENS:—NORTH CAROLINA: County unknown but probably Cherokee Co., "from Cherokee" *collector and date unknown* (MO). GEORGIA: Bartow Co., 3.8 mi. n., 14° w. of Allatoona Dam, *Duncan 8613* (GA); Catoosa Co., Catoosa Springs, *Biltmore Herb. 4512b* (US); Walker Co., Pigeon Mt., *Wilson 172* (NY, US); Whitfield Co., base of Dick's Ridge, *Wilson 142* (NY, US); County unknown, *Boykin* (GH, NY, US, TYPE and ISOTYPES of *S. boykinii*). TENNESSEE: Marion Co., Cumberland Mts. at Whiteside, *White*, 22 July 1895 (US). ALABAMA: Blount Co., without exact locality, *Rugel*, Oct. 1843 (NY); Cherokee Co., Lookout Mt., *Freeman*, 11 July 1905 (KSC); Clay Co., Millerville, *Pollard & Maxon 173* (NY, US); DeKalb Co., Valley Head, *Biltmore Herb. 4512e* (US); Etowah Co., near Coosa River, *Mohr*, July 1880 (US); Jackson Co., Eliza, *Graves 1191* (MO); Marshall Co., 3.2 mi. n. of Boaz, *Hubricht B1668* (FLAS, MO); Shelby Co., Calera, *Everts* (NY); Talladega Co., s. of Childersburg, *Hood 285* (FLAS); Tuscaloosa Co., without exact locality, *Smith*, July (US).

17. **Sabatia gentianoides** Ell., Sk. Bot. S. C. & Ga. **1:** 286. 1817. *Pleienta gentianoides* [Ell.] Raf., Fl. Tell. **3:** 30. 1837, without basionym. *Lapithea gentianoides* (Ell.) Griseb., Prodr. **9:** 48. 1845. *Sabbatia oligophylla* Featherman, Rep. Bot. Surv. S. & Cent. La. 72. 1871.

Erect annual (15–)30–50(–65) cm. high; stem 1–3 mm. in diameter, rigid, hollow, more or less terete but with fine and irregular internodal ridges. Very commonly unbranched below the terminal inflorescence, but when branched, the branches usually restricted to the upper quarter of the stem, occasionally branched in the lower half or even more rarely with several stems arising from the base; commonly either opposite or alternate but more typically alternate, usually about 5–8 cm. long or rarely up to 20 cm., strongly ascendent forming an angle of about 20–40 degrees with the stem. Root-system of several to numerous slender, fibrous roots 3–8 cm. long and less than 1 mm. in diameter. Leaves thick and somewhat succulent, drying rather thickly chartaceous and rugose, strikingly dimorphic, venation obscure except for the midvein; those of basal rosette wide-spreading, oblong to orbicular-spatulate, typically long-persistent, (1–)2–3(–3.5) cm. long, (4–)8–12(–15) mm. wide, usually about 2–3 times as long as wide, obtuse, rather strongly tapering to the base and therefore appearing petiolate; the cauline very narrowly linear, 20–60 times longer than broad, width equaling or less than the diameter of the stem, strongly ascendent and sometimes even appressed especially in the lower portion of the leaf, (15–)40–80(–100) mm. long, 1–3 mm. wide, acute and slightly callous-tipped, sessile or clasping the stem. Flowers sessile or very nearly so, borne singly at the principal apex or at that of the lateral branches, or more typically in more robustly developed plants, especially at the apex of the principal axis, in few to several (2–5 or rarely even 7) flowered compact clusters. Each flower closely associated with 2 subtending, narrowly linear bracts, (1–)1.5–4(–7) cm. long. Calyx-tube broadly campanulate, (3–)4–6(–8) mm. long, smooth and unnerved, membranous, light green to pale yellowish-green. Calyx-lobes conspicuously subulate, (3–)5–10(–17) mm. long, spreading-ascending, arching outward especially at the tip, often unequal in size, 7–12 in number, 1–2 times as long as the calyx-tube, and usually about half or less than half the length of the corolla. Corolla-tube 6–10 mm. long, about 1.5–2 times as long as the calyx-tube, pale greenish-yellow, cylindrical. Corolla-lobes (12–)18–24(–30) mm. long, (4–)6–8(–11) mm. wide, elliptical, spatulate to oblanceolate, acute to obtuse, pink to deep rose with an unlobed greenish-yellow area at the base of the lobe 2–3 mm. high. Filaments slender, short, often about half as long as the anthers, 1–3 mm. long, pale yellow; anthers stout, slightly twisted laterally even prior to pollen discharge, golden-yellow, (3–)4–6(–7) mm. long. Style 5–8 mm. long; stigmatic branches spatulate, 4–7 mm. long, 1.5–3 mm. wide. Capsule ovoid, 7–10 mm. high, about 6 mm. wide at the base. TYPE LOCALITY: "in Bullock Co., Georgia." Type: *Mr. Abbott s.n.* (CHARL!). DISTRIBUTION: Pinelands and savannas along the Coastal Plain from North Carolina south into Florida and west into eastern Texas. Map 16.

This species is unmistakable once the distinctive characteristics of the plant are understood. The combination of a pluripetalous corolla and an annual habit alone set this species off from all the members of Section *Eusabatia.* These two features together with sessile to sub-sessile flowers arranged in capitate to sub-capitate clusters, and the laterally half-twisted anthers (as opposed to revolute) are shared by both *S. gentianoides* and *S. capitata* which together form section *Pseudochironia. S. gentianoides* is not only clearly distinguished morophologically by its strongly dimorphic basal and cauline leaves but also geographically by its restriction to the Coastal Plain which contrasts sharply with the southern Appalachian endemic, *S. capitata.* Elliott's species is one of the most easily recognizable and nomenclatorially least misunderstood of all the species. In spite of this it has been surprisingly often misidentified; ten to fifteen per cent of the specimens that I have seen were misnamed. This is at least in part due to the incomplete ranges published in Small's Flora (1903) "Ga. to Fla." and also in his Manual (1933) "Fla. to Tex. and Ga." The species is known to range from Texas to Florida and northward throughout eastern North Carolina.

That *S. oligophylla* is a synonym of *S. gentianoides* is strongly indicated by the original description and conclusively shown by a water-color plate drawn for Professor Featherman and preserved at the Gray Herbarium. Featherman thought that it differed from *S. gentianoides* for that species "which it seems to resemble, has no bracts." *S. gentianoides* does, of course, possess bracts at the base of each flower.

REPRESENTATIVE SPECIMENS:—NORTH CAROLINA: Bladen Co., on Rt. 211, 2.1 mi. ne. of Columbus Co. line, *Fox & Whitford 1867* (NCS); Brunswick Co., 2.5 mi. s. of Grissettown, *Fox & Godfrey 2836* (GH, MICH, NCS, NCU); Carteret Co., Newport, *Godfrey 5789* (GH, US); Columbus Co., 1 mi. se. of Delco, *Fox & Godfrey 2872* (NCS, SMU); Duplin Co., 8 mi. w. of Richlands, *Godfrey 5784* (GH, US) Johnston Co., s. of Selma, *Dlans*, 28 July 1933 (NCU); Nash Co., between Bailey and Middlesex, *Oosting 35574* (DUKE); New Hanover Co., near Wilmington, *Abbe & Spalteholz*, 3 Aug. 1927 (CU, NCU); Northampton Co., near Jackson, *Rhoades*, Aug. 1935 (GH); Onslow Co., near Folkstone, *Alexander*, 25 July 1923 (NCU); Pender Co., Burgaw, *Godfrey 5924* (GH, NCS, US); Wake Co., just w. of Raleigh, *Fox 1828* (DUKE, GH, NCS). Also represented (F, NY) by specimens reputedly from Statesville, Iredell Co., made by M. E. Hyams. These and other Coastal Plain plants known only from the Piedmont by his collections are suspected of having been gathered in the Coastal Plain and distributed with his printed Statesville labels. SOUTH CAROLINA: Georgetown Co., 12 mi. nw. of Georgetown, *Godfrey & Tryon 745* (DUKE, F, GH, MO, NY, TENN, US); Horry Co., 6 mi. e. of Loris, *Wilbur 2902* (MICH). GEORGIA: Bullock Co., without exact locality, *Abbot* TYPE of *S. gentianoides* (CHARL); Calhoun Co., 3 mi. e. of Cordrays Pond, *Thorne 6476* (CU); Charlton Co., 8 mi. s. of Folkston, *Wright 863* (CU); Dodge Co., Eastman, *Biltmore Herb. 4509c* (NY); Sumter Co., without exact locality, *Harper 1121* (GH, MO, NY, US); Worth Co., 3.5 mi. w. of Sylvester, *Thorne 6350* (F, GA, MT, US). FLORIDA: Baker Co., without exact locality, *Curtiss 2233* (CU, F, MO, NY, US, YU); Bradford Co., w. of Starke, *Bratley & Murrill*, 5 July 1940 (FLAS); Clay Co., Doctor's Inlet, *West & Arnold*, 29 June 1939 (DUKE, FLAS, MO, US); Escambia Co., near Ala. state line, *Porter*, 21 July 1938 (FLAS); Franklin Co., near Apalachicola, *Biltmore Dist. Chapman Herb. 4509a* (GH, NY, US); Gulf Co., Wewahitchka, *Chapman* (MO); Indian River Co., 5 mi. n. of Vero Beach, *Woodson & Schery 126* (MO); Jackson Co., w. of Marianna, *Porter*, 21 July 1938 (FLAS); Liberty Co., near Bristol, *Arnold*, 23 July 1940 (FLAS); Nassau Co., Boulogne, *Hume & West*, 14 July 1933 (FLAS); Okaloosa Co., about 3 mi. e. of Crestview, *Webster & Wilbur 3589* (MICH); St. Johns Co., near St. Augustine, *Garber*, July 1876 (BRU, F, NY, US, YU); Walton Co., Argyle, *Curtiss 6484* (CU, GH, MO, NY, SMU, US). ALABAMA: Baldwin Co., 8 mi. s. of Foley, *Webster & Wilbur 3532* (MICH); Butler Co., near Bolling, *Smith*, 28 Aug. 1885 (F, MO, US); Mobile Co., about 12 mi. sw. of Mobile, *Webster & Wilbur 3478* (MICH). MISSISSIPPI: Forest Co., about 8 mi. se. of Hattiesburg, *Webster & Wilbur 3379* (MICH); Hancock Co., Bay St. Louis, *Langlois*, 12 Sept. 1883 (PENN); Harrison Co., Biloxi, *Tracy 7007* (CU, F, GH, MO, US); Jackson Co., 2 mi. e. of Ocean Springs, *Webster & Wilbur 3450* (MICH); Pearl River Co., Picayune, *Reed*, 2 Aug. 1934 (NA); Perry Co., 9 mi. n. of Beaumont, *Webster & Wilbur 3420* (MICH). LOUISIANA: Allen Parish, Oakdale, *Bomhard*, 22 June 1933 (NO); Calcasieu Parish, 3 mi. sw. of Vinton, *Webster & Wilbur 3212* (MICH): Grant Parish, 4 mi. s. of Pollock, *Webster & Wilbur 3258* (MICH); Natchitoches Parish, about 2 mi. s. of Kisatchie, *Correll 9796* (DUKE); Orleans Parish, New Orleans, *Carpenter* (MO); Rapides Parish, Alexandria, *Hale* (BRU, F); St. Landry Parish, Opelousas, *Carpenter* (GH, NY); St. Tammany Parish, 1 mi. n. of Abita Springs, *Pennell 4150* (PENN); Vernon Parish, 2 mi. w. of Leander, *Webster & Wilbur 3241* (MICH). TEXAS: Hardin Co., Sour Lake, *Tharp*, 29 July 1929 (TEX); Harris Co., Houston, *Hall 509* (BRU, F, GH, MO, NY); Henderson Co., without exact locality, *Tharp 2882* (US); Houston Co., Grapeland, *Palmer 14405* (MO, US); Jasper Co., Jasper, *Fisher 32117* (F); Jefferson Co., Beaumont, *Hooks*, 14 July 1931 (TEX); Liberty Co., 21 mi. se. of Cleveland, *Webster &*

Wilbur 3171 (MICH); Orange Co., Orange, *Letterman,* 11 Aug. 1880 (MO); Rusk Co., without exact locality, *Vinzent 39* (MO); Smith Co., without exact locality, *Tharp,* 5 July 1924 (TEX); Trinity Co., Big Thicket, *Murray,* 1 June 1938 (NA); Tyler Co., 2 mi. n. of Warren, *Webster & Wilbur 3204* (MICH).

Doubtful and Excluded Species

CHIRONIA DECANDRA Walt., Fl. Car. 95. 1788. *Nomen dubium.* See discussion under *Sabatia bartramii* Wilbur.

CHIRONIA PULCHERRIMA Bartram, Bartr. Trav. 19. 1791. *Nomen nudum.*

PLEIENTA FASCICULATA Raf., Fl. Tell. **3:** 30. 1837. *Nomen nudum.*

PLEIENTA QUINQUENERVIA Raf., New Fl. **4:** 91. 1838. Perhaps a synonym of *S. calycina* (Lam.) Heller.

PLEIENTA RIGIDA Raf., Herb. Raf. 80. 1833.

SABBATIA ALBEOLA Raf., Cat. Bot. Gard. Transyl. Univ. 15. 1824. *Nomen nudum.*

SABBATIA AMENA Raf., Fl. Tell. **3:** 30. 1837. *Nomen nudum.* Probably a misprint for *S. amoena* (= *S. stellaris* Pursh).

SABBATIA ANCEPS Raf., Fl. Tell. **3:** 30. 1837. *Nomen nudum.*

SABBATIA AUSTRALIS Cham. & Schlect., Linnaea **1:** 194. 1826. = *Zygostigma australe* (Cham. & Schlect.) Griseb., Gen. et Sp. Gent. 50. 1839.

SABBATIA CENTAURIUM (L.) Raf., Casket 1827: 316. *f.29–1827.* Publication not seen. Merrill (1949) states that this name was based on *Gentiana Centaurium* L. (= *Centaurium umbellatum* Gilib.).

SABBATIA DECANDRA (Walt.) Harper, Bull. Torrey Club **27:** 432. 1900. *Nomen dubium.* See discussion under *S. bartramii* Wilbur.

SABBATIA DECLINATA Raf., Herb. Raf. 69. 1833. *Nomen nudum.* Probably a synonym of *S. stellaris* Pursh.

SABBATIA LINGULATA Raf., Fl. Tell. **3:** 30. 1837. *Nomen nudum.*

SABBATIA NIVEA Raf., Med. Fl. **2:** 77. 1830. Briefly discussed under *S. quadrangula* Wilbur.

SABBATIA OBTUSIF. [obtusifolia] Raf., Fl. Tell. **3:** 30. 1837. *Nomen nudum.*

SABBATIA PETIOLATA Raf., Fl. Tell. **3:** 30. 1837. *Nomen nudum.*

SABBATIA PULCHELA Raf., Herb. Raf. 69. 1833. Publication not seen. Merrill (1949) states that it was listed from "Long Island, New Jersey, Chesapeake Bay" and " = *Sabatia gracilis* Salisb. = *S. campanulata* (Linn.) Britton." However, if it is not the *Centaurium* listed below, it is more likely a synonym of *Sabatia stellaris* Pursh.

SABBATIA PULCHELLA (Sw.) Spreng., Syst. ed. 16. 581. 1825. = *Centaurium pulchellum* (Sw.) Druce.

SABBATIA PUMILA Raf., Herb. Raf. 69. 1833. Publication not seen. Merrill (1949) provides the following information: "nom. Long Island, New Jersey, Chesapeake Bay." Perhaps, judging from the localities, a synonym for *S. stellaris* Pursh.

SABBATIA SIMPLEX Bertol., Misc. Bot. **10:** 27. (1842–1863). Publication not seen. A. Gray (Syn. Fl. 2: 116. 1878.) equates this name with *Rhexia stricta* Pursh.

SABBATIA STRICTA Raf., Fl. Tell. **3:** 30. 1837. *Nomen nudum.*

SABBATIA TENUIFOLIA Raf., Fl. Tell. **3:** 30. 1837. *Nomen nudum.*

Sabbatia umbellata Raf., Fl. Tell. **3**: 30. 1837. *Nomen nudum.*

Sabbatia verticillaris Spreng., Syst. ed. 16. 580. 1825. Described from South America. Grisebach (Prodr. **9**: 50. 1845.) equates this name with *Schuebleria stricta* Mart., a synonym of *Curtia gentianoides* Cham. & Schlecht.

Literature Cited

Adanson, M. 1763. Familles des plantes. Paris. 2 vols. cccxxv, 189; 640 pp.

Bentham, G., & Hooker, J. D. 1862–1883. Genera plantarum. London. 3 vols. (Gentianaceae by Bentham **2**(2): 799–820. 1873.)

Blake, S. F. 1915. Notes on the genus Sabatia. Rhodora **17**: 50–57. *pl. 112.*

Britton, N. L., & Millspaugh, C. F. 1920. The Bahama flora. New York. viii, 695 pp.

Chapman, A. W. 1860. Flora of the southern United States. Ivison, Phinney and Company. New York. xxxvii, 621 pp.

Deam, C. C. 1940. Flora of Indiana. Indiana Dept. of Conservation, Division of Forestry. Indianapolis. 1236 pp.

Don, G. 1838. A general history of dichlamydeous plants. J. G. and F. Rivington. London. 4 vols. (Sabatia in **4**: 206–207.)

Elliott, S. 1816–1824. A sketch of the botany of South Carolina and Georgia. J. R. Schenck. Charleston. 2 vols. 666; viii, 741 pp. (Sabatia in **1**: 282–287. 1817.)

Fernald, M. L. 1950. Gray's manual of botany. ed. 8. The American Book Company. New York. lxiv. 1632 pp.

Fraser, J. 1789. A short history of the Agrostis Cornucopiae;—and also some account of a journey to the Cherokee Nation in search of new plants. London. 8 pp.

Gilg, E. 1895. *Gentianaceae in* Die natürlichen Pflanzenfamilien. **4**(2): 50–108.

Gleason, H. A. 1952. The new Britton and Brown illustrated flora of the northeastern United States and adjacent Canada. Lancaster. 3 vols. (Sabatia in **3**: 56–58.)

Gray, A. 1848. A manual of the botany of the northern United States. J. Munroe and Company. Boston. lxxii, 710 pp.

————. 1878. The synoptical flora of North America. ed. 1. (Sabatia in **2**(1): 113–116.)

Grisebach, A. H. R. 1839. Genera et species gentianearum. Stuttgart. viii, 364 pp.

————. 1845. *Gentianaceae in* Prodromus systematis naturalis regni vegetabilis. **9**: 38–141.

Gronovius, J. F. 1739. Flora Virginica. Leiden.

Lanjouw, J., & Stafleu, F. A. 1952. The herbaria of the world. Regnum Vegetabile **2**: 1–167.

Linnaeus, C. 1753. Species plantarum. Stockholm. 2 vols.

Merrill, E. 1949. Index Rafinesquianus. Arnold Arboretum. ix, 296 pp.

Pursh, F. 1814. Flora americae septentrionalis. White, Cochrane and Company. London. 2 vols. xxxvi, 751 pp. (Sabatia in **1**: 137, 138.)

Small, J. K. 1903. Flora of the southeastern United States. New York. xii, 1370 pp.

————. 1933. Manual of the southeastern Flora. New York. xxii, 1554 pp.

Volume 57, no. 674, including pages 37–72, was issued 11 March, 1955.

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Vol. 57 **April, 1955** **No. 676**

CONTENTS:

The New England Botanical Club, Inc.

8 and 10 West King St., Lancaster, Pa.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of the Gray's Manual Range and regions floristically related. Price, $4.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) of not more than 24 pages and with 1 plate, 40 cents, numbers of more than 24 pages or with more than 1 plate mostly at higher prices (see 3rd cover-page). Back volumes can be supplied at $4.00. Some single numbers from these volumes can be supplied only at advanced prices (see 3rd cover-page). Somewhat reduced rates for complete sets can be obtained on application to Dr. Hill. Notes and short scientific papers, relating directly or indirectly to the plants of North America, will be considered for publication to the extent that the limited space of the journal permits. Illustrations can be used only if the cost of engraver's blocks is met through the author or his institution. Forms may be closed five weeks in advance of publication. Extracted reprints, if ordered in advance, will be furnished at cost.

Address manuscripts and proofs to Reed C. Rollins,
Gray Herbarium, 22 Divinity Ave., Cambridge 38, Mass.

Subscriptions (making *all remittances* payable to RHODORA) to

Dr. A. F. Hill, 8 W. King St., Lancaster, Pa., or, preferably, Botanical Museum, Oxford St., Cambridge 38, Mass.

Entered as second-class matter March 9, 1929, at the post office at Lancaster, Pa., under the Act of March 3, 1879.

Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 57 | April, 1955 | No. 676

EVIDENCE FOR THE HYBRID ORIGIN OF DROSERA ANGLICA

Carroll E. Wood, Jr.

Amphiploidy as a mechanism whereby new species of plants come suddenly into being has been demonstrated in a number of groups of plants and new examples continue to come to light. These include both artificial species unknown in nature and an increasing number of wild and cultivated species for which an origin in the past by hybridization followed by polyploidy has been either proved or postulated. (See Stebbins, 1950, Chap. 8.) That this process continues to operate in nature has been shown by three wild species which are known to have originated by amphiploidy within historic time (*Spartina Townsendii*, *Tragopogon mirus* and *T. miscellus*). From the nature of amphiploidy it would be expected that such species might spring into existence more or less simultaneously at two or more different points, thus being polytopic in origin. This indeed appears to be the situation with *Tragopogon mirus*, for which Ownbey (1950) and Ownbey & McCollum (1954) have presented evidence of independent origin at three separate localities. Similarly, an independent origin presumably is true for each of five colonies of *T. miscellus* reported by the same authors. It may also be expected that a widespread and successful species of amphiploid origin might be synthesized again and again in the course of time as long as the diploid ancestors continue in existence and hybrids between them are genetically and ecologically possible. Ordinarily, it would be difficult to detect such an event occurring under natural conditions unless the diploids and the original amphiploid occupy different areas at the time of resynthesis, thus making it possible to distinguish the new amphiploid from the old. It is with such an event, however, that this report is concerned: the finding of sterile hybrids between two diploid sundews, *Drosera linearis* and *D. rotundifolia,* and the chance finding of a small colony of a fertile hybrid of the same parentage which, from all of the evidence available, appears to be a spontaneous resynthesis of the circumpolar *Drosera anglica,* the only known tetraploid of this genus in the northern hemisphere.

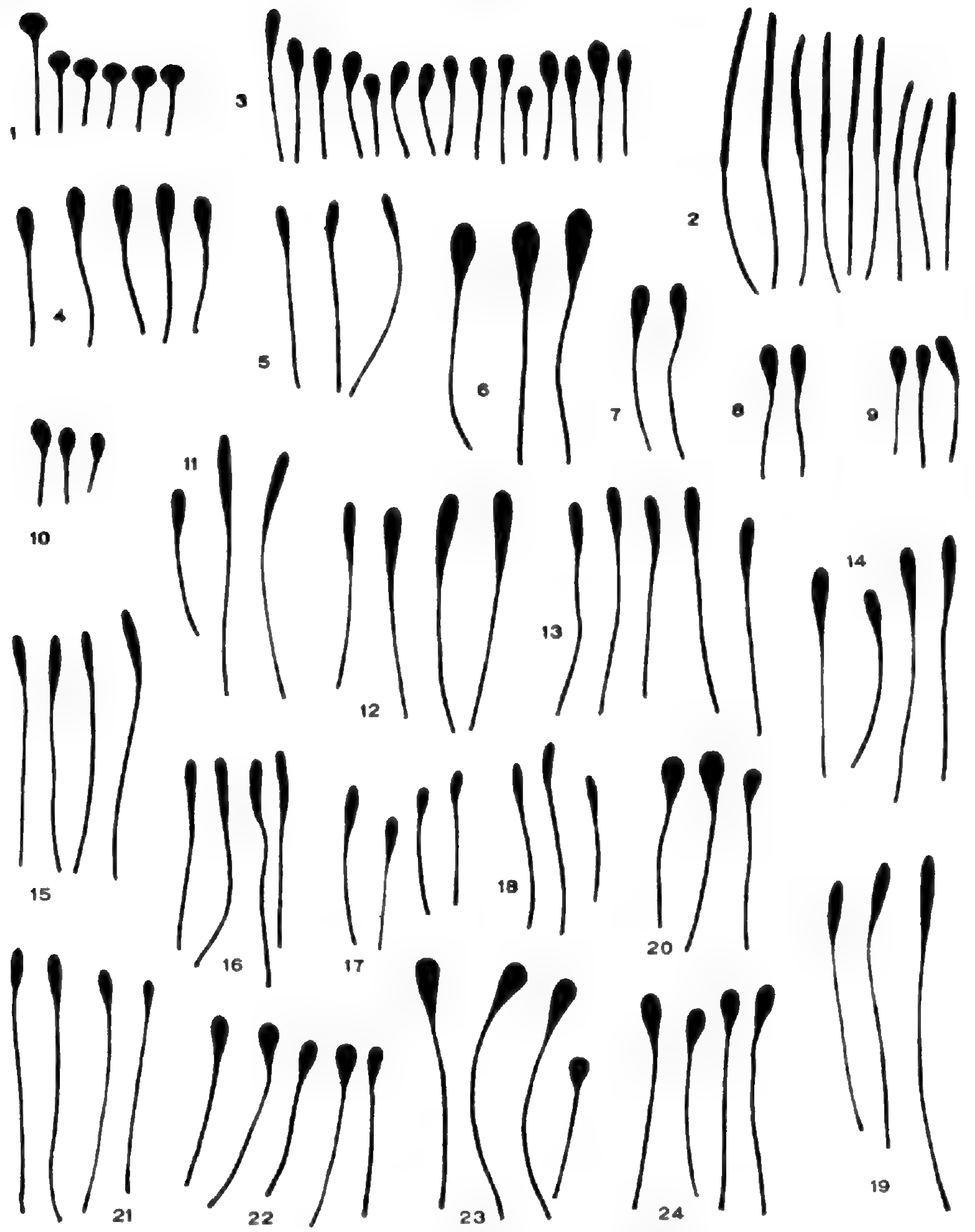
It may be remarked both for the historical interest attached and for its bearing upon the origin of *Drosera anglica* that a hybrid origin for this species was suggested by Winge (1917) in the classical paper in which he proposed the origin of polyploid series of species by hybridization followed by chromosomal doubling. As Stebbins (1950) has pointed out, he apparently was at the time unaware of Digby's work (1912) on *Primula kewensis,* the only concrete supporting example. Winge cited, however, the equally classical work of Rosenberg (1904, 1909) on a triploid hybrid in *Drosera* which had focused attention on polyploidy and on chromosomal behavior in hybrids.

Rosenberg reported that in *Drosera rotundifolia,* with 10 pairs of chromosomes, and *Drosera anglica,* with 20 pairs of chromosomes, meiosis is normal with the chromosomes pairing and disjoining regularly. However, in *D.* × *obovata,* the hybrid between them, he found that the 30 chromosomes formed 10 bivalents which disjoined normally while the remaining 10 chromosomes remained unpaired and were distributed irregularly. The interpretation suggested was that the 10 chromosomes from *D. rotundifolia* paired with 10 of those from *D. anglica,* the other 10 having no homologues and remaining unpaired. (Shimamura later [1941] reported identical behavior in Japanese material of these three plants.) Recounting these and other observations of Rosenberg, Winge wrote (p. 244): "I could therefore imagine that *D. longifolia* [*D. anglica*] was produced by hybridization between two species or forms with $x = 10$, the chromosomes of which had become added together in the zygote, and then suffered division. On further crossing with *D. rotundifolia* only half would then be capable of conjugation with those of the latter."

Although it now appears that *Drosera anglica* is indeed an amphiploid of which *D. rotundifolia* is one of the progenitors, it has been pointed out by various authors (e.g., Sharp, 1934; Darlington, 1937; Dobzhansky, 1941) that in this particular example Rosenberg's interpretation of chromosomal behavior is open to doubt, it being impossible to determine whether this is a case of allosyndesis, as suggested, with pairing only between "rotundifolia" and "anglica" chromosomes or whether the 20 "anglica" chromosomes are forming 10 pairs with each other or whether some intermediate degree of autosyndesis is present with some "rotundifolia" chromosomes and some "anglica" chromosomes pairing with other members of their own sets. On the basis of the behavior of the chromosomes in the sterile *D. linearis* × *D. rotundifolia* I should also wish to re-examine this interpretation, as well as to question the regular formation of 20 bivalents in *D. anglica.* It is to be noted, however, that Winge's suggestion based on Rosenberg's interpretation fits in with all of the other evidence which suggests a hybrid origin for *Drosera anglica.*

A Sterile Diploid Hybrid

In August, 1951, during the course of a field trip from the University of Michigan Biological Station to beach pools along the shore of Lake Huron at Hammond Bay, Presque Isle County, near the tip of the southern peninsula of Michigan, a clump of a *Drosera* with obovate-spatulate leaves was collected by Mr. Clare B. Kenaga from the midst of a large colony of *Drosera linearis.* In leaf-shape this plant resembled *Drosera intermedia,* a widespread species of wet and very acid habitats, but the leaves were much larger, the color a yellowish green with bright red tentacles, in contrast to the rather dull, dark red of *D. intermedia* in northern Michigan, and the plants were quite sterile, the ovaries containing only aborted ovules. The sterility of the plants, the leaf shape, and the occurrence of *D. linearis* in the pools and *D. rotundifolia* on hummocks nearby suggested, instead, a hybrid between these two species. Two summers later when I was again at the Biological Station, I had the opportunity of revisiting Hammond Bay and of studying other areas along the northern shores of the southern peninsula of



FIGURES 1–24. Leaves of Drosera. Tracings from herbarium specimens, tentacles and leaf-bases omitted. $\times$ ⅛. 1. Drosera rotundifolia, Hammond Bay, Mich., *Wood 8236, et al.* (GH). 2. D. linearis, Hammond Bay, Mich., *Wood 8075, 8316* (GH). 3. Sterile hybrid (D. linearis $\times$ D. rotundifolia), Hammond Bay, Mich., *Wood 8315, Wood 8327, et al.* (GH). 4. Sterile hybrid, Lake Orion, Mich., *Sutton 440* (MICH). 5. Sterile hybrid, Raspberry Island, Isle Royale, Mich., *McFarlin 2238* (MICH). 6. Sterile hybrid, Lake Orion, Mich., *Billington 66* (MICH). 7. Sterile hybrid, Lake Orion, Mich., *Billington 66* (NY). 8. Sterile hybrid, Emmet Co., Mich., *Wood 8122* (GH). 9. Sterile hybrid, Presque Isle, Mich., *Wood 8307 & McVaugh* (GH). 10. Fertile hybrid (D. linearis $\times$ D. rotundifolia Amphiploid), Presque Isle, Mich., *Wood 8308 & McVaugh* (GH). 11. D. anglica, Keeweenaw Co., Mich., *Hermann 8208* (NY). 12. D. anglica, Ireland, *Prager*, 1896 (GH). 13. D. anglica, Gaspé Co., Quebec, *Collins, Fernald & Pease* (*Pl. Exsic. Gray. 218*) (NY). 14. D. anglica, Sweden, *H. Svenonius*, 1932 (NY). 15. D. anglica, Japan, *Uno 21043* (GH). 16. D. anglica, Marquette Co., Mich., *Dachnowski*, 1906 (MICH). 17. D. anglica, Glacier Park,

Michigan. The sterile plants are of sporadic occurrence around the northern Great Lakes in company with *Drosera linearis* and *D. rotundifolia* and are indeed hybrids between these two species.

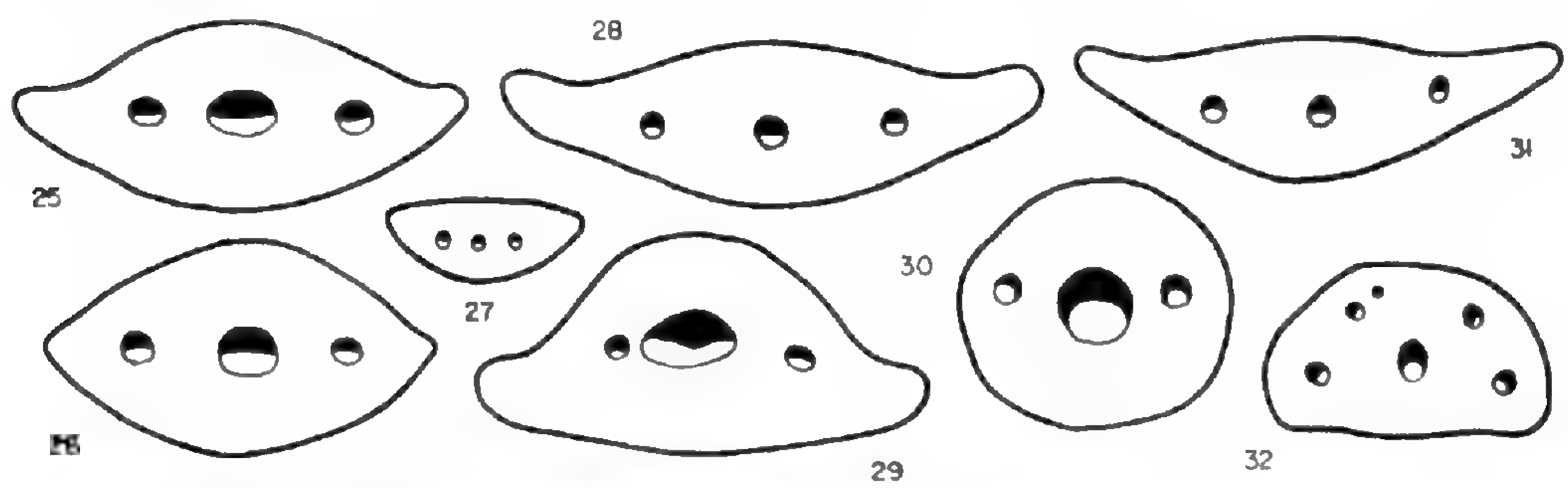
Morphology. The parental species, the common and widespread *Drosera rotundifolia*[1] and the sometimes abundant but very much more local *Drosera linearis*, differ from one another

D. ROTUNDIFOLIA	STERILE HYBRID	D. LINEARIS
Leaves spreading or horizontal.	Leaves ascending or spreading.	Leaves ascending or erect.
Petioles compressed and winged, moderately to densely hairy with flat, twisted hairs.	Petioles somewhat compressed (intermediate), sparsely to moderately hairy.	Petioles terete, glabrous or with a few scattered hairs.
Leaf blades suborbicular to orbicular-reniform, broader than long, (4–)6–10 mm. long, (5–) 7–11 mm. wide, bright yellowish green, the tentacles bright red.	Leaf blades obovate-spatulate to elongate-spatulate, longer than broad, 11–17(–20) mm. long, 4–6(–7) mm. wide, bright yellowish green, the tentacles bright red.	Leaf blades exactly linear, the tip rounded, 20–50 mm. long, 2–2.5 mm. wide, dull green or reddish, the tentacles dull red.
Leaf base slightly winged, the stipules adnate 2–3 mm. above the base, of fimbriate segments.	Leaf base with a narrow wing-like margin and numerous fimbriate, crinkled segments.	Leaf base dilate-winged, the stipules adnate 2–4 mm. above the base, of numerous crinkled, fimbriate, setaceous segments.
Inflorescences (4–)7–16 (–21) cm. long, the peduncle (3.2–)6–15 cm. long.	Inflorescences (2.5–)6–14(–19) cm. long, the peduncle (2.3–) 4–13.5 cm. long.	Inflorescences (3–)5–11(–12) cm. long, the peduncle (2.7–) 4–8(–8.7) cm. long.
Flowers per inflorescence (3–) 4–13(–15).	Flowers (2–)4–8(–11).	Flowers (1–)4–6(–7).
Calyx green; petals white; pollen white.	Calyx blackish; petals white, pink tinged without; pollen orange.	Calyx blackish; petals white, tinged pink at tips without; pollen orange.
Capsules oblanceolate-elliptic in outline, 4.5–5.5 mm. long, 2.5 mm. diameter.	Ovaries fail to develop into fruit.	Capsules elliptic in outline, 5–5.5 mm. long, 2.5–3.5 mm. wide.
Seeds light brown, shiny with a metallic luster, sigmoid-fusiform, finely longitudinally striate, 1–1.5 mm. long.	Seeds fail to develop. Ovules aborting.	Seeds shining black, oblong-obovate in outline or rhomboidal, minutely and densely pebbled, 0.5–0.8 mm. long.

[1] See Wynne (1944) for range-maps of the North American species of *Drosera*.

Montana, *Mains 6053* (MICH). 18. D. anglica, Kauai, Hawaiian Ids., *Rock*, 1909 (NY). 19. D. anglica, Alaska, *Anderson 764* (NY). 20. D. × obovata (D. anglica × D. rotundifolia), Sweden, *Bergström*, 1915 (GH). 21. D. × obovata, Ozegahara, Japan, *Suzuki 45* (GH). 22. D. × obovata, Finland, *Hallström 1202* (NY). 23. D. × obovata, Sweden, *Asplund*, 1923 (NY). 24. D. × obovata, Newfoundland, *Fernald, Long & Fogg 1759* (GH).

in a number of conspicuous features, including habitat and habit, leaf-shape, cross-sectional shape and pubescence of petioles, stipules, the number of flowers per inflorescence, color of anthers and color, shape and surface-markings of seeds. There are also other less conspicuous differences. In most respects the sterile, spatulate-leaved plants from Hammond Bay are morphologically intermediate between the two species, but in a few characteristics resemble one or the other species more strongly. In pollen color and color of the calyx the



FIGURES 25–32. Cross-sections of petioles of Drosera. × 20. Cross-sectional shape of petioles offers interesting possibilities as an additional distinguishing characteristic in fresh material of *Drosera*, as will be noted from the five species and one hybrid shown here. Fresh specimens or material preserved in liquid must be used, however, for the tissues shrink so badly in drying that it is difficult to re-expand petioles from herbarium specimens. Vascular bundles are shown diagrammatically, the xylem in black, the phloem in white.

25. Drosera rotundifolia, middle of petiole; Emmet Co., Mich., *Wood 8076* (GH). 26. D. linearis × D. rotundifolia, middle of petiole; Hammond Bay, Mich., *Wood 8237 et al.* (GH). 27. D. brevifolia, middle of petiole; Carteret Co., N. C., *Wood 8237* (GH). 28. D. capillaris, middle of petiole; Pender Co., N. C., *Wood 8236* (GH). 29. D. rotundifolia, petiole near the base of the blade. 30. D. linearis, middle of petiole; Emmet Co., Mich., *Wood 8120* (GH). 31. D. capillaris, petiole near base of the blade; compare with fig. 29. 32. D. intermedia, middle of petiole; Cheboygan Co., Mich, *Wood 8130* (GH).

plants are similar to *D. linearis* but in the yellow-green of the leaf blades and the bright red of the tentacles and in the elongate shape of the aborted ovules they approach *D. rotundifolia.* A comparison of all three plants is given in the accompanying table[2] from which the intermediacy of the sterile plants is, I believe, evident. (See also fig. 1–9, 25, 26, 30.)

The only other species which could be involved as a parent of the hybrid is *Drosera intermedia* Hayne, which it superficially

[2] Since there is abundant evidence of ecological variation in *Drosera*, the comparisons drawn in the table are based upon material from northern Michigan, rather than upon specimens from throughout the range of the parental species, so that a more uniform sample is obtained for this purpose.

resembles in leaf-shape. This species in northern Michigan, however, is a plant of very acid and wet habitats, particularly *Sphagnum* bogs where it occupies the wettest depressions in the *Sphagnum* mat. It occasionally crosses with *D. rotundifolia*, which grows on the drier *Sphagnum*, producing a sterile hybrid with much more rotund leaves than the sterile plant of the beach pools. I have never found *Drosera intermedia* growing anywhere in the vicinity of *D. linearis*. *Drosera intermedia* is also ruled out by its completely glabrous petioles, D-shaped in cross-section (compare figs. 25, 26, 30 & 32), small, spatulate leaf blades, free stipules and inflorescences which emerge horizontally before curving upward.

On morphological grounds the sterile plant of the Hammond Bay beach pools is certainly a hybrid between *Drosera linearis* and *D. rotundifolia*. It is now known from a number of other localities and the description given below is drawn from all of these collections. Since I believe that the amphiploid of this hybrid is *Drosera anglica*, nothing but confusion would result from a "specific" name for this putative hybrid. It is accordingly designated only by formula.

Drosera linearis Goldie × **D. rotundifolia** L.

Very short-stemmed rosette plant intermediate between the parental species and occurring with them. Principal leaves ascending or spreading, (2–)2.5–6(–8) cm. long, the petioles (1.3–)2–4(–5.5) cm. long, slightly compressed and winged, sparsely to moderately hairy with crinkled or twisted white hairs to 2 mm. long; base of petiole flattened, with a narrow wing-like margin, the stipules pink, adnate 2–4 mm. above the base, with several flat fimbriate segments and few to many twisted flat hairs to 5 mm. long. Leaf blades obovate-spatulate to oblanceolate-spatulate, the apex rounded, 11–23(–30) mm. long, 4–6(–8) mm. wide, bright yellowish-green, the tentacles bright red (as in *D. rotundifolia*), to 5 mm. long. Inflorescences 1–3(–4), scapose, including the peduncle (2.5–) 6–14(–20) cm. tall, the first usually the largest; peduncle (2.3–)4–13(–15) cm. long, glabrous or with scattered hairs near the base. Flowers (2–) 4–8(–11) per inflorescence, the pedicels 1–2.5 mm. long. Calyx dark blackish-green (as in *D. linearis*), 4–5 mm. long, the lobes oblong, obtuse to acute, 3–3.5 mm. long, 1–1.5 mm. wide, the margins glandular-denticulate. Petals white, obovate-cuneate or narrowly obovate, 4–4.5 mm. long, 2.5 mm. wide. Stamens 3.5–4 mm. long, the pollen orange (as in *D. linearis*). Ovary failing to develop into a fruit; ovules fusiform, aborting; styles slender, clavate, bifurcate to the base, the branches 1.5–2 mm. long. Somatic chromosomes 20; meiosis irregular.

Specimens Examined.[3] Canada. Ontario. Bruce Co.: edges of pools in marly bog-marsh area near Lake Huron, Oliphant, Annabel Twp., *Cain, Hagenah & Thompson*, 6 July 1947 (BLH); grassy bog, Sauble Beach, *Krotkov 9099* (US).

United States. Michigan. [Charlevoix Co.:] border of a (marl) lake near Charlevoix, *C. F. Wheeler*, 26 Aug. 1894 (GH). Emmet Co.: marly flats with scattered *Thuja* and *Larix* behind dunes along Sturgeon Bay, Sec. 5, R5W, T38N, Bliss Twp., *Wood 8122* (GH). Keeweenaw Co.: transition zone between sedges and sphagnum, Raspbery Island bog, Isle Royale, *R. M. Linn*, 9 & 15 Aug. 1954 (GH); bog on Raspberry Island, Rock Harbor, Isle Royale, *J. B. McFarlin 2238*, 22 July 1930 (MICH); Isle Royale, *University Party*, 1868 (MICH) (probably this plant—one plant with a plant of *D. intermedia*). Oakland Co.: [all of the following are from the same locality]: marsh, edge of Lake Orion, *B. F. Chandler*, 30 July 1914 (BLH, US); boggy ground, Marl Lake, near Orion, *Chandler*, 19 Sept. 1915 (MICH); wet open ground (boggy ground) on the margin of Marl Lake, Orion Twp., *Billington*, 9 & 13 July 1916 (NY), 9 July & 13 Aug. 1916 (MICH), 9 July 1916 (MICH); borders of Marl Lake near Orion, *O. A. Farwell 4289*, 9 July 1916 (BLH, GH), *4289½* (GH), *4371*, 13 Aug. 1916 (GH); Marl Lake, north of Orion, *Sutton 440*, 30 July 1914 (MICH); Marl Lake, near Rochester, *Ballard*, July 1897 (GH). Presque Isle Co.: on edge of open beach pool at Hammond Bay, Sec. 22, R3E, T36N, *Kenaga 14*, 6 Aug. 1951 (UMBS); boggy beach pool, Evans property, Hammond Bay near old Coast Guard Station, *F. K. & A. G. Sparrow*, 19 July 1952 (UMBS); open sand and small hummocks along seeping edges of shore and sandy, marly beach pools in front of Thujas along low shore of Hammond Bay, Lake Huron, w. of Coast Guard Station, Sec. 22–23, R3E, T36N, Ocqueoc Twp., *Wood 8077*, 23 June 1953, *8315*, 22 Aug. 1953, *Wood 8237*, *E. Clover & M. Fulford*, 24 July 1953 (GH, MICH, NY, UMBS, US); rare, with *D. rotundifolia* and *D. linearis*, both of which are abundant, marly flats back of Lake Huron beach, small bay, ca. 3 mi. n. of Presque Isle P. O., between Sec. 21 & 27, R8E, T34N, *McVaugh 10892*, 11 July 1949 (MICH), *Wood 8307 & McVaugh*, 22 Aug. 1953 (GH).

Ecology. In northern Michigan *Drosera rotundifolia* and *D. linearis* usually occupy very different habitats. *Drosera rotundifolia* is characteristically a plant of *Sphagnum* bogs but it also occurs on other mosses, on wet, rotting logs, or on moist or wet sands, usually in acid habitats with a pH in the neighborhood of 4 or 5. The very different *D. linearis*, in contrast, is always (insofar as I can determine) a plant of constantly wet, open, circumneutral (pH 6.5–7.5) or slightly alkaline habitats, such as marl bogs and the seeping beach flats of the northern Great Lakes, especially Lake Huron. In these areas the plant often occurs by the thousands, literally covering the ground. Although the respective habitats of the two species are, for the

[3] The abbreviations used to designate herbaria are those of Lanjouw and Stafleu in Index Herbariorum, Pt. I., The Herbaria of the World, ed. 2, Utrecht, 1954, with the exception of the University of Michigan Biological Station, Cheboygan, Michigan (UMBS).

most part, quite separate, at some points they come together and it is in these areas that hybrids have been found.

A description of one such area, that at Hammond Bay, Presque Isle County, Michigan, is given below. At this locality, back from the gently curving shore of Hammond Bay south of the Ocqueoc River, the land drops abruptly from the level of the fossil beaches of glacial Lake Algonquin to a *Thuja* bog which stretches toward Lake Huron. At the edge of the bog, some 40–50 yards from the lake shore, is a low, stabilized dune with a dirt road running along the top to several summer cottages. On the shoreward side of the road the sand slopes gently to a wet depression, the inner edge of a beach pool, a distance of some 25 feet. Characteristic plants of the stabilized upper portion of the slope are *Pinus Strobus, Larix laricina, Thuja occidentalis, Juniperus horizontalis, Shepherdia canadensis, Andropogon scoparius, Calamovilfa longifolia, Arctostaphylos Uva-ursi, Linnaea borealis* var. *americana,* and *Campanula rotundifolia.* The lower portion of the slope, some 10 feet in width, is more open and is quite moist or even wet with constant seepage from the *Thuja* bog. Here are found scattered shrubs of *Myrica Gale* with *Sarracenia purpurea, Primula intercedens, Lobelia Kalmii* and numerous plants of *Drosera rotundifolia.* In the very shallow water of the wet depression, 8 feet wide at the foot of the slope, occur *Rhynchospora capillacea, Pogonia ophioglossoides, Sarracenia purpurea, Utricularia cornuta, U. intermedia,* many plants of *Drosera linearis* and scattered individuals of the obovate-spatulate-leaved hybrids. A low, somewhat irregular ridge, from 6 inches to a foot high and from two to five feet wide, rises from the wet depression paralleling the shore. Beyond this the shallow beach pool, broken by hummocks, reaches about 30 feet to end abruptly at a wide, sandy beach which slopes gradually into Lake Huron. The low, irregular ridge provides conditions suitable for the growth of both *Drosera linearis* and *D. rotundifolia* and it is here that the greatest numbers of hybrid plants (75 or more individual plants or clumps of various sizes) were found. Also on this ridge were a few small Thujas and an occasional plant of *Myrica Gale,* along with *Cladium mariscoides, Scirpus hudsonianus, Lilium philadelphicum, Pogonia ophioglossoides, Sarracenia purpurea,* *Gentiana procera, Lobelia Kalmii* and *Solidago ohionis*. The beach pool proper is dotted with scattered plants of *Sarracenia purpurea*, but none of the sundews grows there. The conspicuous plants of the beach pool are *Cladium, Rhynchospora* and the two species of *Utricularia*. The sandy beach is occupied by the common shore plants of the region, including *Equisetum variegatum, Calamagrostis inexpansa, Scirpus americanus, Juncus balticus* var. *littoralis, Triglochin palustris, Salix interior, Cakile edentula* var. *lacustris, Parnassia glauca, Hypericum Kalmianum* and *Lobelia Kalmii*, the distribution of these seemingly dependent upon the varying wetnesses of the beach.

The principal area in which the hybrid sundews are found parallels the shore for about 250 feet. Beyond this on either side conditions change and the two parental species are separated again, although at another area a quarter of a mile away similar conditions obtain and here again hybrids are found.

In each locality in northern Michigan where I have collected the hybrids ecological conditions similar to those described above occur. A seeping shore with open, marly flats and scattered Thujas or larches with hummocks at their bases are indications that hybrids may be looked for (but not always found, of course). *Drosera linearis* will be confined to the constantly wet soils or very shallow water, while *D. rotundifolia* may occur on the drier hummocks or at the bases of the trees. Hybrids have been found growing with either parent; at one locality (Emmet Co.), after a great deal of search I found only two hybrids, one in the midst of a colony of *D. rotundifolia*, the other among plants of *D. linearis* some distance away. I assume that the cross has occurred in both directions. Generally, however, the hybrid seems to be best developed in the wetter locations which favor *Drosera linearis*.

The hybrid was formerly abundant at Lake Orion, in southern Michigan, where both *Drosera rotundifolia* and *D. linearis* (the latter here near its southern limit) occurred. Conditions there seem to have been very favorable for its growth, for many of the specimens from this locality are large and vigorous, including one, the largest I have seen, with leaves 8 cm. long and an 11-flowered inflorescence 20 cm. tall. Accompanied by Dr. Rogers McVaugh and Dr. W. H. Wagner, Jr., I visited Lake Orion in

August of 1953 in search of the plant, only to find that the lake level has been raised several feet artificially, apparently eliminating *Drosera linearis* and the hybrid quite effectively. *Drosera rotundifolia* still survives on sphagnum hummocks along the shrubby border at several places.

Cytology. While, on the basis of occurrence and morphology alone, the spatulate-leaved plants may be presumed to be hybrids, high sterility is an additional indication of their hybrid nature. In an attempt to determine possible cytological causes for this sterility meiosis was studied in both parental species and in the hybrid from material collected at Hammond Bay on June 23, 1953. Mr. Robert Linn has also sent buds from plants which prove to be this hybrid growing in a bog on Raspberry Island, Isle Royale, Michigan. Various other collections of *Drosera rotundifolia* and *D. linearis,* as well as of *D. intermedia,* from northern Michigan have been studied. In the course of this investigation it has subsequently been possible to examine meiotic material of *Drosera brevifolia, D. capillaris, D. filiformis* and *D. filiformis* var. *Tracyi* from the southeastern United States, so that I have had the opportunity of studying all of the species occurring in North America, with the exception of one of the most crucial, the tetraploid *Drosera anglica.* The chromosome numbers now known in the genus are given in the accompanying table.

Cytological material from northern Michigan was fixed in a modified Carnoy's fixative (4 chloroform: 3 alcohol: 1 acetic acid) and that from the Southeast in Newcomer's fixative (1953). Both gave excellent results. Anthers were squashed in propriono-carmine, drawings made with the aid of a camera lucida, and the slides made permanent by Bradley's vapor transfer technique (Bradley, 1948).

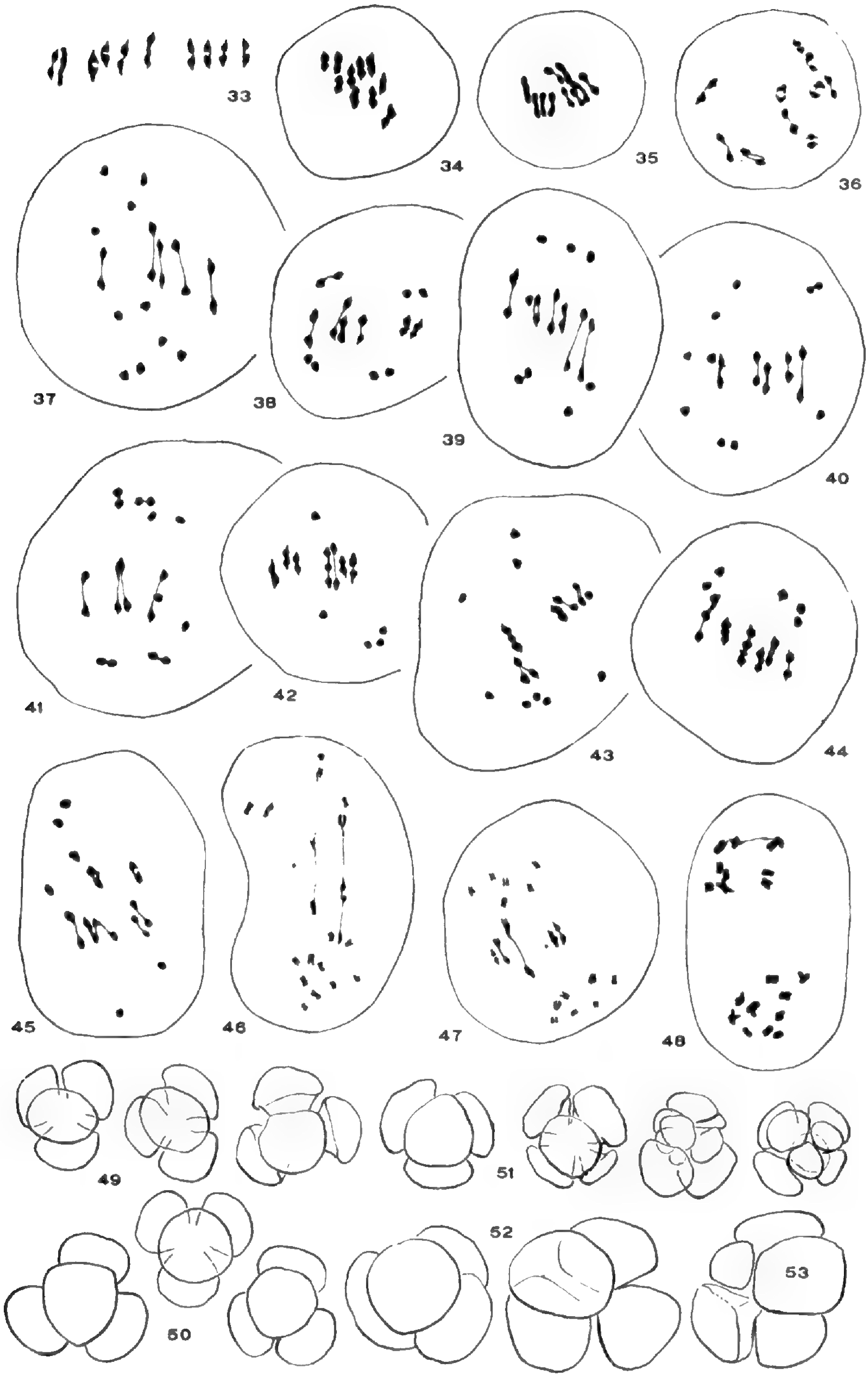
In all material of *Drosera linearis, D. rotundifolia* and *D. intermedia* examined ten bivalents are formed in the first division of meiosis. One pair of chromosomes is associated with the nucleolus in each of these species. (This is also true of *D. linearis* $\times$ *D. rotundifolia* and the various other diploid species reported here.) Chromosomes pair and disjoin with no irregularities (fig. 33–36). In the sterile hybrid, although in many instances the 20 chromosomes seem to be at least loosely asso-

CHROMOSOME NUMBERS IN THE GENUS DROSERA

	Chromosomes	*Source*	*Author*
SEC. I. PSYCHOPHILA			
D. regia Stephens	$2n = 34$	Hamburg Bot. Gard. [S. Africa]	Behre, 1929
SEC. II. BRYASTRUM			
D. pygmaea DC.	$2n = 20–22, 30?$	Not given	Heitz, 1925
	$2n = 32?(28–34)$	Hamburg Bot. Gard. [Australia & N. Z.]	Behre, 1929
SEC. IV. THELOCALYX			
D. Burmannii Vahl.	$n = 10, 3n = 30$ (endosperm)	Bangalore, India	Narasimhachar, 1949
SEC. IX. PHYCOPSIS			
D. binata Labill.	$2n = 32$	Hamburg Bot. Gard. [Australia & N. Z.]	Behre, 1929
SEC. X. PTYCNOSTIGMA			
D. cistiflora L.	$2n = 60$	Hamburg Bot. Gard. [S. Africa]	Behre, 1929
SEC. VII. ROSSOLIS			
D. brevifolia Pursh	$2n = 20, 2n = 10_{II}$	Carteret Co., N. C.	*Wood 8327* (GH)*
	$2n = 10_{II}$	Durham Co., N. C.	*R. B. Channell*
D. capillaris Poir.	$2n = 10_{II}$	Jackson Co., Miss.	*Wood 8458 & Demaree*
	$2n = 10_{II}$	Pender Co., N. C.	*Wood 8326*
D. filiformis Raf.	$2n = 10_{II}$	Lakehurst, N. J.	Levine, 1916
	$2n = 20$	Mashpee, Mass.	Dahl, 1937
	$2n = 10_{II}$	Columbus Co., N. C.	*Wood 8507, Channell & Rock*
D. filiformis	$2n = 10_{II}$	Jackson Co., Miss.	*Wood 8438 & Demaree*
var. *Tracyi* (McFarlane) Diels	$2n = 10_{II}$	Mobile Co., Miss.	*Wood 8463 & Demaree*
D. intermedia Hayne	$2n = 20$	Germany	Behre, 1929
	$2n = 20, n = 10$	Lakehurst, N. J.	Levine, 1916
	$2n = 10_{II}$	Cheboygan Co., Mich.	*Wood 8130*
	$2n = 10_{II}$	Columbus Co., N. C.	*Wood 8550 & E. Anderson*

D. linearis Goldie	$2n = 10_{II}$	Presque Isle Co., Mich.	*Wood 8075, 8235*
	$2n = 10_{II}$	Emmet Co., Mich.	*Wood 8120*
D. rotundifolia L.	$2n = 20, n = 10$	Germany, Norway, Sweden, Denmark	Rosenberg, 1903, 1904. 1909.
	$2n = 20$	Germany	Behre, 1929
	$2n = 10_{II}$	Lakehurst, N. J.	Levine, 1916
	$2n = 20$	North Falmouth, Mass.	Dahl, 1937
	$2n = 20, n = 10$	Japan	Shimamura, 1941
	$n = 10$	Japan	Nakajima, 1933
	$2n = 10_{II}$	Presque Isle Co., Mich.	*Wood 8076, 8236.*
	$2n = 10_{II}$	Cheboygan Co., Mich.	*Wood 8204, 8129*
	$2n = 10_{II}$	Emmet Co., Mich.	*Wood 8121*
D. linearis × *D. rotundifolia*	$2n = 20$	Presque Isle Co., Mich.	*Wood 8077, 8237.*
	$2n = 3\text{–}7_{II} + 1\text{–}3_{III} + 2\text{–}10_{I}$		
D. anglica × *D. rotundifolia* (*D.* × *obovata* Mert. & Koch)	$2n = 10_{II} + 10_{I}$	Norway, Sweden, Denmark	Rosenberg, 1904, 1909
	$2n = 30$		
	$2n = 30$	Japan	Shimamura, 1941
	$2n = 10_{II} + 10_{I}$		
D. anglica Huds.	$2n = 40, 2n = 20_{II}$	Norway, Sweden, Denmark	Rosenberg, 1903, 1904, 1909
	$2n = 40$	Germany	Behre, 1929
	$2n = 40, 2n = 20_{II}$	Japan	Shimamura, 1941
D. capensis L.	$2n = 36\text{–}38$	Not stated [S. Africa]	Heitz, 1925
	$2n = 40$	Hamburg Bot. Gard. [S. Africa]	Behre, 1929
D. spathulata Labill.	$2n = ca.\ 72$	Not stated [Japan to N. Z.]	Heitz, 1925
	$2n = 80$	Hamburg Bot. Gard.	Behre, 1929

* Documenting specimens for all numbers reported here are in the Gray Herbarium.


33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
51
52
50
53

ciated into 10 pairs in Prophase I, some pairs either fall apart or fail to move onto the spindle so that at Metaphase I only 3–7 bivalents are present. (fig. 37–45). One, two or three trivalents may occur (fig. 41–44) and an occasional quadrivalent is seen (fig. 45).

For example, of 28 metaphases (the largest number analyzable from any one hybrid plant), 3 pairs of chromosomes were present on the spindle in 3 cells, 4 pairs in 6 cells, 5 pairs in 11 cells, 6 in 5 cells and 7 in 3 cells. Twelve cells showed one trivalent and five had two. Only a single quadrivalent was seen in this plant (fig. 45). The number of unpaired chromosomes varied from 2 to 10 and the number of bivalents not on the spindle from one to four. Figure 41 shows a cell with three bivalents and one trivalent on the spindle, while four bivalents lie off the spindle.

Chromosomal distribution is consequently quite erratic. Some chromosomes lag and divide tardily and there is evidence of bridges and fragments (fig. 46–48). Following meiosis conjoined nuclei, micronuclei and other irregularities are often seen. It is not surprising that the hybrids of *Drosera linearis* and *D. rotundifolia* are sterile.

In the Droseraceae the four microspores from each pollen mother cell remain associated and develop into a united tetrad of pollen grains, generally tetrahedral in arrangement (fig. 49–50). It is thus possible to see the products of each pollen mother cell and the extent to which meiotic irregularities result in the formation of abnormal microspores or pollen grains. Fresh *Drosera* pollen mounted in lactophenol with a little cotton blue absorbs the stain readily making it fairly easy to determine

---

FIGURES 33–53. Meiosis in Drosera. × 800. 33. Drosera linearis, metaphase I; Hammond Bay, Mich., *Wood 8075*. 34. D. rotundifolia, metaphase I; Hammond Bay, Mich., *Wood 8076*. 35. D. capillaris, metaphase I, Pender Co., N. C., *Wood, 8236*. 36. D. brevifolia, diakinesis; Carteret Co., N. C., *Wood, 8237*. 37–45. D. linearis × D. rotundifolia (2n, sterile), metaphase I, Hammond Bay, Mich., *Wood 8077, 8237*. 46–47. D. linearis × D. rotundifolia (sterile), metaphase II, showing tardily disjoining bivalents and dividing univalents, *Wood 8077, 8237*. 48. D. linearis × D. rotundifolia (sterile), metaphase II, *Wood 8077, 8237*. 49. Three pollen tetrads from D. rotundifolia, *Wood 8305 & McVaugh* (GH). 50. Three pollen tetrads from D. linearis, *Wood 8075* (GH). 51. Four pollen "tetrads" from D. linearis × D. rotundifolia (sterile), *Wood 8077*, with 4, 5, 9 and 8 microspores, respectively. 52. Two pollen tetrads from fertile hybrid, D. linearis × D. rotundifolia Amphiploid, *Wood 8308 & McVaugh*. 53. Pollen "tetrad" with 5 grains from same fertile hybrid. Fig. 49–53. × 250.

the number of associated pollen grains and something of the condition of the protoplasmic contents.

In hybrids from Hammond Bay approximately half of the grains are associated in tetrads, although the four are sometimes of different sizes. The remaining "tetrads" consist of from 2 to 9 microspores or grains of various sizes, in most of these (about 40 per cent of the total) consisting of 5 or 6 (fig. 51). In no instances were any grains with evenly distributed and staining protoplasmic contents observed in the hybrids. Most grains (even those united in regular tetrads) lack contents altogether and the remainder show only deeply stained and clumped protoplasm. Apparently pollen sterility approaches 100 per cent. This is in great contrast to both of the parental species which are very nearly as fertile as the hybrid is sterile.

In spite of the lack of sexual reproduction, at Hammond Bay and presumably at Lake Orion the hybrid reproduced itself vegetatively by adventitious plantlets from leaf blades, scapes, or even flowers, the carpels of which may be converted into a rosette of leaves similar to that described by Fernald as *Drosera rotundifolia* var. *comosa.* This kind of vegetative reproduction was seen at Hammond Bay in July and August and was shown by experimentally detached leaves which produced adventitious plantlets from the adaxial surfaces of the blades. Such reproductive methods are shared (at least potentially) by most species of the genus.[4] Vegetative reproduction may thus be of considerable importance in allowing the persistence and even spread of a sterile plant over a period of years. It greatly increases the chances for the formation of restitution nuclei or other phenomena which could lead to polyploidy and the production of a fertile amphiploid such as the plant to be discussed next.

A Fertile Hybrid

On July 11, 1949, Dr. Rogers McVaugh had collected two plants of the sterile hybrid growing with abundant *Drosera*

[4] In his Flore Laurentienne (1935, p. 273), Marie-Victorin noted vegetative reproduction in *D. rotundifolia*, saying, "At the maturation of the fruits, the leaves detaching themselves are disseminated by water or wind and they are from this moment capable of giving rise to adventitious buds which develop into new plants. The process recalls the classic case of the budding of *Bryophyllum.*" [Translation.] See Behre (1929) for descriptions of modes of vegetative reproduction or Lloyd (1942) for a general review in English.

linearis and *D. rotundifolia* on beach flats along the shore of Lake Huron about 3 miles north of Presque Isle Post Office, Presque Isle County, Michigan (*McVaugh 10892*). Since it was of considerable interest to obtain some idea of how widespread and frequent hybridization between these two species may be, Dr. McVaugh kindly showed me this locality on August 22, 1953. The ecological situation was similar to that in which hybrids have been found elsewhere, with marly flats becoming a cobble beach, a seeping shoreline along a *Thuja* bog and scattered plants of *Thuja* and *Larix* with ridges and hummocks of herbaceous vegetation. *Drosera linearis* was abundant on the wet flats and *D. rotundifolia* grew among the herbaceous plants and on mossy hummocks at the bases of *Thuja* or *Larix*. Both species of sundew were in mature fruit and at the point of shedding their seeds. Careful search produced only a single hybrid, a plant which had flowered but which was very definitely sterile. However, on the lower portion of a mossy hummock at the base of a small *Thuja* and in close proximity to both *Drosera linearis* and *D. rotundifolia,* we found a colony of ten or so plants of various sizes which were quite identical in their vegetative characteristics with both the sterile hybrid collected here and those seen elsewhere. Three of these plants, although rather small, had flowered and, unlike the other hybrids, had matured fruit and were shedding seeds. (*Wood 8308 & McVaugh,* GH.)

These fruiting plants are quite remarkable. The capsule is well developed, oblong in outline, 7–7.5 mm. long and 3.5 mm. wide, thus larger than that of either *Drosera linearis* or *D. rotundifolia* in this area. The scapes were 6 to 11 cm. long and bore 3 to 7 flowers. It is the seeds, however, which are most notable. These are precisely what might be expected in a fertile hybrid between *D. linearis* and *D. rotundifolia,* with the black coloration of the seeds of the former, the spindle-shape and size of those of the latter and surface markings which are quite intermediate. Most remarkable of all, they are a perfect match for the seeds of the circumpolar tetraploid *Drosera anglica,* the only species of the northern hemisphere, other than *D. rotundifolia,* with fusiform seeds. This, in a group in which seed characteristics have proved to be among the most distinctive and stable, can not be regarded as mere coincidence. (See Wynne, 1944, text and figures, and the same illustrations in The New Britton & Brown.) Figures 60–63 show a comparison of the cells from the outer seed coats of *Drosera rotundifolia*, *D. linearis*, the fertile plants from Presque Isle and *D. anglica* from Montana.

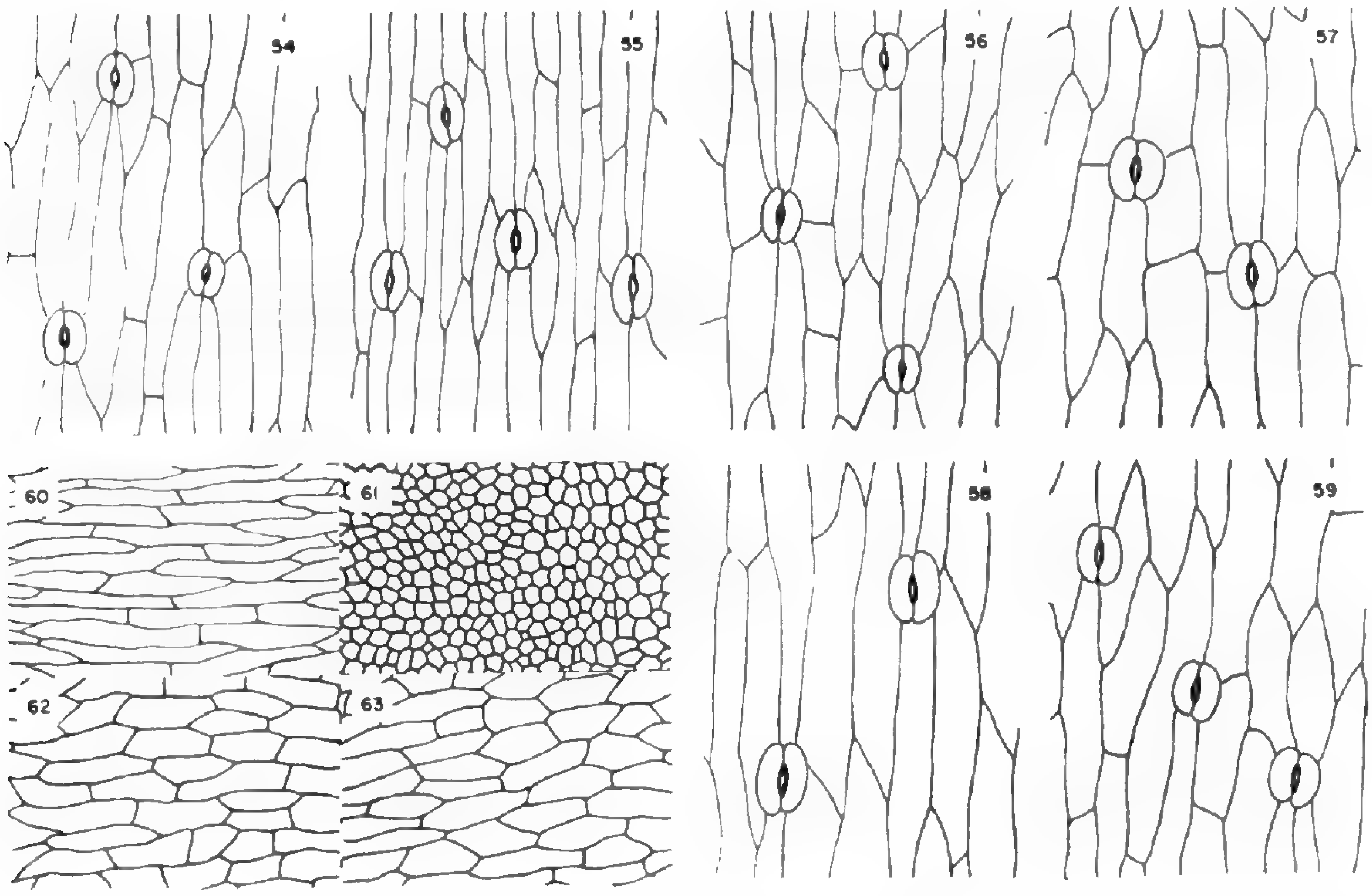
Although this small colony of exceptional fertile plants might conceivably represent a recent introduction of *Drosera anglica* from some locality to the north (the nearest in Michigan in the upper peninsula at Marquette, some 180 miles west-northwestward),[5] the circumstances of its occurrence suggest that these are plants of *D. linearis–D. rotundifolia* parentage which have somehow acquired fertility. In any event, the identical vegetative characteristics of these fertile plants which produce "anglica" seeds and of the sterile offspring of *D. rotundifolia* and *D. linearis* need explanation, for some tie-up with *Drosera anglica* is indicated, whether this is an introduction to the area or whether it is a spontaneous development. I can see no reason to think that this is anything other than a fertile hybrid.

Assuming that these are indeed derived from *D. linearis* and *D. rotundifolia*, the very production of seeds by the fertile plants, in contrast to the sterile hybrids with their erratic chromosomal behavior and inviable pollen, suggest that these exceptional plants may be amphiploids on the same chromosomal level as *Drosera anglica*, a tetraploid with 20 pairs of chromosomes.

It was not possible to determine directly the chromosome number of the fertile plants, but this was attempted by a comparison of the areas and volumes of epidermal guard cells on the principle that the cells of a recent amphiploid, having twice the number of chromosomes of a diploid should have twice the nuclear volume and roughly twice the cellular volume. Leaves preserved in 70 per cent alcohol were available from Presque Isle plants of *Drosera rotundifolia*, *D. linearis*, the sterile hybrid and the fertile hybrid, but boiled-up herbarium material had to be used for *Drosera anglica*. Whole leaves were mounted

[5] I have no evidence of *Drosera anglica* in the lower peninsula of Michigan, although Wynne (1944) shows two localities on her map. One of these is certainly Lake Orion and represents sterile *D. linearis* × *D. rotundifolia* and I suspect that the other, farther north in the part of the state with which I am most familiar, does also.

in water, the epidermis on the backs of the leaves studied, and pairs of guard cells (chosen at random from the central portion of the blade) drawn with camera lucida at a final magnification of 1100 diameters. The guard cells of the two diploid species and their sterile hybrid are all smaller than those of either the fertile hybrid or *D. anglica* (fig. 54–59). Areas of



FIGURES 54–59. Epidermis from lower side of leaf blades of Drosera. × 125. 54. Drosera rotundifolia, Presque Isle, Mich., *Wood 8305 & McVaugh.* 55. D. linearis, Presque Isle, Mich., *Wood 8306 & McVaugh.* 56. D. linearis × D. rotundifolia (sterile), Presque Isle, Mich., *Wood 8307 & McVaugh.* 57. D. linearis × D. rotundifolia (fertile), Presque Isle, Mich., *Wood 8308 & McVaugh* 58. D. anglica, Sweden, *Svenonius*, 1932 (NY). 59. D. anglica, Montana, *Mains 6053* (MICH).

FIGURES 60–63. Portions of outer seed coats responsible for surface sculpturing of seeds of Drosera. × 75. 60. D. rotundifolia, *Wood 8305 & McVaugh.* 61. D. linearis, *Wood 8306 & McVaugh.* 62. D. linearis × D. rotundifolia (fertile), *Wood 8308 & McVaugh.* 63. D. anglica, *Mains 6053.*

the individual cells of each of the plants were determined by means of a planimeter, the average of five circumferences being used for each cell. In attempting to obtain a rough approximation of the volumes, the diameter of each guard cell was used as its depth and the volume calculated as though the guard cell were a flat-topped, straight-sided figure. Areas and volumes were calculated only for purposes of comparison; no attempt was made to convert these to the actual volumes of the cells. The results are given in the adjoining table.

A statistically significant difference exists between the mean areas of the guard cells of *D. linearis* and *D. rotundifolia.* Their sterile hybrid lies midway between, as might be expected. The mean area of the guard cells of the fertile hybrid is 1.5 times that of the sterile hybrid. There is no significant difference between the means of the fertile hybrid and those of *D. anglica* from either Montana or Sweden.

From the volume relationships it is quite evident that two distinct groups of plants, corresponding to the known diploids and tetraploids, are represented. The fertile plant from Presque Isle fits in with the latter group and the mean volume of its guard cells is 1.9 times that of the sterile plant. No statistically significant difference exists between the means of the volumes of *Drosera rotundifolia, D. linearis,* or their sterile hybrid, or between those of *Drosera anglica* from Europe, that from America and the fertile hybrid, but the difference between the two groups is highly significant and not due to chance.

Since in this genus the petals are persistent, shriveling together above the capsule and protecting the dried stamens and pollen grains adhering to the stigmas, it is often possible to recover pollen tetrads from plants with mature fruits. While the shape and confluence of the grains makes the determination of the volumes impossible, those of the fertile hybrid are conspicuously larger than those of either putative parental species or the sterile hybrid. (Compare fig. 52–53 with fig. 49–51.) It may be remarked in this connection that Erdtmann (1943) gives the width of a tetrad of *Drosera anglica* as 72 microns, the equatorial diameter of a single grain about 50 microns, and the width of a tetrad of *D. rotundifolia* as about 55 microns, the diameter of a single grain about 34 microns. I have not followed this line of evidence further.

Although these indications are not as precise as is desirable, it seems highly probable, on the basis of its fertility, guard cell area and volume, and pollen size, that the fertile hybrid from Presque Isle is at the tetraploid or near tetraploid level, representing a spontaneous amphiploid of *Drosera linearis* and *D. rotundifolia.*

Such a plant might be expected to be fairly fertile and could propagate itself sexually, setting seeds by self-pollination. The

Comparisons of Area and Volume of Guard Cells of Drosera

	Mean AREA $\bar{x}$	σ	Relative Area	Mean VOLUME $\bar{x}$	σ	Relative Volume	No. cells
D. rotundifolia (Wood & McVaugh 8305)	3.6 ±0.08	0.51 ±0.05	0.90	4.6 ±0.14	0.90 ±0.10	0.9	40
D. linearis (Wood & McVaugh 8306)	4.4 ±0.09	0.67 ±0.07	1.10	4.9 ±0.16	1.11 ±0.11	1.0	50
Sterile hybrid (Wood & McVaugh 8307)	4.0 ±0.09	0.62 ±0.07	1.00	4.9 ±0.15	1.04 ±0.11	1.0	42
Fertile hybrid (Wood & McVaugh 8308)	6.1 ±0.08	0.63 ±0.06	1.52	9.4 ±0.18	1.43 ±0.13	1.9	62
D. anglica Montana (Mains 6053, MICH)	5.9 ±0.13	0.76 ±0.09	1.47	8.4 ±0.32	1.79 ±0.22	1.7	32
D. anglica Sweden (Svenonius, 1932, NY)	6.0 ±0.10	0.58 ±0.07	1.50	8.8 ±0.30	1.73 ±0.21	1.8	34

flowers of *Drosera* are usually open for cross pollination only in full sunlight from morning to mid-day or early afternoon, after which the petals close bringing the anthers into contact with the stigmas, insuring pollination. A number of undeveloped ovules were noted among the seeds of the fertile Presque Isle hybrids; these might indicate either a degree of sterility or merely lack of fertilization of some ovules. Of 70 pollen "tetrads" recovered from these plants, 69 had four grains and a single one five (fig. 52, 53). It was not, of course, possible to determine whether or not the contents had been functional.

Drosera anglica

There is no question of the close morphological similarity of the fertile and sterile hybrids. Lacking the flowering scapes or without a compound microscope it would be quite impossible to distinguish between them. It is also quite impossible to distinguish between the distinctive seeds of the fertile plant and those of *Drosera anglica.* If the fertile plant is *Drosera anglica* at a station considerably outside of its known range, the identical features of this plant and the sterile hybrid indicate that *D. anglica* was derived from the sterile hybrid of *D. linearis* and *D. rotundifolia* by amphiploidy. If the fertile plant is regarded as a spontaneous amphiploid or near amphiploid derived from the sterile hybrid it is still tied to *D. anglica* in the same way by its seeds and other morphological features. The indications are that the latter is the case and that *D. anglica* must have first originated in this same manner at some unknown time in the past. This should be regarded, then, as an instance of the spontaneous resynthesis of a widespread and successful species.

The morphological similarities of the sterile and fertile hybrids to *Drosera anglica* are striking. Fernald and Wynne both identified the sterile hybrid as *D. anglica* and a specimen of the sterile plant from Lake Orion is illustrated as *D. anglica* in The New Britton & Brown (Gleason, 1952). In studying specimens of *D. anglica* I unhesitatingly identified a series of plants in bud from a bog on Raspberry Island, Isle Royale, Michigan, (*McFarlin 2238*) (fig. 5) as this species. However, when Mr. Robert Linn sent me cytological material from seemingly identical plants from the same bog the plant proved to be the sterile diploid hybrid!

In all of the characteristics which I have been able to compare, the hybrids and *Drosera anglica* match well, with the exception of the leaves of many specimens. The hybrids from the lower peninsula of Michigan tend to have obovate-spatulate leaves, (fig. 3–9), in contrast to the narrower linear-spatulate or very narrowly obovate-cuneate leaves of *Drosera anglica* over much of its range (fig. 11–19). Some leaves are a perfect match, (e.g., compare fig. 5 and the leaves at either end of fig. 3 with fig. 11–19), but most leaves of the hybrid resemble a great deal more those of *Drosera* × *obovata,* the sterile triploid hybrid of *D. anglica* and *D. rotundifolia* (fig. 20–24). Several possibilities suggest themselves by way of explanation. Ecological differences may well be responsible, at least in part. Shimamura (1941) who studied *D. anglica, D. rotundifolia* and *D.* × *obovata* in Japan found that, although tetraploid *D. anglica* and triploid *D.* × *obovata* were separable in the field when collected, they became morphologically indistinguishable when cultivated in Tokyo. It may also be noted that the specimens of *D.* × *obovata* figured by him are very narrow-leaved and would easily pass as many European or American specimens of *D. anglica.* (Compare fig. 21 with fig. 11–19.) Thus the difference between the Isle Royale hybrids and those from farther south (fig. 5 vs. fig. 3–4, 6–9) may be merely an ecological difference.

Another possibility which warrants careful investigation but which must, for the present, await further evidence is that *Drosera anglica* is not a genomic allopolyploid but a segmental allopolyploid which resembles *D. linearis* more strongly than it does *D. rotundifolia.* In view of the partial chromosomal pairing shown by the sterile hybrid it would seem quite likely that this type of polyploidy might come about in the course of stabilization of a newly formed allopolyploid derived from it.

As was indicated in the introduction, the evidence from cytology for the origin of *Drosera anglica* is both scanty and in need of re-examination. The work of Rosenberg (1904, 1909) and Shimamura (1941) should be repeated with more modern cytological techniques. Additional evidence could come from the hybrid of *D. anglica* and *D. linearis,* if it can be found.

(This plant should occur in nature where the two species grow in close proximity, as they sometimes do. It should be difficult to distinguish from its parents in the field except by its failure to set seeds.) If *Drosera anglica* originated as suggested, some multivalent formation and other chromosomal irregularities might be expected both in this species and in its hybrids with *D. linearis* and *D. rotundifolia*. Neither Rosenberg nor Shimamura reported anything of the kind in either *D. anglica* or *D.* × *obovata*, perhaps because both used sectioned material in which multivalents are much more difficult to see than in smears and squashes. It is worth noting that in one paper Rosenberg (1904) illustrated a metaphase of *D. anglica* with a lagging univalent, although he later maintained that 20 pairs of chromosomes were regularly formed in *D. anglica* and 10 pairs with 10 unpaired chromosomes in *D.* × *obovata*.

As for this latter plant, the question of autosyndesis versus allosyndesis remains unsettled. The chromosomes of the two parental species (*D. anglica* and *D. rotundifolia*) are not morphologically distinguishable from one another and the chromosome number of the one parent is a straight multiple of the other. There is nothing to suggest, however, that *D. rotundifolia* and other species with 10 pairs of chromosomes (all of which have been referred to as diploids in this paper) are in reality polyploids with a basic chromosome number of 5, a situation which might well lead to autosyndesis in *D.* × *obovata*. The section Rossolis, to which all of the plants under discussion belong, seems to be a polyploid series with 10 as the base number of chromosomes. (See table of chromosome numbers.) The presence of only a single pair of chromosomes in association with the nucleolus in each of the 10-paired species points in the same direction, although this is not conclusive evidence (Stebbins, 1950, p. 464).

In spite of the equivocal nature of the cytological evidence from the pairing relationships of the chromosomes of *D.* × *obovata*, the hypothesis based upon it (that *D. anglica* has derived half of its chromosomes from *D. rotundifolia*) is worth considering and is highly suggestive, especially in view of the evidence from the fertile hybrid from Presque Isle County, Michigan. If it be assumed that half of the chromosomes of *D. anglica* have indeed come from *D. rotundifolia*, it becomes necessary to find a second species with the proper combination of morphological and physiological characteristics to produce *D. anglica.* Of all of the species known from the northern hemisphere only *D. linearis* can supply these and only *D. linearis* is not ruled out by one or more conspicuous morphological features which would certainly be evident in a hybrid. (See especially Diels, 1906, for characteristics of other species.) Moreover, insofar as I can determine, both *D. linearis* and *D. anglica* are unique among northern hemisphere species in growing in marly habitats, although the latter plant appears to have a greater ecological amplitude and certainly is not confined to these.

Thus, although the question must remain unsettled for the present and many more ramifications of the problem continue to develop, the evidence from the sterile *Drosera linearis* × *D. rotundifolia,* that from the fertile hybrid with its "anglica" seeds, the close morphological correspondences, the cytological evidence and the distributional data all indicate strongly that *Drosera anglica* is an amphiploid which originated through the hybridization of *D. linearis* and *D. rotundifolia* at some time in the past and which may continue to appear from time to time in the future.

ACKNOWLEDGMENTS

This work was begun at the University of Michigan Biological Station, continued at the University of North Carolina at Chapel Hill and brought to its present state at the Arnold Arboretum and the Gray Herbarium. At all of these places many people have kindly helped in one way or another with the problem and I am indebted to them all. Among those to whom I am very grateful are Elzada U. Clover, Margaret Fulford, Agnes Kugel, Edgar Anderson, Carter Broad, R. B. Channell, Delzie Demaree, F. C. Gates, Rogers McVaugh, Howard F. L. Rock, Reed C. Rollins, E. G. Voss, and W. H. Wagner, Jr. Mr. Robert M. Linn, of Duke University, went to great trouble, for which I am most appreciative, to obtain crucial cytological material from Isle Royale during the summer of 1954. During the course of this study I have had the opportunity of examining all of the specimens of *Drosera* at the Cranbrook Institute of Science, Duke University, the Gray Herbarium, the University of Michigan, the University of Michigan Biological Station, the New York Botanical Garden, the University of North Carolina, the University of Pennsylvania, and the University of Wisconsin. The curators of these herbaria have been most cooperative in allowing me to study material from the collections in their care.—THE ARNOLD ARBORETUM OF HARVARD UNIVERSITY.

Literature Cited

Behre, K. 1929. Physiologische und Zytologische Untersuchungen über Drosera. Planta **7**: 208–306.

Bradley, Muriel V. 1948. A method for making aceto-carmine squashes permanent without removal of the cover slip. Stain Tech. **23**: 41–44.

Dahl, A. O. 1937. Chromosome studies in sundew (Drosera). Bull. Marine Lab. Woods Hole **73**: 368.

Darlington, C. D. 1937. Recent advances in cytology, ed. 2. Philadelphia.

Diels, L. 1906. Droseraceae in Engler, Das Pflanzenreich **4** (112): 1–136.

Digby, L. 1912. The cytology of Primula kewensis and of other related Primula hybrids. Ann. Bot. **26**: 357–388.

Dobzhansky, Th. 1941. Genetics and the origin of species, ed. 2. New York.

Erdtmann, G. 1943. An introduction to pollen analysis. Waltham, Mass.

Gleason, H. A. 1952. The new Britton & Brown illustrated flora of the northeastern United States and adjacent Canada. New York.

Heitz, E. 1926. Der Nachweis der Chromosomen: Vergleichende Studien über ihre Zahl, Grosse und Form im Pflanzenreich. I. Zeit. für Bot. **18**: 625–681.

Levine, M. 1916. Somatic and reduction division in certain species of Drosera. Mem. N. Y. Bot. Gard. **6**: 125–147.

Lloyd, F. E. 1942. The carnivorous plants. Waltham, Mass.

Marie-Victorin, Frère. 1935. Flore Laurentienne. Montreal.

Nakajima. 1933. Japanese Jour. Genetics **9**: 1 ff. [not seen.]

Narasimhachar, S. G. 1949. A contribution to the embryology of Drosera Burmannii Vahl. Proc. Ind. Acad. Sci. (Sec. B) **29**: 98–104.

Newcomer, E. H. 1953. A new cytological and histological fixing fluid. Science **118**: 161.

Ownbey, M. 1950. Natural hybridization and amphiploidy in the genus Tragopogon. Amer. Jour. Bot. **37**: 487–499.

Ownbey, M. and G. D. McCollum. 1954. The chromosomes of Tragopogon. Rhodora **56**: 7–21.

Rosenberg, O. 1903. Das Verhalten der Chromosomen in einer hybriden Pflanze. Ber. der Deutsch. Bot. Gesellsch. **21**: 110–119. Pl. 7.

———— 1904. Uber die Tetradenteilung eines Drosera-Bastardes. Ber. der Deutsch. Bot. Gesellsch. **22**: 47–53. Pl. 4.

———— 1909. Cytologische und morphologische studien an Drosera longifolia × rotundifolia. Kungl. Svenska Vetenskapsakademiens Handl. **43** (11): 1–65, 4 pl.

Sharp, L. W. 1934. Introduction to cytology, ed. 3. New York.

Shimamura, T. 1941. Cytological study of Drosera obovata Mert. & Koch with special reference to its hybridity. Bot. Mag. (Tokyo) **55**: 553–558.

Stebbins, G. L. 1950. Variation and evolution in plants. New York.

Winge, O. 1917. The chromosomes, their numbers and general importance. Compt. Rend. Trav. Lab. Carlsberg. **13**: 131–275.

Wynne, Frances E. 1944. Drosera in eastern North America. Bull. Torrey Bot. Club **71**: 166–174.

Epipactis Helleborine in Illinois.—The last general account of this orchid appeared in Rhodora **53:** 240–242, 1951, in which the records of its occurrence in Michigan were discussed by Drew and Giles. The concluding sentence in their article is "These facts suggest that this orchid may be reported from other adjacent mid-western states within the next few years." Illinois can now be added to the list.

During the summer of 1954 while botanizing a steep, wooded slope along a creek in the Biltmore Estates subdivision north of Barrington, northeastern Illinois, I located eight plants of *Epipactis Helleborine* in bud. I made daily observations and on July 21 some of the plants began to bloom. They were found about half-way up a natural forested slope covered by *Acer saccharum, Tilia americana,* and *Quercus rubra,* with an understory of *Staphylea trifolia* and *Ostrya virginiana.* Some of the herbaceous plant associates were *Asarum canadense, Uvularia grandiflora, Smilacina racemosa, Polygonatum canaliculatum, Hydrophyllum virginianum,* and *Smilax ecirrhata.* The area is part of an undisturbed section of woodland that harbors many species unusual in this section, such as *Elymus riparius, Botrychium multifidum* var. *intermedium, Liparis liliifolia, Panax quinquefolius, Lithospermum latifolium, Fraxinus nigra, Aster Shortii,* as well as both species of *Hepatica.* So far as I have been able to ascertain, the woodland is a virgin climax stand, and it certainly has not been disturbed within memory. The soil in which the orchids grew was neutral.

During the fifteen years of my residence in this section, this is the first trip I had ever taken to the particular section of the ravine in which the *Epipactis* occurred, so that I can only state that the summer of 1954 is the first year this orchid has come under my observation. It is very likely that it has been in this location for a number of years, and has merely been unobserved.

The data for this collection is as follows:—north-facing, wooded slopes of ravine along creek tributary to Grassy Lake, on south side of Eton Drive, Biltmore Estates subdivision, 5 miles north of Barrington, Lake Co., Illinois, July 21, 1954, *Steyermark 76351* (Herb. Chi. Nat. Hist. Mus.).—Julian A. Steyermark, chicago natural history museum and missouri botanical garden.

Northeastward Range Extensions for Two Species of Hypericum in Nova Scotia.—*Hypericum mutilum* L., var. *parviflorum* (Willd.) Fern., known (Roland 1947) the length of the Nova Scotian mainland, is newly recorded for the Flora of Cape Breton Island: INVERNESS CO.: Judique, occasional on brook bank, 13 Aug. 1951, *Smith, Schofield, Sampson & Bent 5014* (DAO, ACADIA).

Hypericum dissimulatum Bickn., discovered in Yarmouth, Digby, Lunenburg and Halifax Counties (Third Lake, Windsor Junction) by the Gray Herbarium Expedition to Nova Scotia, is now recorded for PICTOU CO.: Barney River, 28 Aug. 1935, *Groh* (DAO). In the new Gray's Manual, Fernald (1950) says that this species may be a hybrid of *H. canadense* with either *H. boreale* or *H. mutilum.* In its fastigiately crowded dense cymes and its small apiculate capsules, this specimen resembles *H. boreale;* in its linear-oblong leaves, acute bracts and acute sepals, *H. canadense.* The capsules are 2.5–3 mm. long, smaller than those of either putative parental species, approaching the size of those of *H. mutilum,* but as they show no developing seeds, this may be accounted for by hybridity. There is no suggestion of the rounded leaves and blunt sepals of *H. mutilum,* var. *parviflorum.* Thus, this may well be interpreted as a specimen of the hybrid *H. boreale* × *canadense.*—David Erskine, TORONTO, ONTARIO, CANADA.

Crooked Oaks on Cape Cod and Martha's Vineyard.—While the late Dr. Frank G. Speck and the writer were studying the ethno-biological relations of Wampanoag Indians on Cape Cod and Martha's Vineyard (Jour. Wash. Acad. Sci. **38** (8): 257–265. 1948.), our attention was called to many oak trees in the region of our study which had crooked trunks. In some sections of North America such growth forms are explained as having been produced by Indians who broke the trunk of saplings in order to mark boundaries. In this case, however, Dr. Speck found no evidence that such an explanation could be attributed to the native tradition of the Wampanoag on Cape Cod and Martha's Vineyard.—Ralph W. Dexter, DEPARTMENT OF BIOLOGY, KENT STATE UNIVERSITY, KENT, OHIO.

Volume 57, no. 675, including pages 73–104, was issued 28 March, 1955.

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Vol. 57 May, 1955 No. 677

CONTENTS:

The New England Botanical Club, Inc.

8 and 10 West King St., Lancaster, Pa.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of the Gray's Manual Range and regions floristically related. Price, $4.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) of not more than 24 pages and with 1 plate, 40 cents, numbers of more than 24 pages or with more than 1 plate mostly at higher prices (see 3rd cover-page). Back volumes can be supplied at $4.00. Some single numbers from these volumes can be supplied only at advanced prices (see 3rd cover-page). Somewhat reduced rates for complete sets can be obtained on application to Dr. Hill. Notes and short scientific papers, relating directly or indirectly to the plants of North America, will be considered for publication to the extent that the limited space of the journal permits. Illustrations can be used only if the cost of engraver's blocks is met through the author or his institution. Forms may be closed five weeks in advance of publication. Extracted reprints, if ordered in advance, will be furnished at cost.

Address manuscripts and proofs to Reed C. Rollins,
Gray Herbarium, 22 Divinity Ave., Cambridge 38, Mass.

Subscriptions (making *all remittances* payable to RHODORA) to

Dr. A. F. Hill, 8 W. King St., Lancaster, Pa., or, preferably, Botanical Museum, Oxford St., Cambridge 38, Mass.

Entered as second-class matter March 9, 1929, at the post office at Lancaster, Pa., under the Act of March 3, 1879.

Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 57 | May, 1955 | No. 677

ECHINODORUS IN THE AMERICAN TROPICS

NORMAN C. FASSETT[1]

I. INTRODUCTION

THIS study includes all the species of *Echinodorus* in the New World north of the Tropic of Capricorn; all are tropical with the exception of one that is confined to the United States. The temperate zone of South America has been excluded because of the several species described from Argentina, Uruguay and southern Brazil, that are not well represented in the available collections.[2]

The first extensive treatment of *Echinodorus* as a genus distinguished from *Alisma* and *Sagittaria* was by Micheli, in DeCandolle, Monographiae Phanerogamarum vol. **3:** 44–60. 1881. It was a splendid work; the descriptions of species were not only long and detailed, but covered just the points that seem most diagnostic today. Further reference to Micheli's acumen will be made in the discussion of *E. andrieuxi*. Micheli, to an extent not followed by later workers, made good use of the pellucid markings present in the leaves of many species. These can be seen only with transmitted light. The present writer uses a binocular microscope placed over a hole in the table-top, with an electric light in the drawer below.

[1] Professor Fassett died September 16, 1954. For a tribute to him and an account of some of his botanical activities see RHODORA **56**: 233–242. 1954. Eds.

[2] Material has been borrowed from the United States National Museum, the New York Botanical Garden, the Chicago Natural History Museum, the Gray Herbarium, the Academy of Natural Sciences of Philadelphia, and the Missouri Botanical Garden. Locations of cited specimens are indicated by the abbreviations recommended in the recently published Index Herbariorum. Maps 1–3, 7, and 13c are on a base map copyrighted by McKnight & McKnight, Bloomington, Illinois.

Unfortunately, many of the collections cited by Micheli are not represented in the herbaria available to the present writer. A few fragments of types turn up, but most of them consist of a bud or two and are of no value; some have mature nutlets and are very helpful. There are a few of Micheli's names that I have not been able to account for.

II. Subgenera and Sections

The dwarf plants passing as *Echinodorus tenellus*, or *E. parvulus*, have been the basis of the genus *Helianthium*.[3] The segregation seems to have been on the following set of differences: *Echinodorus:* (1) style apical; (2) fruit-heads echinate; (3) achenes flat; (4) achenes beaked; (5) stamens 12–30, or rarely fewer; (6) carpels numerous. *Helianthium:* (1) style not apical; (2) fruit-heads not echinate; (3) achenes very turgid; (4) achenes beakless or obscurely beaked; (5) stamens 6 or 9; (6) carpels relatively few.

Another character not listed in the literature appears in the anthers; they are versatile in *Echinodorus* (*sensu stricto*) and basifixed in *Helianthium.*

Some of these characters do not hold, and those that do hold seem insufficient for generic segregation. The style is nearly apical in two hitherto undescribed South American representatives of *Helianthium* (Figs. 71 and 72), and strongly lateral in *Echinodorus cordifolius* (*E. radicans*)—see Fig. 77 in Gray's Manual, ed. 8, or figure on page 96, vol. 1, Britton and Brown's Illustrated Flora, ed. 2; fruiting heads are scarcely echinate in *E. cordifolius.* Two species of the *Helianthium* group have beaked achenes (Figs. 71 and 72), as does *Echinodorus nymphaeifolius*, which is also put into *Helianthium* on the basis of its small number of carpels and stamens. The dozen or so carpels and 6 or 9 stamens with basifixed anthers in *Helianthium*, contrasted with about 100 carpels and usually 12–30 stamens with versatile anthers in *Echinodorus* (*sensu stricto*), appear to be consistent, but scarcely sufficient for generic separation.

The genus *Echinodorus* may be subdivided as follows:

a. Carpels many in a dense head; stamens 12–30; anthers versatile.
Subgenus 1. *Echinodorus.*

[3] Britton, Man. ed. 2, 54. 1905; Small, N. Am. Fl. 17, pt. 1: 45. 1909; Britton & Brown, Ill. Fl. ed. 2, 1: 95. 1913.

a. Carpels 20 or fewer in a loose head; stamens 6 or 9; anthers basifixed. Subgenus 2. *Helianthium*.
b. Ribs of achenes crested; blades of emersed leaves cordate; inflorescence compound........................Section *Nymphaeifolii*.
b. Ribs of achenes not crested; blades of all leaves linear-lanceolate to elliptic; inflorescence of one or few whorls...........Section *Tenelli*.

Subgenus Echinodorus. *Echinodorus* Britton, Man. ed. 2: 54. 1905; Small, N. Am. Fl. 17, pt. 1: 45. 1909; Small, Man. S. E. Fl. 21. 1933. Type species, *Alisma rostratum* Nutt.

Subgenus **Helianthium** (Engelm.) stat. nov. *Helianthium* Engelm. in Britton, l.c.; Small l.c.

Section **Nymphaeifolii,** sect. nov., carpellorum costis alatis; laminis foliorum cordatis. Type species *Alisma nymphaeifolium* Griseb.

Section **Tenelli,** sect. nov., carpellorum costis non alatis; laminis foliorum lanceolatis vel ellipticis. Type species *Alisma tenellum* Mart.

The nutlets of Sect. *Tenelli* frequently have what may be termed a beaklet; it is a small umbo, of the same texture as the rest of the pericarp, directly below the style (Fig. 67) or sometimes some distance below it (Fig. 70). Sometimes the style appears to come directly from the beaklet (Fig. 69). When a longer beak is present, it seems to be of stylar origin (Figs. 71, 72).

III. Taxonomic Treatment

a. Carpels many in a dense head; stamens 12–30; anthers versatile. Subgenus *Echinodorus*.
b. Sepals 12–20-nerved, thin, withering, not accrescent, reflexed or loosely ascending in fruit; pellucid markings of leaves, if present, not reticulate.
c. Blades of leaves cordate or truncate at base (Figs. 1–13) (elliptic on some dwarfed individuals, Figs. 8 and 9, and linear on some submersed leaves); petiole not winged.
d. Flowers on pedicels several times as long as the fruiting heads.
e. Blades with pellucid lines or dots (pellucid markings occasionally obscure or absent, especially on dwarfed or submersed membranous leaves); leaves glabrous except in species no. 8.
f. Nutlets about ⅔ as broad as long, the dorsal margin rounded at summit (Fig. 22), and facial glands nearly round; little-known plant of Mexico......................1. *E. virgatus*.
f. Nutlet twice as long as broad, the dorsal margin sloping downward; facial glands mostly longer than wide (Figs. 23 and 51).
g. Sepals with papillose ridges; scape erect when young but soon procumbent; nutlet with summit of keel often crested and beak ascending (Figs. 23, 24).........2. *E. cordifolius*.
g. Sepals with smooth veins; scape erect at maturity; nutlet with keel entire and beak erect or nearly so (Figs. 25–34).

h. Leaves glabrous, with pellucid lines often several mm. long (Fig. 55); facial glands of nutlet often entering the base of the long (0.5–2 mm.) beak (Figs. 25, 29)
3. *E. Berteroi.*

h. Leaves with stellate hairs on lower surface near base of blade; pellucid dots abundant (Fig. 56) but lines absent or rare (except in varieties (Figs. 57, 58) in Paraguay and Argentina); facial glands of nutlet rounded at both ends and scarcely approaching to within one gland-length of the short (0.2 mm.) and stout beak (Figs. 30, 31)
4. *E. grandiflorus.*

e. Leaves without pellucid markings, with stellate hairs on lower surface near base of blade and summit of petiole (hairs often rubbing off and leaving papilla-like bases). (Fig. 11).

i. Inflorescence erect, often compound, with pedicels reaching 3 cm. in length . . . . 5. *E. muricatus.*

i. Scape creeping, simple, sometimes 2 m. long, rooting at nodes and sometimes proliferous, with erect pedicels sometimes reaching 7 cm. in length . . . . 6. *E. fluitans.*

d. Flowers nearly sessile . . . . 7. *E. bracteatus.*

c. Blades tapered or subtruncate at base (Figs. 14–21), petioles mostly winged.

j. Petioles not winged (Fig. 13); little-known plant of Cuba.
8. *E. ovalis.*

j. Petioles winged (Figs. 14–21).

k. Leaves veined from the base of the blade or sometimes slightly pseudopenninerved (Figs. 14, 15, 17–20); flowers pedicelled.

l. Inflorescence racemose; pedicels 2–4-angled, scarcely ribbed or fluted; body of nutlet 2–2.5 times as long as wide (Figs. 41–43), with beak (0.5)–0.8–1 mm. long, the face with one gland (rarely 2)
9. *E. Andrieuxi.*

l. Inflorescence paniculate on larger plants; pedicels (when dry) with about 10 winged angles; body of nutlet more than half as wide as long (Figs. 48, 49), with short stout beak and no glands
10. *E. paniculatus.*

k. Leaves pseudopenninerved (Figs. 16, 21); flowers sessile or nearly so.

m. Leaves many times as long as wide, acuminate (Fig. 21); rachis of inflorescence with green wings about 2 mm. wide; fruit glandless (Fig. 50) . . . . 11. *E. trialatus.*

m. Leaves about 3 times as long as wide, acute (Fig. 16); rachis of inflorescence not winged; fruit with several facial glands (Fig. 51) . . . . 12. *E. Grisebachii.*

b. Sepals about 30-nerved, thick and brittle, enlarging in fruit to cover the fruiting head; pellucid markings reticulate (Fig. 64) . . . . 13. *E. tunicatus.*

a. Carpels 20 or fewer in a loose head; stamens 6 or 9; anthers basifixed.
Subgenus *Helianthium.*

n. Ribs of nutlet crested (Fig. 53); blades of emersed leaves ovate and deeply cordate . . . . Section *Nymphaeifolii.*
14. *E. nymphaeifolius.*

n. Ribs of nutlets not crested (Figs. 66–72); blades of all leaves linear-lanceolate to elliptic (Figs. 73–76) . . . . Section *Tenelli.*

o. Summit of nutlet rounded above the beaklet (Figs. 66–70); stylar beak nearly absent or up to 0.4 mm. long; anthers 0.2–1.0 mm. long.
p. Facial ribs 3 on each side (Figs. 66, 67, 70) or suppressed (Fig. 68) 15. *E. tenellus.*
p. Facial ribs 4 on each side (Fig. 69). . . . . .16. *E. isthmicus.*
o. Summit of nutlet horizontal or sloping downward from the beaklet (Figs. 71, 72); stylar beak 0.6–0.8 mm. long; anther 0.4–0.6 mm. long.
q. Nutlet with 4 distinct facial ribs (Fig. 72). . . .17. *E. quadricostatus.*
q. Nutlet with facial ribs nearly or quite obsolete (Fig. 71). 18. *E. magdalenensis.*

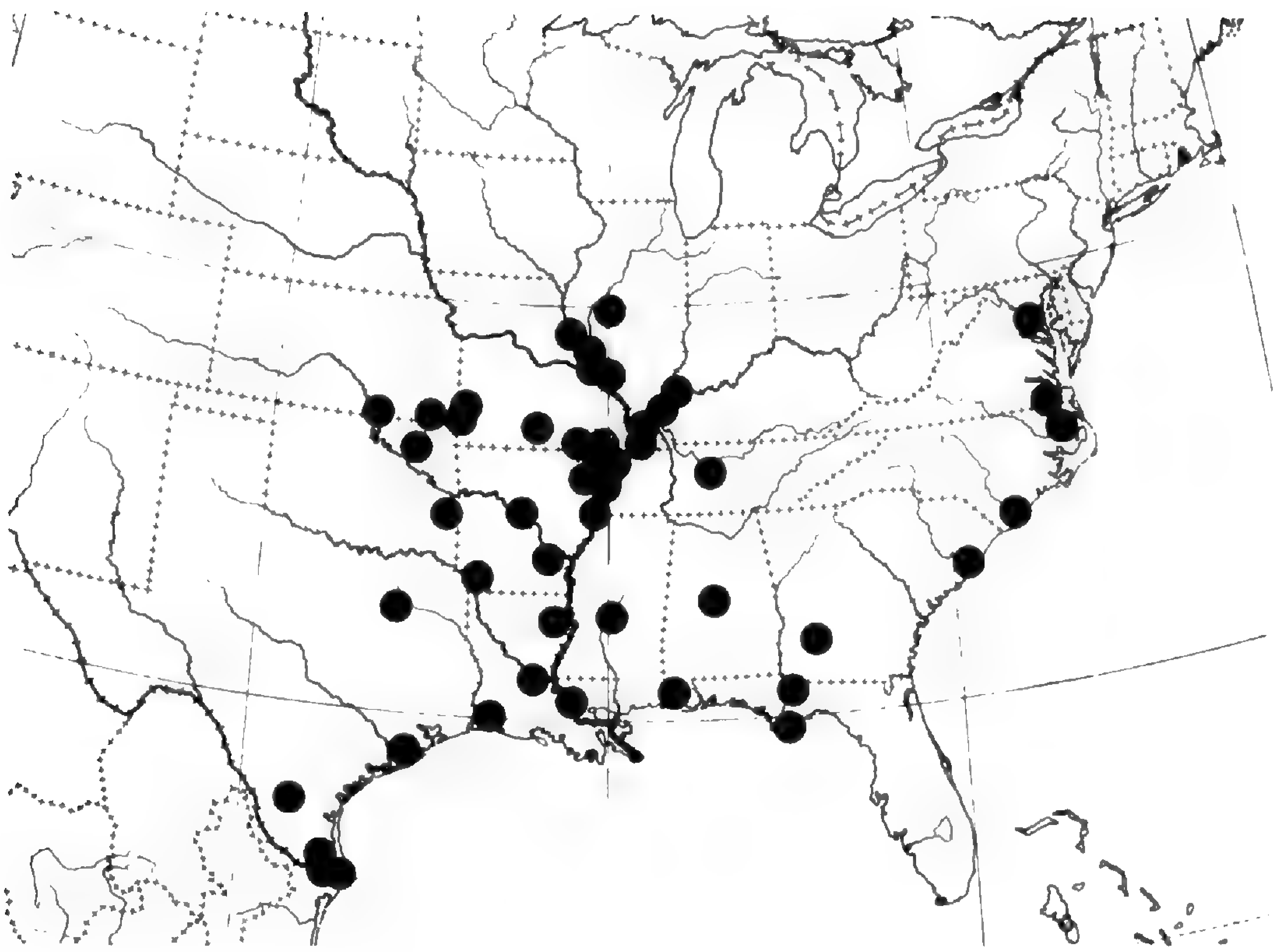
1. Echinodorus virgatus (Hook. & Arn.) Micheli in DC. Monogr. Phan. **3:** 54. 1881; Buch. in Engler, Pflanzenr. **4,** pt. 15: 32. 1903; Small, N. Am. Fl. **17,** pt. 1: 47. 1909. *Alisma virgata* Hook. & Arn., Bot. Beech. Voy. 311. 1839.
Tepic, Mexico.

Our Fig. 22 shows the very distinctive nutlet, from a fragment of the TYPE (MO). "Mexico" is the only locality given in the original description, but on page 275 is the statement, "When no habitat is mentioned, the specimens are understood to have been collected at Tepic." Fig. 1 is traced from a drawing of the TYPE (NY); I have not seen an actual leaf to examine the pellucid lines, which Micheli describes as being elongate. The drawing of the type shows about 10 flowers at a node, on pedicels 0.5–1 cm. long.

2. Echinodorus cordifolius (L.) Griseb. in Goett. Abh. **7:** 257, repr. 109. 1857, at least as to Linnean basionym, not as to other synonyms; Fernald, Rhodora **49:** 107. 1947, and in Gray's Manual, ed. 8. 85. 1950. *Alisma cordifolia* L. Sp. Pl. 343. 1753. *Sagittaria radicans* Nutt., Trans. Am. Phil. Soc. **5:** 159. 1837. *Echinodorus radicans* Engelm. in Gray, Man. 460. 1848, and ed. 2. 438. 1856; Robinson & Fernald in Gray's Manual, ed. 7. 84. 1908; Fassett, Man. Aquat. Pl. 93. 1940; Muenscher, Aquat. Pl. U.S. 84. 1944.

In transferring the Linnean *Alisma cordifolia* to *Echinodorus,* Grisebach confused it with another species, perhaps the Brazilian *E. macrophyllus* (Kunth) Micheli. Grisebach also refers to Vell. Ic. Fl. Flumin. 10, t. 31. 1827, which illustrates an erect compound inflorescence quite unlike that of *E. cordifolius* as here treated. But, as Fernald demonstrates, the name rests on *Alisma cordifolia* L. from Virginia.

Leaves erect, long-petioled, the blade broadly ovate, shallowly cordate or truncate at base and rounded at apex, 6–20 cm. long, 4–8 cm. wide; pellucid markings nearly round or elongate, seldom exceeding 1 mm. but rarely reaching 3 mm. in length, mostly 1 mm. or more apart (Fig. 54),



Map 1. Echinodorus cordifolius.

very rarely obscure or lacking; scape at first erect, soon prostrate, usually with long-triangular bracts but sometimes with small leaves at the nodes; flowers 5–15 at a node, on pedicels 2–6 cm. long; sepals with papillose ridges; nutlets about 2.5 mm. long and 0.8–1.2 mm. wide, with ascending beaks only about 0.2 mm. long (rarely –0.8 mm.) so that the head of nutlets appears smooth to the naked eye; nutlet with an often irregularly crested dorsal keel (Figs. 23, 24); facial ribs 3–4, often abruptly bent, the two toward the dorsal keel most strongly winged toward the summit; glands 1 or 2, short and rounded, not approaching to within one gland-length of the base of the beak.

Atlantic Coastal Plain from southern Texas to northern Florida and the District of Columbia; up the Mississippi Valley to central Tennessee, southern Indiana, central Illinois, northeastern and southwestern Missouri, southeastern Kansas, eastern Oklahoma and northeastern Texas (Map 1). **District of Columbia:** flats of Potomac at Chain Bridge, 1 August 1900, *Steele* (NY). **Virginia:** Franklin, Southampton Co., 22–29 July 1893, *Heller 1026* (PH, MO, F, US, NY). **North Carolina:** Wilmington, 2 August 1900, *Williamson* (NY, PH); Edenton, Chowan Co., 10 July 1938, *Godfrey 5353* (US). **South Carolina:** mud bank, Santee River, near Jamestown, Berkeley Co., 27 June 1939, *Godfrey & Tryon 118* (MO, US, NY); St. Johns, *Porcher* (NY). **Georgia:** margin of pool in Flint River bottoms, Dooly Co., 3 September 1900, *Harper 564* (US, NY). **Florida:**

Aspalaga, October 1897, *Chapman* (MO); Apalachicola, *Chapman* (NY). **Illinois:** Menard Co., 1861, *Bebb* (F); Menard Co., August 1864, *Hall* (F, PH); lakes by Cahokia, 23 August 1878, *Eggert* (MO); Bluffs Lake, St. Clair Co., 27 July 1878, *Eggert* (MO); swamps opposite St. Louis, August 1863, *Engelmann* (MO); Flat Lake, Calhoun Co., 19 October 1920, *Metcalf 1117* (US). **Indiana:** in the dried up bottom of the Pitcher pond about 6 mi. northwest of Mt. Vernon, Posey Co., 8 October 1916, *Deam 22303* (NY). **Kentucky:** in water at Swan Pond, Wicliffe, 18 August 1923, *McFarland & Anderson 168* (MO, US). **Tennessee:** Nashville, August, *Gattinger 2741* (MO, US, NY). **Alabama:** Prattville, 22 July 1874, *Smith* (US); exposed open places, Mobile, 30 May 1884, *Mohr* (US). **Mississippi:** Jackson, 19 July 1925, *Cook* (US); creek bottom, Natchez Trace Parkway, 24 June 1948, *McDougall 1683* (US). **Missouri:** low wet woods, near Torch, Ripley Co., 12 July 1933, *Palmer & Steyermark 41598* (MO); Little Creve Coeur Lake, 15 September 1891, *Douglass* (MO); Poplar Bluffs, Butler Co., September 1897, *Russell* (MO); Kennett, 18 September 1893, *Bush* (MO); wet mud around margin of Goose Lake, Papinsville, Bates Co., 1 October 1938, *Steyermark 9986* (F, MO); low woods bordering Stulz Lake along Marmaton River, Nevada, Vernon Co., 29 September 1938, *Steyermark 9800* (F, MO); ditches along road, Quilin, Butler Co., 27 May 1939, *Steyermark 26640* (F); Kings Lake, Lincoln Co., 7 August 1927, *Kellogg 816* (MO); Pike Co., 1860, *Peck* (F); Pence Lake, Vernon Co., 1 August 1919, *McAtee 3042* (US). **Arkansas:** moist soil in bottoms, Little Rock, 7 June 1885, *Haase* (PH); Bayou Bartholomew, Lincoln Co., Yorktown, 10 September 1936, *Demaree 13760* (MO, US); Fulton, 18 September 1900, *Bush 931* (MO); low swampy woods, Corning, Clay Co., 24 June 1914, *Palmer 6056* (MO, F); sandy bogs along Yellow Creek, near McNab, Hempstead Co., 27 October 1924, *Palmer 26722* (MO); Dryden, Craighead Co., 22 August 1913, *Emig 55* (MO); wet spring ditches, Lake City, Craighead, 25 June 1929, *Demaree 6940* (F, US); Lake Waponoca, Crittenden Co., 17 November 1910, *McAtee 1884* (US). **Louisiana:** single plant at spring in pine barrens, Alexandria, 27 May 1899, *Ball 482* (MO); Hamburg, 13 September 1912, *McAtee 2215* (US); Baton Rouge, July 1914, *Griffins* (NY); swamp east of Tallulah, 29 June 1946, *Fassett 26692* (WIS). **Kansas:** Cowley Co., 1898, *White* (MO); Wilson Co., 1895, *Haller 983* (MO, US, NY). **Oklahoma:** Verdigris River, 21 August 1895, *Blankinship* (MO, US); E. Dartlesville, Washington Co., 31 August 1927, *Stratton 505* (MO); Heavener, 20 June 1936, *de Gruchy 119* (NY). **Texas:** swamps, Dallas, 5 June 1902, *Reverchon 4043* (MO, NY); Santa Maria, 1889, *Nealley 505* (F); water's edge, Riviera, Brooks Co., 9 April 1933, *Clover 825* (NY); Houston, October 1842, *Lindheimer* (MO); San Antonio, Bexar Co., 30 June 1911, *Clemens 124* (MO); Los Fresnas, 10 July 1923, *Runyon 446* (US); in marshy pond, Tarrant Co., 10 August 1925, *Ruth 1349* (US).

3. ECHINODORUS **Berteroi** (Spreng.) n. comb. *Alisma Berteroi* Spreng., Syst. **2:** 163. 1825. *A. Berteroanum* Balbis in R. & S., Syst. Veg. **7:** 1605. 1830; Kunth, Enum. **3:** 152. 1841. *A. cordifolius* Kunth, Enum. **3:** 152.

1841, not L. *A. Sprenglii* Kunth, Enum. **3:** 152. 1841. *Echinodorus cordifolius* β. *Berteroanus* Griseb. in Goett. Abh. **7:** 257, reprint 109. 1857. *E. rostratus* Engelm., Gray's Man. 460. 1848.

Emersed leaves erect, long-petioled, the largest (reaching perhaps 20 cm. in length) broadly oval and shallowly cordate (Fig. 2) or broadly ovate (Fig. 3), the smaller becoming narrower in proportion, down to the small elliptic or lanceolate leaves on dwarfed plants (Figs. 4, 5, 7); pellucid lines usually very clear, the longest commonly reaching about 2.5 mm. in length (a maximum of 11 mm. observed), extending nearly from veinlet to veinlet (Fig. 55), rarely locally absent; submersed leaves, when present, usually ribbon-like and membranous; scape erect, the lower branches compound; head of nutlets appearing echinate due to the spreading beaks; nutlets (Figs. 25–29) broadly keeled, with 2 winged ribs alternating with 3 non-winged ribs; facial gland commonly single, close to the beak, usually with an attenuate tip entering its base.

West Indies and southern Mexico, north to Ohio, Illinois, Missouri, Kansas, Texas and California (Maps 2a & 2b). Reported from Central America in Gray's Manual, ed. 8, and in North American Flora, probably erroneously.

The positive identification of *Alisma cordifolia* as the creeping plant also known as *Echinodorus radicans* (no. 2 of the present treatment) was followed by the adoption of the name *E. rostratus* (Nutt.) Engelm. for the erect species sometimes called *E. cordifolius* (Fernald, Rhodora **49:** 108. 1947). But there are at least two older names for *E. rostratus*, both based on material from Guadeloupe. The description of *Alisma Berteroi* was brief: "A. foliis oblongis utrinque attenuatis 3 nervis, scapo 3 gono, capsulis cuspidatis." Only the last two words are helpful, referring to the beaked fruit (Figs. 25–29). The leaves were certainly from a dwarfed plant, like our Figs. 5 & 9. The description of *A. Berteroanum* is ample and clear, and the leaves are stated to be 5- or 7-nerved. Kunth, substituting the name *A. Sprenglii* for *A. Berteroi*, suggested that it was but a form of *A. Berteroanum*. The more ample material now at our disposal demonstrates the polymorphism of the leaves of this species (Figs. 2–9) as quite sufficient to include both *A. Berteroi* and *A. Berteroanum*.

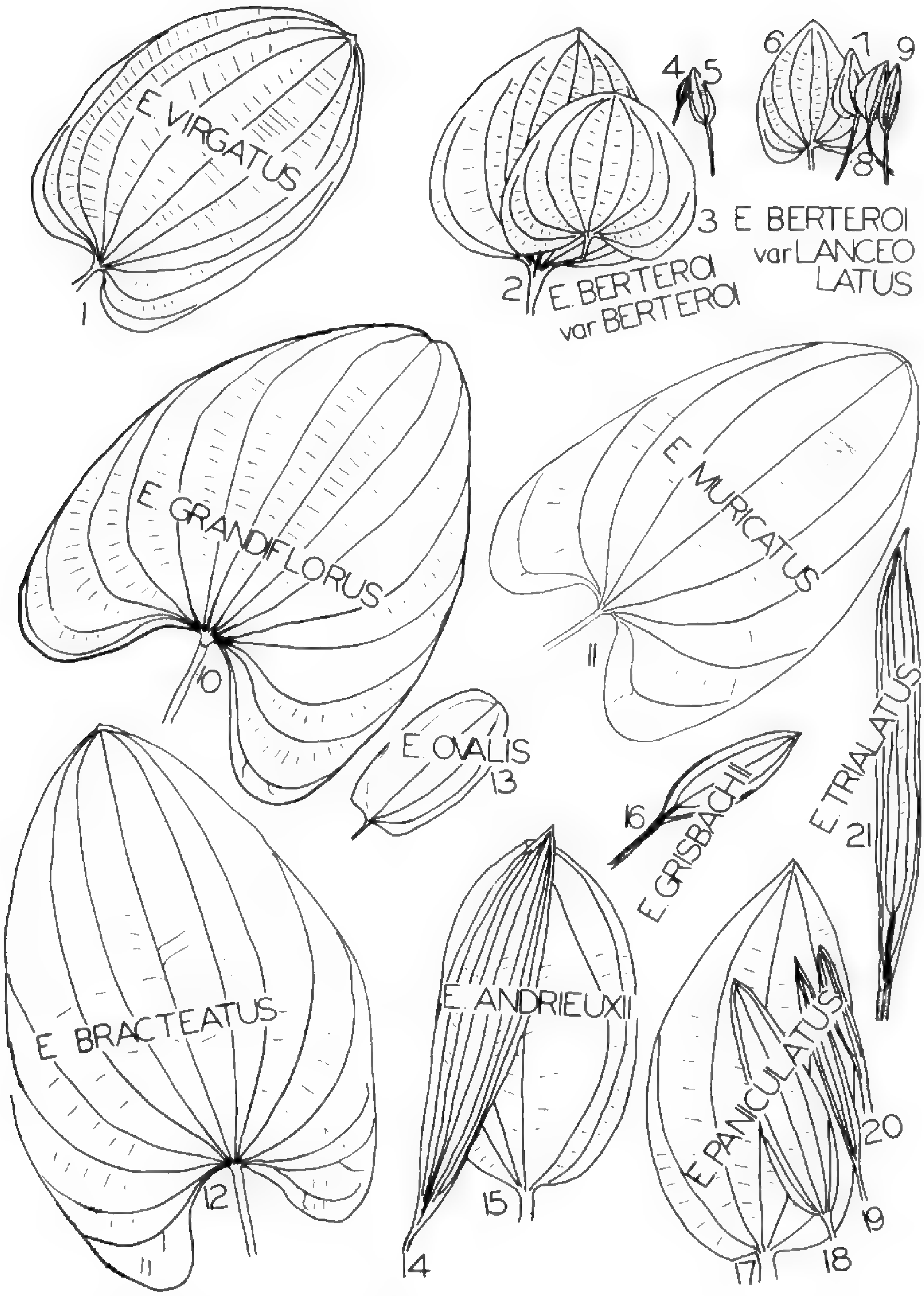
The northern and southern phases of this species differ mainly in the length of beak on the nutlet; much material in the region of overlap, in Texas, Oklahoma and California, is intermediate.

a. Beak of nutlet 1.2–2 mm. long, ½–⅔ as long as the body (Figs. 25–27); anthers 0.8–1.2 mm. long. . . . . 3a. *E. Berteroi* var. *Berteroi*.

a. Beak of nutlet 0.5–0.8 (–1) mm. long, ⅓–½ as long as the body (Figs. 28, 29); anthers 0.5–0.8 mm. long. . . . . 3b. *E. Berteroi* var. *lanceolatus*.

3a. E. Berteroi (Spreng.) Fassett, var. Berteroi. *Alisma Berteroi* Spreng., l.c. From southern California, Kansas, Oklahoma and Texas, where many individuals are more or less intermediate with the northern variety, var. *Berteroi* ranges southward to central Mexico and northern Yucatan. I have not seen material from the mainland of Florida, but it is on the Keys. It appears to be local in Cuba, but abundant throughout the Bahamas, Hispaniola, Puerto Rico and the Lesser Antilles. Just as it approaches but is not known to reach continental Florida, so it is represented by several collections from Curaçao but not from continental South America (Map 2a).

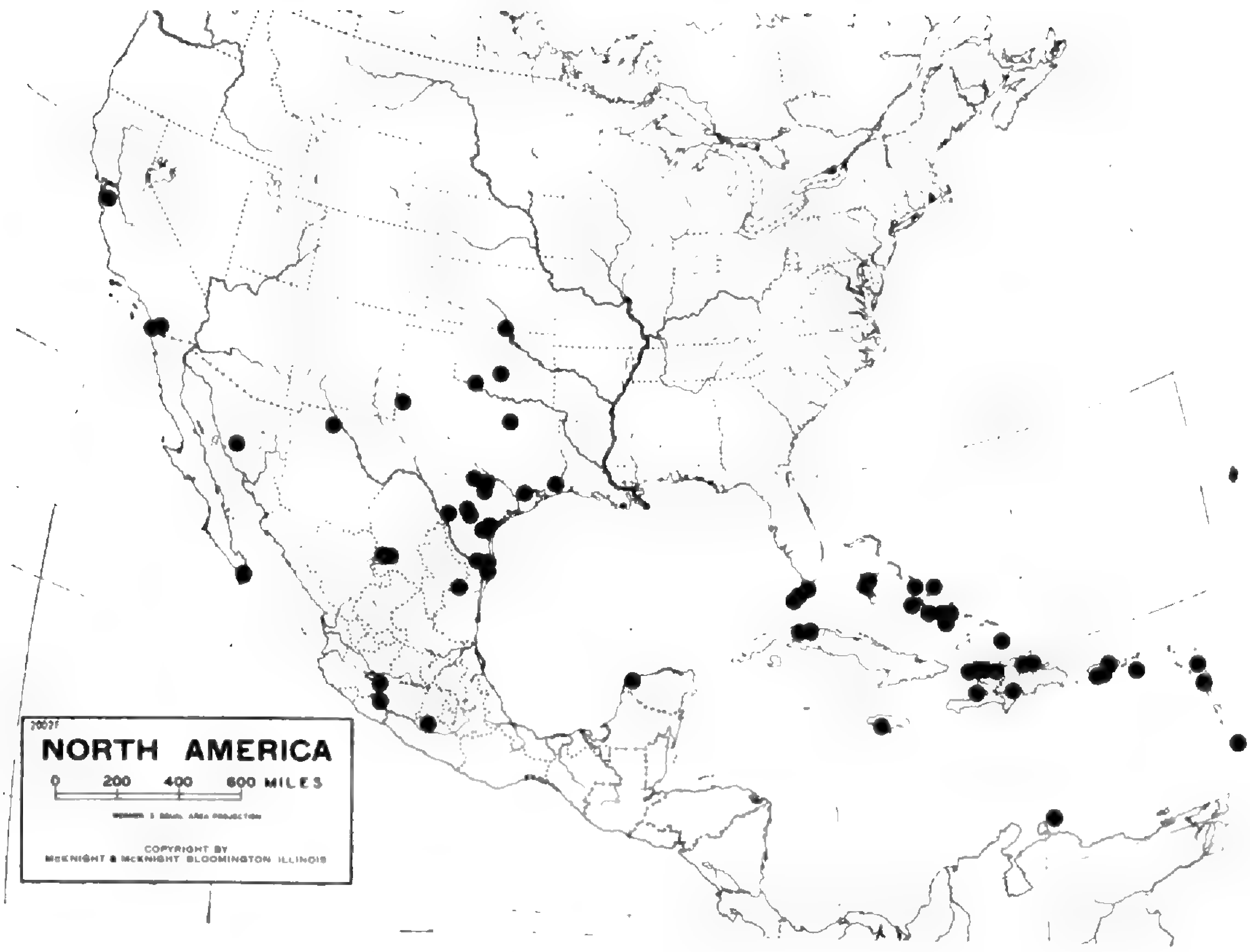
Florida: Key West, June 1839, *Ritch* (US); dry ponds, Lower Matecumbe, 4 February 1892, *Simpson 434* (US, NY); Key West, *Blodgett* (NY). **Kansas:** Cowley Co., 1898, *White* (MO, US). **Oklahoma:** creek bed, covered with water to a depth of about 4″, also on wet banks, 2 mi. sw. of Cache, 26 May 1936, *de Gruchy 13* (MO); pond, 6 mi. n. of Oklahoma City, 30 May 1939, *Waterfall 1182* (NY). **Texas:** on banks of Lake Como, Tarrant Co., 12 October 1919, *Ruth 203* (PH, F); dry sink in prairie, Caldwell Co., 13 July 1943, *Barkley 13135* (US); in paludosis prope las Nuces, April 1834, *Berlander 2422* (US); San Antonio, 2 October 1900, *Bush 1222* (MO); San Antonio, 23 June 1911, *Clemens 120* (MO); water's edge, La Joya, Hidalgo Co., 14 March 1933, *Clover 639* (NY); land on which water has stood near old river channel, Brownsville, Cameron Co., 1–5 August 1921, *Ferris & Duncan 3178* (MO, NY); water-hole, Corpus Christi, September 1884, *Havard* (US); Comanche Spring, New Braunfels, August 1850, *Lindheimer 1233* (F, NY); swamp, Pleasanton Rd. 9 mi. s. of San Antonio, 9 July 1931, *Metz 198* (NY); shallow pools, Silsbee, Hardin Co., 13 June 1916, *Palmer 10174* (MO); shallow pools, Uvalde, 14 October 1916, *Palmer 11031a* (MO); Lubbock, *Reed 3169* (US); Curry Creek, Blanco Co., 1884, *Reverchon 1772* (MO); Lavaca River, Jackson Co., 27 August 1941, *Tharp 15* (MO); Demmit Co., 24 June 1941, *Tharp* (MO); Brownsville, 26 October 1927, *Rose & Russell 24243* (US); Austin, August 1921, *Schulz 906* (NY); San Marcos, Spring, 1897, *Stanfield* (NY). **California:** San Diego Co., August 1897, *Allen* (NY); Lakeside, San Diego Co., 23 (or 30?) June 1906, *Brandegee* (MO, F); lake margin, Laguna Cañon, Laguna Beach region, 26 July 1916, *Crawford* (MO); Sweetwater, July 1884, *Orcutt* (MO, F); drying lake bed, Stanford University lake, Santa Clara Co., 14 July 1946, *Rose 46218* (MO). **Baja California:** along stream below Santiago, 6 May 1931, *Wiggins 5663* (US, NY, GH); **Sonora:** Canyon Estrella, Dist. Alamos, 1 October 1933, *Gentry 421M* (F); Agua Caliente, Alamos, 10 November 1933, *Gentry 896M* (US). **Chihuahua:** water hole near Guadalupe, 11–12 October 1852, *Thurber 805* (GH). **Coahuila:** Torreon, 13–20 October 1898, *Palmer 466* (F, GH, MO, US, NY). **Tamaulipas:** Matamoros, 2 September 1939, *LeSueur 53* (F); El Mulato, 16 August 1930, *Bartlett 10984* (F, GH). **Michoacan:** swamps, Zamora, 5000 ft. alt., 21 May 1901, *Pringle 8484* (F, GH, PH, MO, US, NY); LaHuerta, District of Apatzingan, 29–30 December 1890, *Maury 5310* (NY). **Guerrero:** Iguala, 25 October 1900, *Pringle 9277* (GH, US). **Yucatan:** Progreso, 5 March 1899, *Millspaugh 1692bis* (F, US); in fresh water pool, Progreso,



11–15 August 1932, *Steere 3093* (NY). **Bahamas:** Long Cay, 7–17 December 1905, *Brace 4081* (F, US, NY); Pompey Bay, Acklin's Island, 21 December to 6 January 1906, *Brace 4424* (F, NY); water holes, Stopper Hill, Crocked Island, 9–23 January 1906, *Brace 4829* (F); sink holes near Georgetown, Great Exuma, 22–28 February 1905, *Britton & Millspaugh*

3104 (F, GH, US, NY); Cat Island, 1–6 March 1907, *Britton & Millspaugh 5798* (F); Watling's Island, Graham's Harbor to Cockburn Town, 15 March 1907, *Britton & Millspaugh 6206* (F, NY); Grand Turk Island, The Wells and vicinity, 16 March 1911, *Millspaugh & Millspaugh 9338* (F); black loam, swampy, Fresh Creek settlement, Andros, 31 March 1905, *Wight 256* (F, GH, NY). **Cuba:** *Wright,* without locality (GH); Barreras, Playa de Tarara, Habana, 28 August 1930, *Léon 14661* (GH); Playa de Marianao, Prov. Habana, 22 February 1910, *Britton & Wilson 4556* (NY); little lagoon on a serpentine hill, Guyana, Havana, 1 June 1911, *Léon 2585* (NY); in water, serpentine hill, Cuabal de Figueras, ne. of Canasí, Matauzas, 31 May 1928, *Leon 13381* (NY). **Jamaica:** in shaded swamps, Salt Ponds, 27 December 1915, *Harris 13312* (F, GH, NY, US). **Haiti:** shallow pond and swamp area between Terrier Rouge and Fort Liberté, northeastern alluvial plain, 26 June 1941, *Bartlett 17472* (GH, US); moist place, Presqu'ile do Nord-Ouest, Port-de-Paix, Etang-Portalus, 13 March 1928, *Ekman 9683* (US); among cat-tails, common, Etang Saumatre, 7 April 1920, *Leonard 3516* (GH, NY, US); muddy bank of stream, scarce, La Source, Pikmi, Gonave Island, 7 July 1920, *Leonard 5188* (US, NY); Ennery, Dept. de l'Artibonite, alt. 325–900 m., 3 February 1926, *Leonard 9449* (US); in bed of Mole River, Mole St. Nicolas, 13–19 February 1929, *Leonard & Leonard 13139* (US, GH, NY); muddy roadside, west of Trois Rivières, Port de Paix, 12 May 1929, *Leonard & Leonard 15630* (US); sea level, Bayeux, near Port Margot, 3 August 1903, *Nash 60* (F, NY). **Dominican Republic:** Peñon, Prov. Barahona, September 1911, *Fuertes 1132* (F, GH, NY, US); Sto. Domingo in paludosis ad Rio Muñoz, 100 m., 15 June 1887, *Eggers 2477* (NY); sitio húmedo, cerca de la playa, Cerca de Gaspar Hernandez, 5 April 1950, *Jimenez 1958* (US). **Puerto Rico:** river swamp, Coamo Reservoir, 8 February 1922, *Britton, Britton & Brown 5949* (NY); along stream, Coamo Springs, 23 March 1906, *Britton & Cowell 1340* (NY); Guayanilla, 10 March 1913, *Britton & Shafer 1793* (NY, US); borders of Lake Guanica, Guanica, 11–12 March 1913, *Britton & Shafer 1868* (NY, US); in paludosis, Coamo, 21 December 1885, *Sintenis 3200* (GH, US); Guanica, in arenosis litoralibus ad lagunas, 20 January 1886, *Sintenis 3375* (US, MO); Guanica, in litore ad la Plata, 24 February 1886, *Sintenis 3844* (F, GH, PH, NY, US); Palo Seco, 3 February 1916, *Stevenson 3837* (US); marsh, Guanica Lagoon, 17 March 1937,

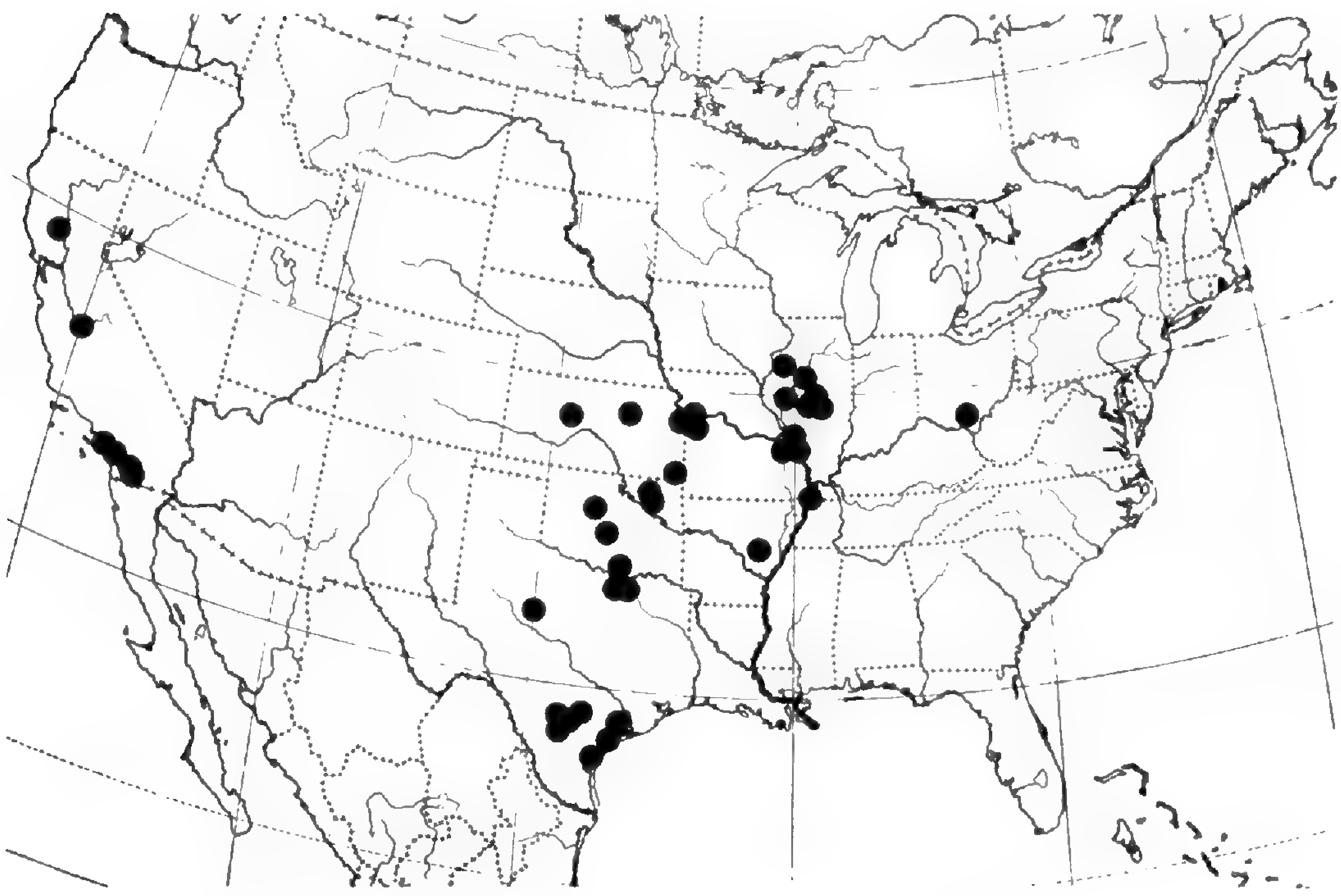
FIG. 1–21. LEAVES OF SUBGENUS ECHINODORUS (× ¼). FIG. 1: *E. virgatus.* Mexico, Beechey (from drawing of type in NY). Fig. 2–5. *E. Berteroi* var. *Berteroi.* 2: Puerto Rico, Sentenis 3200 (US). 3: Guadeloupe, Duss 3652 (US). 4, 5: Haiti, Bartlett 17472 (US). Fig. 6–9: *E. Berteroi* var. *lanceolatus.* 6: Illinois, Engelmann (MO). 7–9: Illinois, Engelmann (Type of *E. rostratus* var. *lanceolatus,* in MO). Fig. 10. *E. grandiflorus* var. *grandiflorus,* Panama, Woodson & Schery 754 (US). Fig. 11. *E. muricatus,* Brazil, Tate 61 (NY). Fig. 12. *E. bracteatus* var. *bracteatus,* Ecuador, Hitchcock 20084 (US). Fig. 13. *E. ovalis,* Cuba, Wright (US). Fig. 14, 15. *E. Andrieuxi.* 14: Mexico, Pringle 8256 (US). 15: Mexico, Mexia 1065 (NY). Fig. 16. *E. Grisebachii,* Cuba, Wright 4198 (isotype in US). Fig. 17–20. *E. paniculatus* var. *paniculatus.* 17: Venezuela, Fernandez 71 (US). Fig. 18: Brazil, Krukoff 2030 (US). 19: Brazil, Glaziou 14288 (US). 20: Venezuela, Chardon 26 (US). Fig. 21. *E. trialatus,* Colombia, Cuatrecasas 5283 (type in US)



Map 2a. Echinodorus Berteroi var. Berteroi.

Vélez (NY). **Virgin Islands:** King's Hill gut, St. Croix, 17 March 1897, *Ricksecker 255* (F, MO, US); Catherine's Rest, 14 February 1896, *Ricksecker 275* (F, GH, MO, NY, US). **Antigua:** in small colonies in estate ponds and in sluggish streams, Elliots, 15 February 1938, *Box 1370* (US); ponds and the lower reaches of sluggish streams, Judges, 1 November 1937, *Box 1243* (US). **Guadeloupe:** Capesterre Marie-Galante, 1895, *Duss 3652* (F, GH, MO, NY, PH, US); Grande-Terre, 5 March 1937, *Stelé 1555* (US); Gosier, March 1937, *Questel 4584* (US). **Barbados:** Ealin Grove pond, 13 August 1906, *Dash 163* (US, NY). **Curaçao:** Water hole, Mt. Pleasant, 20–27 March, 1913, *Britton & Shafer 3115* (F, NY, US).

3b. E. Berteroi (Spreng.) Fassett, var. **lanceolatus** (Engelm.) n. comb. *E. rostratus* var. *lanceolatus* Engelm. ex Wats. & Coult. in Gray's Man. ed. 6. 556. 1891. *E. cordifolius* var. *lanceolatus* Mackenzie & Bush, Man. Fl. Jackson Co., Missouri 10. 1902: Robinson & Fernald in Gray's Man. ed. 7. 84. 1908. *E. cordifolius* f. *lanceolatus* Fernald, Rhodora **38:** 73. 1936. *E. rostratus* f. *lanceolatus* Fernald, Rhodora **49:** 108. 1947, and in Gray's Man. ed. 8. 85. 1950. *Alisma rostratum* Nutt., Trans. Am. Phil. Soc. **5:** 159. 1837. *Echinodorus rostratus* Engelm., Gray's Man. 460. 1848; Wats. & Coult. in Gray's Man. ed. 6. 556. 1891; Fernald, Rhodora **49:** 108. 1947, and in Gray's Man. ed. 8. 85. 1950. *E. cordifolius* Mackenzie & Bush, Man. Fl. Jackson Co., Missouri 10. 1902;



Map 2b. Echinodorus Berteroi var. lanceolatus.

Britton & Brown, Ill. Fl. **1:** 86. 1896; Small, Fl. S.E. U.S. 42. 1903; Robinson & Fernald in Gray's Man. ed. 7. 84. 1908; Small, N. Am. Fl. 17, pt. **1:** 47. 1909; Small, Man. S.E. Fl. 22. 1933; Fassett, Man. Aquat. Pl. 93. 1940; Muenscher, Aquat. Pl. U.S. 82. 1944.

Centering in the lower Missouri and central Mississippi River valleys, north to central Illinois and southern South Dakota, thence southward to intergrade with var. *Berteroi* in Texas and in outlying districts westward in California (Map 2b).

Ohio: pond ½ mi. west of Vause Station, Liberty Twp., Ross Co., 23 July 1936, *Bartley & Pontius 91* (NY). **Illinois:** Oquawka, Henderson Co., 29 July 1892, *Patterson* (F); Peoria Co., *Stewart* (F); Peoria, *Brendell* (F, US); Beardstown, August 1928, *Turner 784* (F); Menard Co., 1861, *Bebb* (F); Menard Co., various collections of *Hall* (F, MO, US, NY); margin of ponds, American Bottom, September 1846, *Engelmann* (MO)—marked "lanceolat." by Engelmann, and to be taken as TYPE of *E. rostratus* var. *lanceolatus* Engelm.); Mitchell, Madison Co., 7 September 1927, *Steyermark 871* (MO); Mason Co., 23 August 1845, *Mead* (MO); St. Clair Co., 12 June 1879, *Eggert* (F, MO); East St. Louis, 9 August 1897, *Eggert* (F, US, NY). **Iowa:** mud flats, infrequent, Fremont Co., 15 August 1898, *Fitzpatrick* (F, MO, NY); Hamburg, *Hitchcock* (MO, NY); California Junction, Harrison Co., October 1904, *Shimek* (US) & 25 August 1908, *Shimek* (MO). **Missouri:** Independence, 22 August 1882, *Bush 10* (MO); Atherton, Jackson Co., 9 July 1896, *Bush 437* (MO, US); Clay Co., 9 August 1895, *Bush 598* (MO); St. Louis, August 1845 & August 1848, *Engelmann* (NY); Sheffield, 28 September 1895, *Mackenzie 556* (MO, NY); Wolf Island, Mississippi Co., 11 July 1933, *Palmer & Steyermark 41508-A* (MO). **South Dakota:** Yankton, September 1892, *Thornber* (MO); water hole, Vermillion, Clay Co., 18 August 1927, *Over 17422* (US). **Nebraska:** Omaha, August 1899, *Williamson* (PH); in ditch along road, flooded early in growing season, Holt Co., 20 miles south of O'Neill, 20 August 1941, *Tolstead 41464* (MO); Dodge Co., 18 July 1883, *Pepoon* (MO). **Kansas:** Claflin, 19 August 1929, *Benke 5099* (F); ponds, Crawford Co., 1896, *Hitchcock 853* (MO, US, NY); Ellis Co., 28 July 1885, *Kellerman* (US, MO); Manhattan, 29 July 1892, *Clothier* (US); Argentine, 23 September 1895, *Mackenzie* (NY). **Oklahoma:** Verdigris, 5 October 1894, *Bush 605* (NY, MO); shallow water, Fish Hatchery Pond, Medicine Park, 28 May 1936, *de Gruchy 52* (MO, NY); Sapulpa, 1 October 1894, *Bush 606* (MO); pond west of Daugherty, Murray Co., 2 June 1945, *Waterfall 6044* (MO); wet sandy shore of Crystal Lake, 2 miles north of Norman, Cleveland Co., 9 October 1936, *Hopkins 775* (MO); Cache Creek, 2 miles southwest of Cache, 26 May 1936, *de Gruchy 13* (NY); Durant fish hatchery, Durant, 29 May 1936, *de Gruchy 66* (NY). **Texas:** bases submerged in water of small pool near Barton Springs Creek, 23 July 1943, *Barkley 15* (MO, NY); common in ponds, Columbia, 14 October 1900, *Bush 1497* (MO); Dallas, 2 July 1872, *Hall 622* (F, MO, US, NY); Dallas Co., 1926, *Hynes 15* (MO); Comanche Spring, New Braunfels, September 1849, *Lindheimer 1232* (MO, PH, US); Corpus Christi, May 1913, *Orcutt 5800* (MO); ditches, Wharton, Wharton Co., 24 September 1914, *Palmer 6630* (F, MO); shallow pools, Brazoria, Brazoria Co., 3 May 1916, *Palmer 9666* (MO); Lake Como, Tarrant Co., 7 October 1920, *Ruth 203* (F, MO); Camp Barkley, Taylor Co., 1943, *Tolstead 7346* (MO). **California:** Ramona, October 1903, *Brandegee* (US); Lakeside, San Diego Co., 30 June 1906, *Brandegee* (US); Laguna Canyon, 26 July 1916, *Crawford* (US); Tranquillity, Fresno Co., 10 August 1937, *Hoover 2656* (US); Laguna Cañon, Orange Co., alt. 350 ft., 3 September 1918, *Johnston 2151* (US); Sweetwater, July 1884, *Orcutt 321* (US); shores of Elsinore Lake, San Diego Co., 3 November 1891, *Parish 2246* (F, MO); Laguna Lakes, 15 July 1919, *Streit* (PH); Moreno Dam, San Diego Co., alt. 3200 ft., 7 October 1938, *Wiggins 9204* (US).

There are two sheets that would extend the range considerably, but whose authenticity is to be doubted. One is labelled Delaware: borders of ponds, Canterbury, July, *Wm. M. Canby* (NY). Mr. Bayard Long, of the Academy of Natural Sciences of Philadelphia, writes me that this is without doubt a case of mixing of labels, and that *E. rostratus* (*E. Berteroi*) does not to his knowledge appear anywhere in the region. Canby did collect *E. parvulus* at Canterbury and his material appears in several herbaria. Actually, the label on the sheet in question bears the name *Echinodorus parvulus;* "*parvulus*" has been crossed out and "*cordifolius*" written above it, in a hand other than the original collector's. The other sheet is labelled Minnesota: borders of ponds in mud, Fort Snelling, July 1888, *Dr. W. H. Forwood* (US). Dr. Gerald B. Ownbey of the University of Minnesota writes me that none of the many collectors in the Fort Snelling area have taken this species, unknown north of southern Iowa. He quotes Dr. John Moore who thinks Dr. Forwood was an army doctor who did some traveling on the plains. In view of these facts, and of the extensive collecting that has been done in this part of Minnesota and southward along the Mississippi River, it seems likely that Dr. Forwood's plant did not come from Fort Snelling.

Although the northern phase of *E. Berteroi*, like the southern, generally has leaves of the broadly cordate type (Fig. 6), the earliest name applied in the varietal category is that of Engelmann, applied to dwarfed plants with lanceolate leaves (Figs. 8, 9 are from the type). And so we have another case where a slightly atypical plant, named and distinguished from the common phase, becomes the TYPE of the common phase from which it was originally distinguished. The type of *E. rostratus* var. *lanceolatus* was only a small and narrow-leaved plant such as one might pick up on almost any pond-shore where the species abounds.

Alisma rostratum Nutt. was described from "the ponds of the Verdigris river of Arkansas" (now in Oklahoma). The type is at the Academy of Natural Sciences of Philadelphia, and through the kindness of Mr. Walter M. Benner I have before me two achenes from this collection. Fig. 28 illustrates one of them; while it belongs with the northern short-beaked variety, it is in the region of overlap and shows a little more tendency toward the long-beaked variety than do plants from regions farther north.

Introgression between *E. Berteroi* and *E. cordifolius* is suggested by several individuals. **Missouri:** Stoddard Co.; woods bordering Swan Pond, T 28 N, R 10 E, sect. 35, 4 mi. south of Advance, 28 August 1948, *Steyermark 66159* (F). Leaves with pellucid lines 2.5 mm. long, and achenes with a suberect beak and alternate ribs winged, as in *E. Berteroi;* scape creeping, sepals papillose, and glands of the achene well below the beak and rounded as in *E. cordifolius.* **Illinois:** lakes by Cahokia, 23 August 1878, *Eggert* (PH). Leaves with pellucid lines reaching 3 mm. as in *E. Berteroi;* scape creeping as in *E. cordifolius;* achenes short-beaked as in *E. cordifolius* but sometimes with facial glands tapered into the beak as in *E. Berteroi;* papillose condition of sepals intermediate. **Texas:** Lavaca Run, Jackson Co., 27 August 1941, *Tharp 15* (MO), and Gillespie Co., *Jermy* (MO). Pellucid lines closely spaced and reaching 4 mm. in length, and sepals scarcely papillose, as in *E. Berteroi;* scape creeping as in *E. cordifolius.*

4. Echinodorus grandiflorus (Cham. & Schlecht.) Micheli in DC., Monogr. Phan. **3:** 57. 1881. *Alisma grandiflorum* Cham. & Schlecht., Linnaea **2:** 152. 1827; Kunth, Enum. **3:** 153. 1841; R. & S., Syst. Veg. **7:** 1606. 1830; Seub. in Mart., Fl. Bras. **3,** pt. 1: 108. 1847. *Alisma floribundum* Seub. in Mart., Fl. Bras. **3,** pt. 1: 109. 1847. *Echinodorus floribundus* Seub. in Warm., Symb. fasc. **13:** 113. 1872. *E. grandiflorus* α *floribundus* Micheli in DC., Monogr. Phan. **3:** 58. 1881. *E. grandiflorus* var. *floribundus* Hauman, Anal. Mus. Nac. Buenos Aires **27:** 311. 1915, in part at least. *E. grandiflorus* var. *longiscapus* (Arech.) Hauman, l.c., in part. *E. muricatus* Woodson & Schery, Fl. Panama, Ann. Mo. Bot. Gard. **30:** 101. 1943, probably not *E. macrophyllus* β. *muricatus* Griseb.

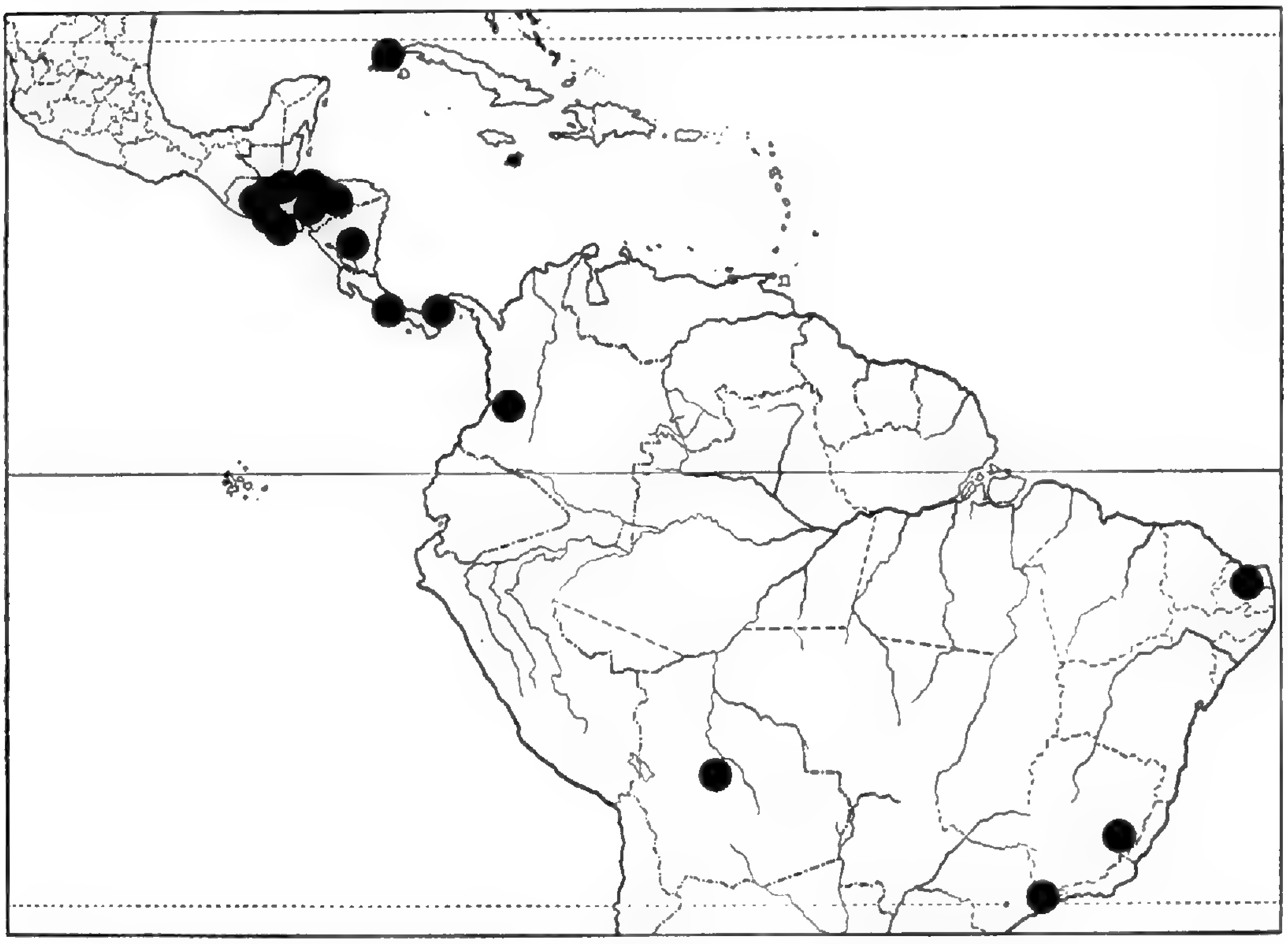
Leaves erect, long-petioled except in individuals from dry soil; blades shallowly cordate, about as wide as long, often very large and reaching 55 cm. in length; pellucid markings usually very clear (Figs. 56–58); inflorescence simple or branching; flowers verticillate on pedicels that may reach 4 cm. in length as the fruits mature; nutlets (Figs. 30–31) winged on the back, with 3 or 4 ribs that are sometimes slightly winged toward the summit, usually 2 facial glands that are elongate and rounded at both ends and are placed well below the summit of the nutlet, and a short stout beak.

Varieties of Echinodorus grandiflorus

a. Blades of leaves with pellucid dots, short lines very rare or absent, petals white or pink . . . . var. *grandiflorus.*
a. Blades of leaves with numerous pellucid lines as well as dots.
  b. Petals yellow; summit of petiole and base of blade with stellate hairs var. *aureus.*
  b. Petals white; leaves glabrous . . . . var. *ovatus.*

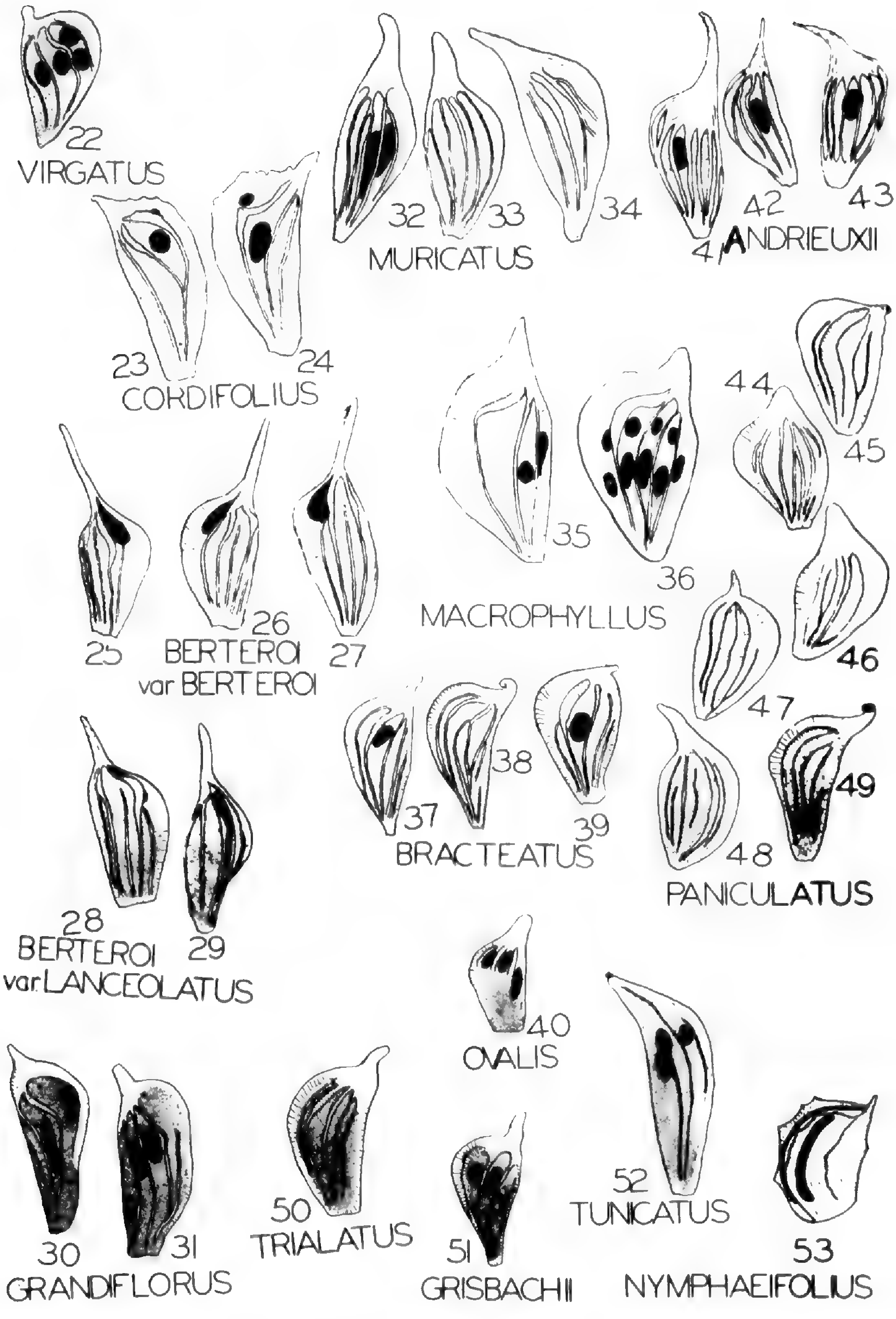
4a. E. grandiflorus (Cham & Schlecht.) Micheli, var. grandiflorus. *Alisma grandiflorum* Cham. & Schlecht., l.c. Leaves with tubercle-based stellate hairs about the summit of the petiole and base of the blade, the hairs sometimes wearing off so that the persistent bases give a muricate appearance; pellucid markings nearly all dots (Fig. 56) with lines very rare or absent; petals white or rarely pink.

Cuba and Guatemala to Paraguay and southern Brazil (Map 3). This range appears to be bicentric, with a long gap between Colombia and Bolivia. I have not found any positive differences between the var. *grandiflorus* of the two parts of the range.



Map 3. Echinodorus grandiflorus var. grandiflorus.

Cuba: Prov. Pinar del Rio, Arroyo Mantua, S. Francisco ad stagnum, flor. albi, 29 May 1920, *Ekman 10974* (NY). **Guatemala:** Rio de Los Esclavos, Dept. Santa Rosa, August 1892, *Heyde & Lux 4074* (GH, NY, US); vicinity of Quirigua, Dept. Izabal, alt. 75–225 m., 15–31 May 1922, *Standley 23858* (GH, NY, US); in a slough, Quirigua, 17 May 1937, *Muenscher 12065* (F); edge of small stream, herb 1 m. tall, petals white, near El Molino, Dept. Santa Rosa, alt. about 600 m., 26 November 1940, *Standley 78399* (F); Los Amates, Dept. Izabal, alt. 90 m., 20 February 1907, *Kellerman 6615* (F); Lago Retana, between Ovejero and Progreso, alt. 600 m., 26 November 1939, *Steyermark 31985* (F); in water of swamp, valley of Río Chiquimula, 1½ mi. northeast of Chiquimula, alt. 400 m., 21 October 1939, *Steyermark 30120* (F). **El Salvador:** edge of river, plants 1 m. high, petals white, vicinity of Ahuachapan, Dept. Ahuachapan, alt. about 700–1100 m., 16–25 January 1947, *Standley & Padilla 2518* (F); herb 3–4 ft., fls. white, open swamp, vicinity of Tepetitán, Dept. San Vicente, alt. about 400 m., 6 March 1922, *Standley 21427* (GH, NY, US); Zacatecoluca, March 1922, *Calderon 301* (GH, NY, US); herb 3–4 ft., fls. white, swamp along river, vicinity of Nahulingo, Dept. Sonsonate, alt. about 220 m., *Standley 22019* (GH, NY, US); herb 3–5 ft., fls. white, in swamp, abundant, vicinity of Ateos, Dept. La Libertad, 17 April 1922, *Standley 23346* (US). **Honduras:** in marsh, acaulescent herb 3–4 ft., inflorescence much branched, vicinity of Tela, Dept. Atlántida, at sea level, 14 December 1927–15 March 1928, *Standley 54522* (F, US); Tela, 1923, *van Severén 38* (US); corolla white, in marsh, near


22
VIRGATUS
23
24
CORDIFOLIUS
32
33
34
MURICATUS
4
42
43
ANDRIEUXII
25
26
27
BERTEROI
var BERTEROI
35
36
MACROPHYLLUS
44
45
46
47
28
29
BERTEROI
var. LANCEOLATUS
37
38
39
BRACTEATUS
48
49
PANICULATUS
40
OVALIS
30
31
GRANDIFLORUS
50
TRIALATUS
51
GRISBACHII
52
TUNICATUS
53
NYMPHAEIFOLIUS

Tela, 8 September 1034, *Yuncker 4985* (F, MO); fls. blancas, en sabana, margenes del Río Jalán, 3 kms. al norte de Guaimaca, Dept. Morazán, 13 June 1950, *Molina 3065* (F); El Banco, Dept. Comayagua, alt. 640 m., 13 March 1945, *Valerio 2341* (F); in marsh, herb 1 m., petals white, vicinity of Juticalpa, Dept. Olancho, 380–480 m., 5–16 March 1949, *Standley 18057* (F). **Nicaragua:** in ditch, plants 1 m. high, fls. white, vicinity of La Libertad, about 500–700 m., Dept. Chontales, 29 May–1 June 1947, *Standley 8977* (F). **Panamá:** swamp, Boquete, Prov. Chiriqui, 3800 ft., 21 May 1938, *Davidson 691* (F, GH); flowers lavender pink, lower portion of valley and marshes along R. Antón, El Valle de Antón, about 500 m., 2 February 1935, *Hunter & Allen 381* (F, US); inflorescence 1.5–2 m. tall, marshy borders of streams, El Valle de Antón and vicinity, 500–700 m., 23–27 July 1935, *Seibert 490* (GH, MO, NY); flowers white, vicinity of Boquete, alt. 1200–1500 m., 24–26 July 1940, *Woodson & Schery 754* (GH, MO, US); in bog, flowers white, between Las Margaritas and El Valle, 15 July, 8 August 1938, *Woodson, Allen & Seibert 1736* (GH, NY). **Colombia:** loco uliginoso, 1100 m., Timba, Dept. Valle, 3 January 1937, *von Sneidern 1135* (NY). **Bolivia:** Buena Vista, Dept. Santa Cruz, flor. blanca, 29 October 1916, *Steinbach 2868* (F). **Brazil:** perennial herb 1.5 m. high, white flower, road to São Miguel near km. 11, swampy land near corriga, alt. 650 m., State of Minas Geraes, 28 December 1929, *Mexia 4179* (F, GH, MO, PH, US, NY); Cambuquira, 25 December 1935, *Barreto 927* (F); Minas Geraes, 1840, *Claussen*, cited by Micheli as var. *floribundus* (GH); locis paludosis, Pinhaes, Paraná, 885 m., 14 October 1914, *Dusén 1132a* (GH); Blumenau, Sta. Catarina, January 1888, *Ule 540*—leaf with pellucid lines and dots of var. *ovatus* but pubescence of var. *grandiflorus* (US); Minas Geraes, 1845, *Widgren* (US); Minas Geraes, 1865, *Regnell 418* (US); Prov. Caera, August–November 1838, *Gardner 1860*, cited by Micheli under var. *floribundus* (NY). **Paraguay:** Pilcomayo River, *Morong 853* (MO, US).

FIG. 22–53. NUTLETS OF SUBGENUS ECHINODORUS (× 10). Fig. 22: *E. virgatus*, Mexico, Beechey (fragment of type, in MO). Fig. 23, 24: *E. cordifolius*. Tennessee, Gattinger 2741 (US). Fig. 25–27. *E. Berteroi* var. *Berteroi*. 25: Curacao, Britton & Shafer 3115 (US). 26: Puerto Rico, Sintenis 3375 (US). 27: Mexico, Pringle 8484 (US). Fig. 28, 29. *E. Berteroi* var. *lanceolatus*. 28: Illinois, Engelmann (type of *E. rostratus* var. *lanceolatus* in MO). 29: Oklahoma, Nuttall (type of *Alisma rostrata*, in PH). Fig. 30, 31. *E. grandiflorus* var. *grandiflorus*. 30: Honduras Standley 53610 (US). 31: Uruguay, Bartlett 2182 (unident fied variety in US). Fig. 32, 33. *E. muricatus*. 32: Brazil, Tate 61 (US). 33: Brazil, Tate 61 (NY). Fig. 34. Unidentified species, perhaps *E. muricatus*, Bolivia, Rusby 1419 (NY). Fig. 35, 36. *E. macrophyllus*, Brazil, Pereira 3602 (US). Fig. 37, 39. *E. bracteatus* var. *bracteatus*, Ecuador, Hitchcock 29984 (NY); fig. 39: var. *efenestratus*, Ecuador, Rimbach 90 (type in F). Fig. 40. *E. ovalis*, Cuba, Wright (immature nutlet in US). Fig. 41–43. *E. Andrieuxii*. 41: Mexico, Rose, Standley & Russell 14100 (NY). 42: Mexico, Mexia 1065 (US). 43: Mexico, Hinton 2667 (US). Fig. 44–49. *E. paniculatus*. 44: Bolivia, Kuntze (NY). 45: Venezuela, Chardon 26 (US). 46: Bolivia, Cárdenas 4466 (US). 47: Venezuela, Fernandez 71 (US). 48: Bolivia, Cárdenas 4466 (US). 49: Ecuador, Hitchcock 20278 (US). Fig. 50. *E. trialatus*, Colombia, Cuatrecasas 4283 (type in US). Fig. 51. *E. Grisebachii*, Cuba, Wright 3198 (US). Fig. 52. *E. tunicatus*, Panama, Maxon 7095 (US). Fig. 53. *E. nymphaeifolius*, Mexico, Mell 2090 (US).

4b. E. grandiflorus (Cham. & Schlecht.) Micheli, var. **aureus,** Fassett, n. var., foliorum laminis punctis pellucidis lineisque brevibus (0.2–0.5 mm. longis) instructis; floribus flavis; fructus ignotus.—Pubescence of leaves as in var. *grandiflorus;* pellucid dots intermixed with lines 0.2–0.5 mm. long; flowers yellow.—**Cuba:** in bog, 2 ft. or more, flowers yellow, near Rincón, Prov. Havana, 20 January 1905, *van Hemann 540* (type in f; gh, ny). In absence of fruit, the exact relationships of this plant cannot be determined with certainty.

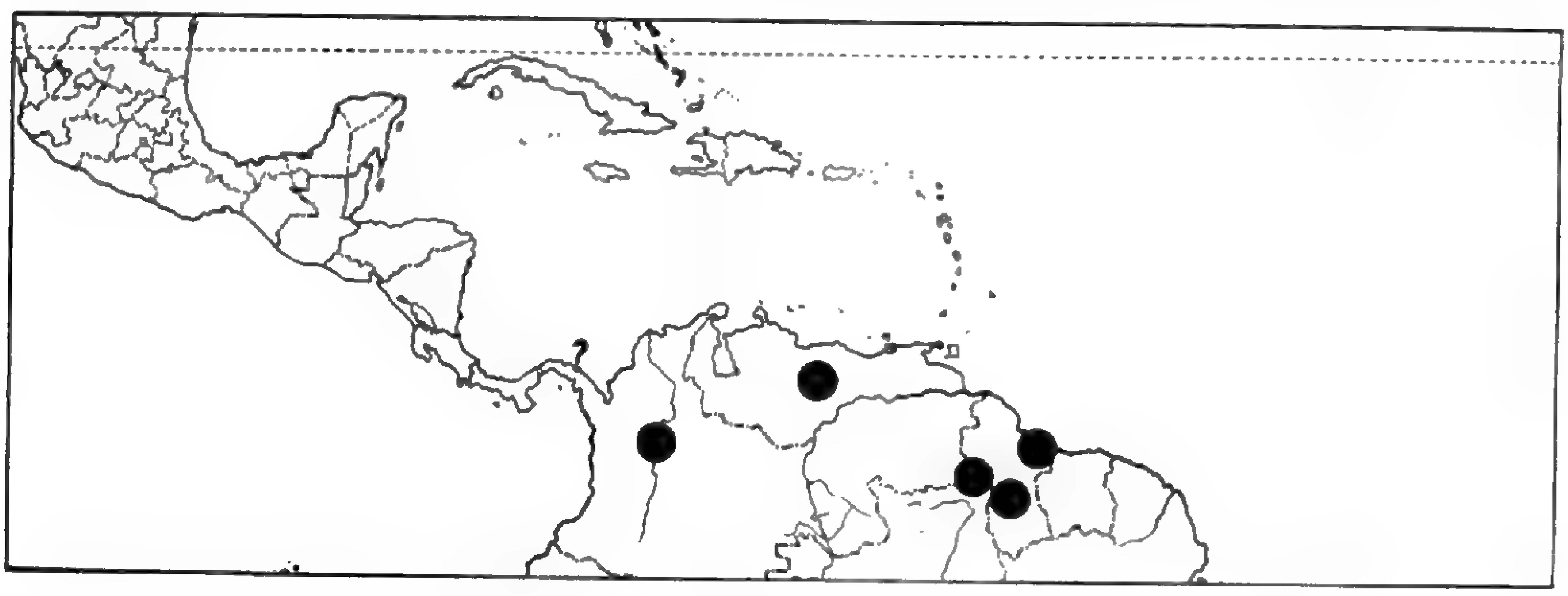
Throughout the northern part of its continental range, *E. grandiflorus* is constant in its diagnostic characters, responding, apparently, only to ecological factors in such features as size of blades and length of petioles. Southward, in southern Brazil, Argentina, Uruguay, and Paraguay, many plants are glabrous, with pellucid lines, mostly 1 mm. or less long, replacing many of the dots in the blades (Fig. 57): they probably represent *E. grandiflorus* var. *ovatus* Micheli in DC., Monogr. Phan. **3:** 58. 1881. In about the same region appear other plants with pedicels up to 4 cm. in length, and pellucid lines to 2 mm. long (Fig. 58), often suggesting those of *E. Berteroi.* Several taxa have been described from the area, including *E. Sellowianus* Buch., Pflanzenr. **4,** fam. 15: 30. 1903, and *E. longiscapus* Arechavaleta, Anal. Mus. Nac. Montevideo **4,** pt. 1: 67, pl. 2. 1903. The treatment of Argentinean Alismataceae by Hauman, Anal. Mus. Nac. Buenos Aires **27:** 311. 1915, appears to have the advantage of being based on familiarity with the plants in the field, but Hauman does not express complete certainty as to the relationships of the species named in this paragraph.

5. Echinodorus muricatus Griseb., Bonplandia **6:** 11. 1858. *E. macrophyllus β muricatus* Micheli in DC., Monogr. Phan. **3:** 50. 1881. Not *E. muricatus* Woodson & Schery, Fl. Panama, Ann. Mo. Bot. Gard. **30:** 101. 1943.

Leaves erect, long-petioled, the blades cordate at base, a little longer than wide (Fig. 11), sometimes reaching about 50 cm. in length, without pellucid lines or dots (veins rarely pellucid); pubescence stellate mostly about the summit of petiole and base of blade, often wearing off and leaving papilla-like bases; inflorescence a meter or more high, compound and ample; pedicels 1–3 cm. long, subtended by bracts or sometimes by reduced cordate leaves; fruit with body 2.5–3 mm. long and beak 0.3–1 mm. long, keeled, with 4–5 scarcely winged ribs on each face, mostly with 1–3 glands (Fig. 32) or rarely glandless (Figs. 33–34).

Panama to Ecuador and British Guiana (Map 4). **Colombia:** wet swamp, alt. 130–140 m., Puerto Berrio, Dept. Antioquia, 14 July 1917, *Pennell & Rusby 57* (NY); Puerto Berrio, 11–13 January 1918, *Pennell 3734* (GH, NY). **Venezuela:** La Rubiera cerca de Calabozo, Guarico, 1925, *Grisel 1*—mixed with *E. paniculatus* (NY, US). **British Guiana:** in water, 4 feet high, Limao, Mount Roraima, 21 September 1927, *Tate 61* (NY); Berbice, June 1889, *Jenman 5162* (NY); near Neue Amsterdam, April 1889, *Jenman 5080* (NY).

I have seen no *Echinodorus* with leaves actually muricate, but there are 3 species with stellate hairs that eventually drop off to leave just the tuberculate bases: these are *E. grandiflorus*, *E. bracteatus* and *E. muricatus*. The type of *E. muricatus* is from Panama; I have not seen this type, nor any other material of



Map 4. Echinodorus muricatus.

E. muricatus from Panama. But Micheli, who seems to have examined the type, and whose observations concerning pellucid markings appear to be very reliable, lists *E. macrophyllus* β *muricatus* under "Folia punctis lineisve pellucidis destituta," thus excluding the possibility of the type of *E. muricatus* belonging with *E. grandiflorus* or *E. bracteatus*.

E. muricatus was treated by Micheli as a variety of the more southern *E. macrophyllus* (Kunth) Micheli. Both species have leaves without pellucid markings (Fig. 59) but those of *E. macrophyllus* are glabrous. The achene of *Alisma macrophyllum* was described by Kunth (Enum. Pl. **3:** 51. 1841) as being 2-ribbed on each side. The only good fruiting material of *E. macrophyllus* available to the writer is *Pereira 3602* from São Paulo (US); it has fruits mostly 3-ribbed (Fig. 35) or 4-ribbed (Fig. 36). This plant also shows variation in the number of glands, not mentioned by Kunth, but given by Micheli as usually 3 or 4.

Collections from near Lake Rogagua, Bolivia, *H. H. Rusby 1419* (flowers & fruit—NY) and *1415* (leaves & fruit—NY) are

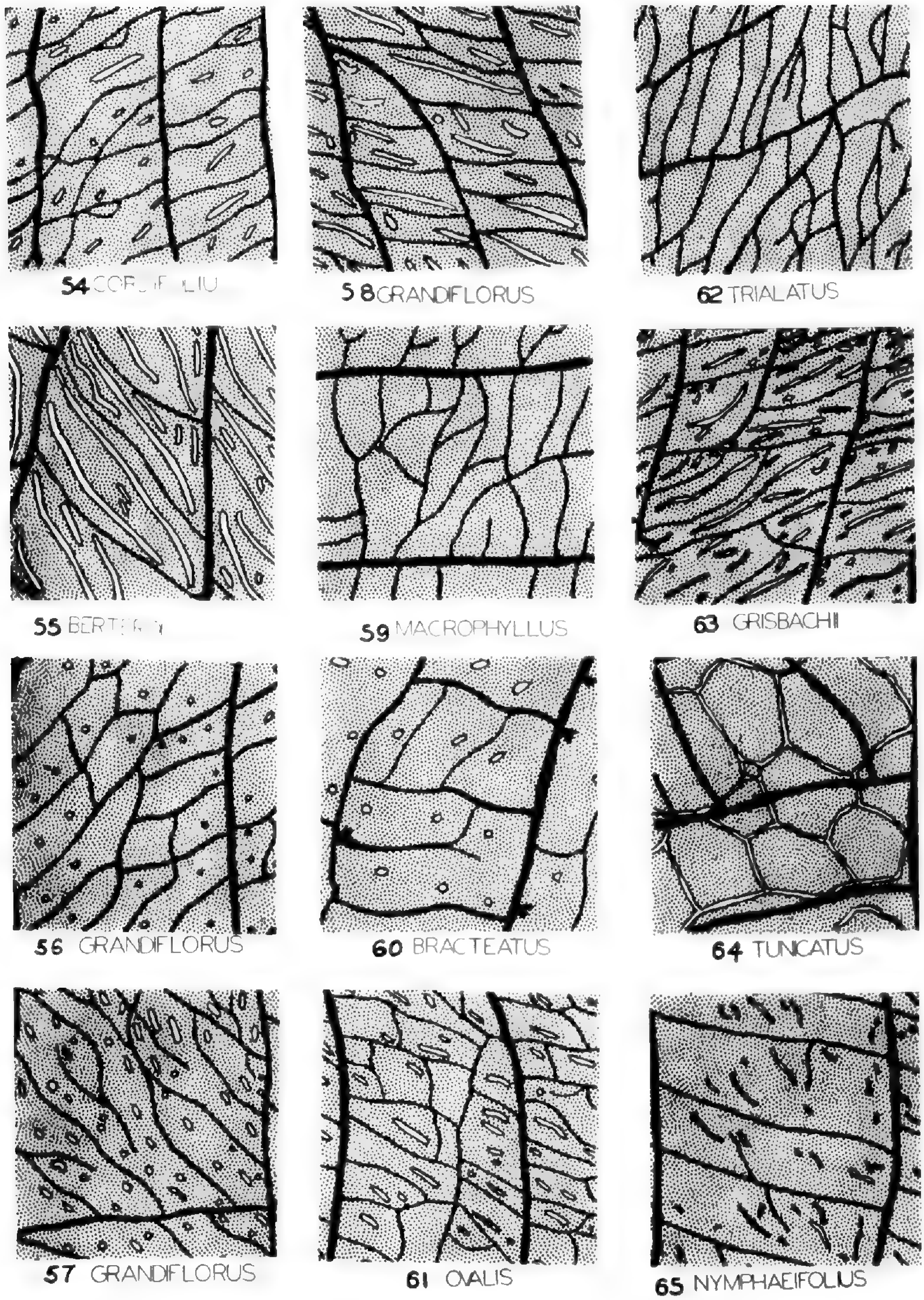
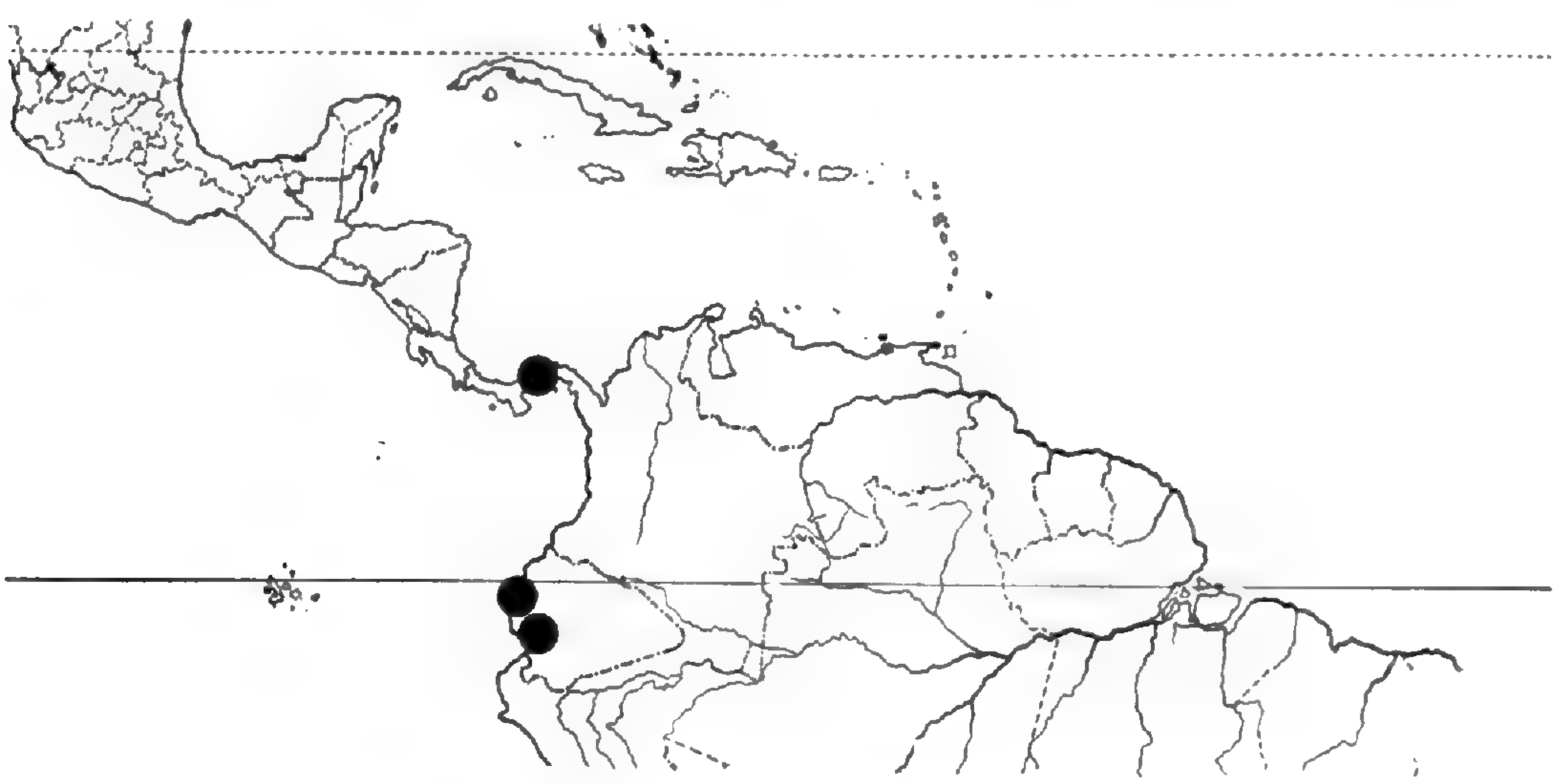


Fig. 54–65. Portions of leaves of subgenus Echinodorus, as seen by transmitted light (× about 7). Fig. 54. *E. cordifolius.* Tennessee, Gattinger 2741 (US). Fig. 55. *E. Berteroi.* Santo Domingo, Eggers 2477 (US). Fig. 56. *E. grandiflorus* var. *grandiflorus.* Honduras, Standley 53610 (US). Fig. 57. *E. grandiflorus* var. *ovatus.* Argentina, Venturi 2416 (US). Fig. 58. *E. grandiflorus,* unidentified variety. Bolivia, Cárdenas 4465 (US). Fig. 59. *E. macrophyllus,* Brazil, Pereira 3602 (US). Fig. 60. *E. bracteatus* var. *bracteatus,* Panama, Standley 26724 (US). Fig. 61. *E. ovalis,* Cuba, Wright, (US). Fig. 62. *E. trialatus,* Colombia, Cuatrecasas 7391 (US). Fig. 63. *E. Grisebachii,* Cuba, Wright 3198 (US). Fig. 64. *E. tunicatus,* Costa Rica, Lankester 947 (US). Fig. 65. *E. nymphaeifolius,* Mexico, Mell 2090 (US).

stellate-pubescent like *E. muricatus* and may be conspecific with it. The nutlets are consistently glandless (Fig. 34) with somewhat branching facial ribs.

6. Echinodorus **fluitans** Fassett, n. sp., planta aquatica, foliorum petiolis longis, laminis 14 cm. longis 8 cm. latis, ad apicem obtusis, ad basim cordatis-subtruncatis; petiolis ad apicem et laminis ad basim tuberculosis-muricatis aut cum pilis stellatis; scapis horizontalibus, usque ad 1 m. longis; nodis cum radicibus et circa 5 floribus erectis cum pedicellis 5–8 cm. longis; fructus ignotus.—**Colombia:** aquatic, growing in about



Map 5. Echinodorus bracteatus.

30 cm. of water. Flowers white, showy; stem to 2 m. long, bearing several inflorescences at intervals, frequently proliferous from these. In ponds near Riohacha, Dept. Magdalena, 24 November 1944, *Oscar Haught 4450* (TYPE in US).—Seen only from Colombia.

In habit this most closely resembles *E. cordifolius,* with its clusters of long-pedicelled flowers from a prostrate axis. The leaf, however, is quite different, with blades nearly twice as long as wide, more pointed at apex and less deeply cordate at base, and quite without pellucid markings.

7. Echinodorus bracteatus Micheli in DC., Monogr. Phan. **3:** 59. 1881.

Leaves erect, long-petioled except on plants from drier places, the blades about $\frac{2}{3}$ as broad as long, cordate at base, obtuse at tip, mostly about 30 cm. long but sometimes more than 50 cm. long (Fig. 12); inflorescence branched except in dwarfed plants, sometimes nearly 3 m. tall; scape and branches sharply but narrowly 3-winged; flowers sessile or nearly so, usually slightly exceeded by the narrow long-acuminate bracts; nutlets (Figs. 37–39) rather wide, short-beaked, broadly keeled on the back, with about 5 facial ribs of which usually one is widened and wing-like toward the summit; facial gland single or absent.

Panama to Ecuador (Map 5).

(To be continued)

TWO NEW CARICES FROM SOUTHEASTERN UNITED STATES

F. J. Hermann

In southern and central Florida occurs a perplexing sedge that keys out to Series Fetae of Section Ovales in Mackenzie's monograph (N. Amer. Flora **18:** 118. 1931),—a series with which it really has no close affinity. Actually, in all characteristics except its ovate-orbicular rather than obovate perigynium, it is most closely related to *Carex alata* Torr. & Gray (Series Alatae). But from this species it further differs in lacking aristate or long-acuminate scales, the lower being obtuse and the upper acute to short-acuminate, and in its longer, more slender perigynium beak. The perigynium is usually broadest near the middle (occasionally near the base or top) and is less thin and flat than that of *C. alata.* The shape of the perigynium is more suggestive of that of *C. brevior* (Dewey) Mackenz., but from this it is readily distinguished by the narrower, stipitate achene, the larger perigynium with much larger corky, crescent-shaped areas bordering the achene, and the lack of ventrally hyaline leaf-sheaths. This sedge may be known as:

Carex vexans sp. nov. (Ovales). Caespitosa; culmi folia plus minusve superantes; folia ad basim culmi maxima ex parte aggregata, vaginis non artis, modo sub ore albidis; squamae lanceolatae, obtusae vel acutae vel interdum breviacuminatae; perigynia modice concavo-convexa, crasse membranacea vel subcoriacea, ovato-orbicularia, manifeste spongiosa, in rostrum 1–1.5 mm. longum abrupte contracta; achaenia elliptico-oblonga stipitata.

Cespitose; culms 2.5–7 cm. high, equaling to considerably exceeding the leaves, bluntly triangular, scabrous below the heads, otherwise smooth; sterile shoots conspicuously developed; lowest leaves bladeless; leaves with well-developed blades 2 to 5 to a fertile culm, mostly on the lower half of the culm, the blades flat, linear, 4–15 cm. long, 2.5–4 mm. wide, scabrous on the margins and midrib toward attenuate apex, the sheaths rather loose, white-hyaline only below the mouth, rupturing tardily and not becoming fibrillose, the ligule from slightly longer to twice as long as wide, 2.5–4 mm. long, 2–3 mm. wide, blunt; head oblong to ovoid-oblong, 1.5–3 cm. long, 1–1.5 cm. wide, the spikes 3 to 6, green to glaucous-green, gynaecandrous, aggregated or the lowermost somewhat separate, ovoid-oblong to subglobose, 8–12 mm. long, 6–9 mm. wide, rounded or abruptly tapering at the base, truncately obtuse to rounded-obtuse at the apex, the perigynia ascending, their beaks spreading at maturity; bracts setaceous, often lacking except below the lowest spikes; scales lanceolate, obtuse to acute or occasionally short-acuminate, shorter and much narrower than the perigynia, more or less tawny-hyaline, the center green and 1-nerved; perigynia shallowly concavo-convex, 4–5.2 mm. long, 3–4 mm. wide, thick-membranaceous to subcoriaceous, greenish stramineous or in age deep brown, glossy, the body ovate-orbicular, broadest near the middle or occasionally toward the base or top, conspicuously corky, strongly winged to the base, minutely serrulate above the middle, finely many-nerved dorsally, few-nerved ventrally, rounded or abruptly tapering at the sessile base, abruptly tapering into a beak 1–1.5 mm. long, the beak flat, serrulate, dorsally cleft, rather shallowly bidentate; achenes lenticular, elliptic-oblong, 1.5–2 mm. long, 1 mm. wide, on a slender stipe 0.75–1 mm. long, apiculate, stramineous to brown; stigmas two, slender, 1.5–2 mm. long, reddish brown.

FLORIDA: Collier County—open places, edge of hammock, Deep Lake, *J. B. McFarlin 4651*, March 31, 1931, and marginal woods, Collier West Pasture, Sec. 25, T 47S, R28E, *R. O. Woodbury & R. S. Rummell SE-71*, June 15, 1954; Hendry County—wet border of roadside ditch along State Road 25 about 11.8 miles west of Lewiston, *C. C. Deam 58,634*, Feb. 2, 1938 and *C. C. Deam 61,177*, March 19, 1941 (TYPE—U. S. National Herbarium); Lake County—Eustis, *G. V. Nash*, May 28 to June 15, 1895.

In 1938 Drs. Rogers McVaugh and J. H. Pyron collected an anomalous sedge near Chatsworth, Gilmer County, Georgia, which bears a superficial resemblance to *Carex communis* Bailey, particularly to var. *wheeleri* Bailey because of its small, few-flowered, predominantly sessile staminate spikes. It is at once set off from this, however, by its large pistillate scales, these being 1½ to 2 times the length of, and wider than, the perigynia and so partially concealing them. The pistillate scales differ further from those of *C. communis* in being long-acuminate and pale-green rather than obtuse or acute (occasionally short-acuminate) and reddish purple. The predominantly pale staminate scales also differ markedly in having the midrib excurrent as a short awn. The short ligule, generally wider than long or, exceptionally, as long as wide, is suggestive of *C. pensylvanica* Lam., rather than of *C. communis*, but the lack of stolons and much less fibrillose base of the plant clearly set it off from this.

It was hoped that a postponement of publication of this sedge might result in additional localities turning up for it, but to date it remains unique; so it may be a very local species. It is here proposed as:

Carex amplisquama sp. nov. (Montanae). Dense caespitosa, estolonifera; culmi tenues basibus aliquantum fibrillosis; foliorum ligula plerumque latior quam longa; spica terminalis mascula vulgo parva paucifloraque, squamis elliptico-oblongis, obtusis, cuspidatis vel aristulatis; spicarum feminearum squamae ovato-lanceolatae, longe acuminatae vel aristatae perigynia multo longiores, pallidovirides; perigynia obovoidea 2.75–3 mm. longa.

Densely cespitose, without long horizontal stolons; culms 1.3–5 dm. high, slender, rather sharply triangular and scabrous above, equaling or somewhat exceeding the leaves, mostly phyllopodic, somewhat fibrillose and strongly purplish-red at the base, the dried leaves of the previous year conspicuous; leaves several to a culm, clustered at the base, the blades flat, linear, 5–25 cm. long, 1.5–4 mm. wide, scabrous on the margins and veins toward the acuminate apex, the sheaths shallowly concave to slightly convex at the mouth, the lower breaking and becoming fibrillose, the ligule wider than long (1–1.75 × 1.25–2.5 mm.) or exceptionally slightly longer than wide; inflorescence 2–4 (rarely 6) cm. long; staminate spike solitary, linear, sessile to short-peduncled (the peduncle occasionally up to 1 cm. long), generally few-flowered and small, 6–12 mm. long, 0.75–2.25 mm. wide, the scales elliptic-oblong, obtuse (the lowermost generally retuse) and cuspidate or more frequently the midrib excurrent as a short awn, hyaline and greenish to stramineous or brown-tinged except for the prominent green midrib; pistillate spikes 2 or 3, ovate-orbicular, separate, sessile or the lowermost subsessile, 4–6 mm. long, 4–5 mm. wide, containing 2–4 ascending perigynia; lowest bract foliaceous, very short-sheathed, usually equaling or exceeding the inflorescence; upper bracts reduced or squamiform; scales ovate-lanceolate, long-acuminate, frequently awned, much exceeding the perigynia, greenish-hyaline to somewhat brown-tinged except for the broad green midrib; perigynia obovoid, 2.75–3 mm. long, 1.35–1.5 mm. wide, 2-keeled, puberulent, light-green, closely enveloping the achene, obtusely trigonous, abruptly contracted into a spongy base and into a bidentate beak 0.5–0.7 mm. long; achenes orbicular-obovoid, trigonous with convex sides, yellowish green, 2 mm. long, 1.5–1.75 mm. wide, abruptly tapering at the base to a stipe 0.5 mm. long, the apex short-apiculate; style short, deciduous; stigmas 3, long and slender.

GEORGIA: Gilmer County—dry rocky roadside, 8 miles east of Chatsworth, *J. H. Pyron and Rogers McVaugh 2951*, May 15, 1938 (TYPE—U. S. National Herbarium).—PLANT INDUSTRY STATION, BELTSVILLE, MARYLAND.

SOUTHERN ILLINOIS FLORA: RECENT ADDITIONS.—Field collections during the past summer (1954) have resulted in the addition of several new specimens to the herbarium of Southern Illinois University and constitute additions to the known flora of Illinois, based on the listings of Jones' Flora of Illinois (1950).

A new cup-grass, *Eriochloa contracta* Hitchc., was found in considerable abundance on the roadside and low ground near the levee of the Pine Hills recreation area of Union County, Ill. The 8th edition of Gray's Manual gives the range of this species as follows: La. to N.M., Kansas; adv. in Mo. and Va. The specimens were collected Oct. 13, 1954. Specimens have been deposited at the herbaria of the University of Illinois, The Illinois State Museum, and the U. S. National Herbarium. The determination was verified by staff members of the U. S. National Herbarium.

Early in the fall of 1954, a conversation with Dr. L. S. Minckler, Silviculturist, U. S. Forestry Service, Carbondale Research Center, revealed that he had seen what he thought was an American Holly tree, *Ilex opaca* Ait., in Union County. On Sept. 25, he brought a specimen (not flowering or fruiting) to me for my opinion as to its identity. As well as one can tell in the absence of flowers or fruits it does seem to be *Ilex opaca*. Dr. Minckler suggests that its location is such that it must be naturally occuring in southern Illinois. The place of collection is near Alto Pass in Ramberger Hollow. The American Holly is listed in Gray's Manual of Botany, 8th edition, for southern Illinois and the neighboring states of Kentucky, Missouri, southern Ohio and southeastward. The specimen is deposited in the herbarium of southern Illinois University.

An exploration of land abandoned following coal stripping operations in Perry County, on the land of the Truax-Traer Coal company about 5 miles south of Pinckneyville, Illinois, has resulted in the discovery of a colony of smooth-leaved *Silphium terebinthinaceum* Jacq. The upper surface of the leaf was more or less completely smooth except for a narrow fringe around the edge of the leaf. The leaves were typically rough-hairy beneath. Correspondence with Dr. E. Lucy Braun for whom the smooth-leaved variety was named and subsequent checking of the material by Dr. Braun and by Dr. Julian Steyermark reveals that Steyermark considers our material referable to *Silphium terebinthinaceum* Jacq. var. *Lucy-Brauniae* Steyermark. The previously known stations for this taxon are in Adams County, Ohio, the area of the type; Rowan County, Ky., Pendleton County, Ky; Oktibbeha County, Mississippi, and from Lord's Park near Elgin, Illinois.[1] Our specimens were somewhat smaller in stature than is usual for typical *S. terebinthinaceum.* The plants were in bud at the time of collection which was August 4, 1954.

One of the most interesting plants discovered the past season was *Trichachne insularis* (L.) Nees, found one-half mile south of the village of Cambria in Williamson County. This plant was not listed in Gray's Manual, 8th ed., and the range as given in Hitchcock's Manual of the Grasses of the United States (1950) is: Florida, Alabama (Mobile), southern Texas, southern Arizona; Mexico; West Indies to Argentina. A small clump was found by the roadside and in my excitement I pulled all of the material for specimens. Unfortunately we shall never know if it would have survived there. Judging from the range it is very doubtful that it could have survived our winters. Owing to the situation then it would not be correct to make it an addition to our flora. Its occurrence here is nevertheless interesting. The plants were growing well and had produced seed. It will be interesting to watch the location for possible germination of seed next year. The specimens were deposited in the herbaria of the University of Illinois, Illinois State Museum and U. S. National Museum. Workers at the last mentioned institution verified the determination. The date of collection was Oct. 13, 1954. JOHN W. VOIGT, SO. ILL. UNIVERSITY, CARBONDALE, ILL.

Volume 57, no. 676, including pages 105–132, was issued 15 April, 1955.

[1] Steyermark, Julian A., 1951. A glabrous variety of Silphium terebinthinaceum, RHODORA 53: 133–35. 1951.

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Vol. 57 | June, 1955 | No. 678

CONTENTS:

The New England Botanical Club, Inc.

8 and 10 West King St., Lancaster, Pa.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of the Gray's Manual Range and regions floristically related. Price, $4.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) of not more than 24 pages and with 1 plate, 40 cents, numbers of more than 24 pages or with more than 1 plate mostly at higher prices (see 3rd cover-page). Back volumes can be supplied at $4.00. Some single numbers from these volumes can be supplied only at advanced prices (see 3rd cover-page). Somewhat reduced rates for complete sets can be obtained on application to Dr. Hill. Notes and short scientific papers, relating directly or indirectly to the plants of North America, will be considered for publication to the extent that the limited space of the journal permits. Illustrations can be used only if the cost of engraver's blocks is met through the author or his institution. Forms may be closed five weeks in advance of publication. Extracted reprints, if ordered in advance, will be furnished at cost.

Address manuscripts and proofs to Reed C. Rollins,
Gray Herbarium, 22 Divinity Ave., Cambridge 38, Mass.

Subscriptions (making *all remittances* payable to RHODORA) to

Dr. A. F. Hill, 8 W. King St., Lancaster, Pa., or, preferably, Botanical Museum, Oxford St., Cambridge 38, Mass.

Entered as second-class matter March 9, 1929, at the post office at Lancaster, Pa., under the Act of March 3, 1879.

Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 57 | June, 1955 | No. 678

PRELIMINARY STUDIES IN THE GENUS DENTARIA IN EASTERN NORTH AMERICA*

F. H. Montgomery

The taxonomy of the eastern North American species of the genus *Dentaria* (Cruciferae) has been a problem to botanists for many years. So closely may characteristics of some specimens in one species resemble those of another species, that the task of separating them seems hopeless. Considering the two most widely distributed species, Wiegand and Eames (1926) remarked "Many plants of *Dentaria* differ in various ways from typical *D. diphylla* and *D. laciniata.* These have been a constant source of difficulty to local botanists. Field studies through many seasons have led the authors to the belief that these plants are all of hybrid origin, with *D. diphylla* and *D. laciniata* as parents."

Coulter, as far back as 1875, suggested, "These several species (*D. maxima, heterophylla, laciniata,* and *multifida*) should certainly be reduced to one, and some such name as *D. heterophylla* be given to it." Indeed, had he been aware of the variability of *D. diphylla,* he might well have included it with the other species.

The fact that hybrids between nearly all species have been suggested also gives an indication of the complex taxonomic status of the species. Haberer and House (1923) described three hybrids, *D. diphylla* × *maxima* Haberer, *D. laciniata* × *maxima* Haberer, and *D. laciniata* × *diphylla* House. The second hybrid was considered to be similar to *D. incisifolia* Eames,

* **Field work in this study was assisted by a Grant from the Research Council of Ontario.**

and the third to correspond to *D. anomala* Eames. Dr. E. Lucy Braun on herbarium specimens and in personal correspondence has suggested the hybrids *D. laciniata* × *heterophylla*, and *D. multifida* × *heterophylla*. The presence of the parent species in the areas where the hybrids were found, as well as appearances, was the basis for her determinations.

Up to the present, the differentiation of species and hybrids has been based chiefly on morphology. The data presented in this paper are based not only on a morphological study of specimens from numerous herbaria and in the field, but also include information obtained from cytological, embryological, pollen and fertilization studies.

Materials and Methods

Herbarium material was examined from the following sources:

Dr. E. Lucy Braun (private collection), Cincinnati, Ohio; Clemson College, Clemson, S. C.; Chicago Museum of Natural History, Chicago, Ill.; Cornell University, Ithaca, N. Y.; Division of Botany and Plant Pathology, Ottawa, Ont.; Gray Herbarium, Harvard University, Cambridge Mass.; McMaster University, Hamilton, Ont.; Montreal Botanic Garden, Montreal, Que.; Missouri Botanical Garden, St. Louis, Mo.; National Herbarium, Washington, D. C.; National Museum of Canada, Ottawa, Ont.; New York Botanical Garden, New York, N. Y.; North Carolina State College, Raleigh, N. C.; University of Cincinnati, Cincinnati, Ohio; University of Georgia, Athens, Ga.; University of Iowa, Ames, Iowa; University of Michigan, Ann Arbor, Mich.; University of North Carolina, Chapel Hill, N. C.; University of Tennessee, Nashville, Tenn.; University of Toronto, Toronto, Ont.; University of Wisconsin, Madison, Wisc.; University of Western Ontario, London, Ont.

Rhizomes were collected by the writer from Ontario, and the states of Alabama, Georgia, New York, Tennessee, and Virginia. Dr. Wilbur H. Duncan of the University of Georgia very kindly contributed further materials from Alabama and Georgia. Root-tips from these rhizomes were fixed in acetic-alcohol, 1:3, stained by the Feulgen technique, mounted in aceto-carmine and squashed under the coverslip. Chromosome counts and photographs were made before the slides were made permanent.

Pollen for determining the percentage of mature pollen grains was obtained for all species, and from areas throughout the range of each species. Following the technique of Downs (1943), pollen was mounted in polyvinyl alcohol. To give a stain so that the pollen grains could be more easily seen, we dissolved acid fuchsin in the mounting medium. Mature pollen grains stained a deep pink; aborted or empty grains did not take the stain.

Taxonomic Notes

O. E. Schulz (1903) monographed the genus *Cardamine,* and in his monograph considered the genus *Dentaria* to be a section of *Cardamine.* The combining of the two genera was not without precedent, for Crantz (1769), Robert Brown (1812), and Wood (1870) listed the species of *Dentaria* under *Cardamine.* Recent floras in America, as well as in Europe, however, have continued to separate the two genera. Until both have been studied more completely by modern taxonomical methods, no conclusive evidence as to the relationship between them can be established.

The first species of *Dentaria* to be described in eastern North America was *D. laciniata* by Willdenow (1800), apparently from letters and collections sent to him by Muhlenberg. The main diagnostic characteristic was the three, three-parted leaves. In 1803, Michaux described as *D. concatenata,* a species having tuberous segments united by a narrow connective, and with three, three-parted leaves. This has been made synonymous with *D. laciniata.* This leaf character and the concatenate root-stocks are still accepted as the outstanding features of the species. The rhizomal leaf (if present) and the flowering stem arise from the end of the rhizome segment of the previous year. The involucral leaves may be two instead of the typical three. They may be glabrous or pubescent. The peduncles and pedicels most frequently do have pubescence. The trichomes are comparatively long and more or less perpendicular to the leaf, peduncle and pedicel surface. In this respect, they resemble the trichomes of *D. maxima.*

Although all species are polymorphic, in no other has varieties been described. When the leaves are two, they may be opposite, var. *opposita* Farwell (1931). Typically the leaves are in whorls but they may be alternate as in var. *alterna* Farwell (l.c.). As in the original description the leaflets are basically three-parted, but the lateral leaflets may be again divided, giving a five-parted appearance. Several varietal names have been given to variations in those specimens having simply three-parted leaflets, e.g. var. *furcata* Small, (1903), var. *integra* (O. E. Schulz) Fernald, (1908), var. *latifolia* Farwell (l.c.). Variety *coalescens* Fern. (1938) has the leaves merely three-cleft or pinnatifid. Schulz (1903) described a variety with the pubescence also covering the silique, var. *lasiocarpa*.

Dentaria laciniata has a wide distribution (fig. 4). It extends farther westward and southward than any other species, but no records have been seen for Maine and the Maritime Provinces of Canada. Only in southern Ontario has it been found north of the Great Lakes.

Michaux (1803) described *D. diphylla* as the *Dentaria* with dentate roots, with two stem-leaves approximate and three-parted. The rather stout, continuous, dentate rhizomes, on or close to the surface of the ground, are the best distinguishing feature of the species. The basal or rhizome-leaf, and the flowering stem arise from the same point at the end of the rhizome, but the new underground growth forms so quickly in the spring that these may appear to originate from the surface of the rhizome. In all other species the above ground parts appear to come from the constricted portion of the rhizome—actually the tip of the former year's growth. The two, three, or more involucral leaves may be opposite, sub-opposite, or alternate. These leaves are three-parted. The very short, forward-pointing trichomes on the margins of the leaflets may be used to distinguish this species from *D. laciniata, maxima* and *multifida;* however, *D. heterophylla* has similar marginal trichomes. The peduncles and pedicels are nearly always glabrous. The number, size, and color of the flowers varies considerably, and no constant character has been noted.

Dentaria diphylla covers most of the range of the genus (fig. 3) but does not extend as far west as *D. laciniata*. It is, however, found farther northward and eastward than *D. laciniata*.

Dentaria multifida was catalogued by Muhlenberg (1813) but was first described by Nuttall (1818). It is the most delicate of our species. It has very small, concatenate rhizomes with the segments rather firmly united. The leaves are basically similar to *D. laciniata*, being three-parted. The primary divisions are further divided into linear segments. For this reason

Distribution of Eastern North American Species of Dentaria. Fig. 1. *D. multifida;* Fig. 2. *D. heterophylla;* Fig. 3. *D. diphylla;* Fig. 4. *D. laciniata;* Fig. 5. *D. maxima;* Fig. 6. Composite map of distribution areas.

Leavenworth (1824) described *D. dissecta* from a specimen from Cherokee Co., Tenn. This has been placed in synonymy. No pubescent specimens have been seen. Some specimens of *D. multifida* may approach *D. laciniata* in appearance, and vice-versa. Schulz (l.c.) treated *D. multifida* as a variety of *D. laciniata* and said that it was bound with the main species through a continuous series of intermediates.

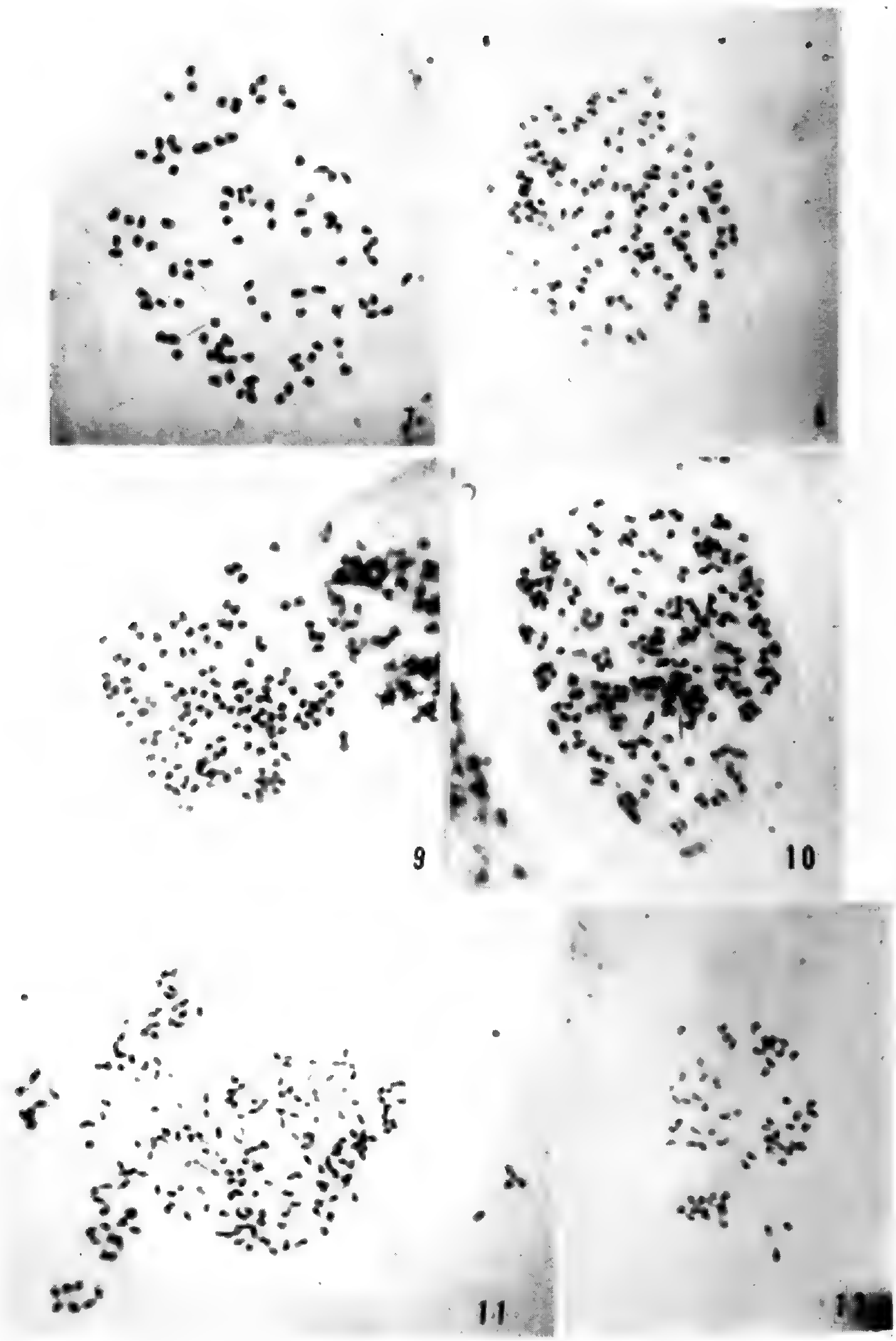
D. multifida has a restricted distribution (fig. 1). Its area of greatest frequency is Tennessee, northern Georgia and northern Alabama.

Nuttall's description of *D. heterophylla* (1818) might well apply to *D. diphylla,* except for the concatenate rhizome. In *D. heterophylla* the segments are short, slender and rather firmly united by a narrow connective. The size of the segments distinguishes them from those of *D. laciniata.* In examining specimens it was frequently necessary to observe the rhizomes in order to separate *D. heterophylla* and *D. diphylla.*

The area of *D. heterophylla* (fig. 2) is much more restricted than that of *diphylla* and *laciniata,* but wider than that of *multifida.* It has migrated into southern Indiana, Ohio and Pennsylvania.

Dentaria maxima was rather thoroughly described by Nuttall (l.c.). His description of the rhizomes requires some clarification. Nuttall described them as "concatenate" but this would not distinguish them from those of *D. laciniata, D. heterophylla* and *D. multifida.* The rhizomes of *Dentaria maxima* closely resemble those of *D. diphylla,* but are distinguished by alternately enlarged and only slightly constricted regions. Also, as to the size and number of leaves and leaflets, the specimens that Nuttall described must have been rather singular. "Stem often near 2 ft. high,—leaves 5 to 7." In the specimens examined, stems seldom exceeded 1 ft. in height, and most frequently there were 3 alternate leaves. However specimens with one, two, or several leaves are to be found. The leaflets are usually more sharply toothed than those of *D. diphylla.* The leaf characters vary, and in some areas they approach those of *diphylla.* In other localities, e.g. Taughannock Falls and Enfield Glen, New York, and Milton and Kitchener, Ontario, the leaves are difficult to distinguish from those of *laciniata.* Nuttall mentioned the slightly asperate margin of the leaf. The trichomes there were found to be longer and more nearly perpendicular to the margin of the leaf than the trichomes of *diphylla.* They are superficially similar to those of *laciniata.* The peduncles are most frequently glabrous, but pubescent specimens have been seen.

D. maxima occurs entirely within the area of the Wisconsin glaciation (fig. 5), and its main distribution is in New York State, and the Provinces of Ontario and Quebec.



CHROMOSOMES OF DENTARIA SPECIES ($\times$ 2000). Fig. 7. *D. diphylla*, 2n = 96; Fig. 8. *D. multifida*, 2n = $\pm$ 112; Fig. 9. *D. heterophylla*, 2n = $\pm$ 128; Fig. 10. *D. laciniata*, 2n = $\pm$ 240; Fig. 11. *D. maxima*, 2n = $\pm$ 208; Fig. 12. *D. multifida* from Rome, Ga., 2n = 64.

Cytology

The chromosomes in all species are small and numerous. This latter fact made it difficult always to obtain complete separation of the chromosomes. Their size prohibited a study of chromosome morphology, but most of them seemed to have a median centromere. Some had a sub-terminal centromere which was rather elongated and often made it uncertain whether one should count one or two chromosomes.

Table 1 gives the chromosome numbers for the species studied.

TABLE 1. Chromosome Numbers for Eastern North American Species of Dentaria

Species	*Source of material*	*No. of cell counts*	*2n no.*
D. diphylla (Fig. 7)	Kitchener, Guelph, Ont.	21	96
D. heterophylla (Fig. 9)	Markham, Va.; Rome, Ga.; Winston Co. Ala.; Johnston City, Tenn.;	42	±128
D. laciniata (Fig. 10)	Kitchener, Guelph, Ont.	15	±240
D. maxima (Fig. 11)	Guelph, Milton, Ont.; Enfield Glen, N. Y.; Taughannock Falls, N. Y.	15	±208
D. multifida (Fig. 8)	Vilanow, Ga.; Chattanooga, Tenn.	10	±112
(Fig. 12)	Rome, Ga.	5	64

Chromosome studies by other workers have shown that most species of *Dentaria* studied from other parts of the world are also polyploids. Those species for which chromosome counts have been made are as follows:

TABLE 2. Chromosome Numbers of Species Outside of Eastern North America

Species	*2n Chromosome No.*	*Author*
D. polyphylla	48	Schwarzenbach, 1922
D. pentaphylla	48	Schwarzenbach, 1922
D. pinnata	48	Schwarzenbach, 1922
D. bulbifera	ca 96	Manton, 1932
D. californica	32	Manton, 1932
D. savensis	ca 80	Manton, 1932
D. macrophylla	16	Morinaga & Fukushima, 1931

With the exception of *D. californica* these are European and Asiatic species.

The basic chromosome number has been given as x = 8 by Darlington and Janaki Ammal (1945). This number is certainly basic to the American species studied here, but the 2n number exceeds those found so far in other parts of the world.

It is the writer's opinion that the chromosome numbers given in Table 1 are not all that may be obtained for specimens in our area. The fact that one specimen of *D. multifida* from Rome, Ga., had 2n = 64 would give credence to this opinion; also the origin of our present species would indicate that other chromosome numbers may be expected, if different populations are examined.

Some verification of chromosome number relationships was sought in stomata number per sq. mm. This method was first suggested by K. and H. J. Sax (1937). Babcock and Stebbins (1938) used stomatal size as a criterion to indicate chromosome number in *Crepis*. In *Dentaria*, neither method proved to be completely satisfactory. However, in three species, *D. diphylla*, *D. laciniata*, and *D. maxima*, stomatal counts per sq. mm. could be used with some degree of accuracy. *D. diphylla* averaged 92 stomata, *D. laciniata* 52 stomata, and *D. maxima* 65 stomata per sq. mm. It was not possible to distinguish *D. heterophylla* and *D. multifida* by this technique.

Sterility in the Genus Dentaria

Sterility in some European species, particularly *Dentaria bulbifera*, has been the subject of several papers, Ernst, (1918), Gams, (1922), Schwartzenbach, (1922), Leopold (1928), and Fritsch, (1922). Eames (1903) remarked on the sterility of *D. diphylla*, and the new edition of Gray's Manual notes that siliques are rarely matured in *D. diphylla* and *D. maxima*. While studying herbarium specimens, observation of those specimens that had fruiting material showed that although pods were developed, few, if any, developed mature seed. Studies in the field led to the same conclusion. Pods may develop to a good size, but when the contents are examined, they will most frequently be found to contain aborted ovules. Efforts to get apparently mature seeds of *D. diphylla*, *D. laciniata* and *D. maxima* from Ontario to germinate were entirely unsuccessful.

Causes of sterility were sought in pollen and ovules. Anthers of all species were observed for aborted pollen. In all, 70 specimens from throughout the area of the genus were examined, and with few exceptions the percentage of normal appearing pollen was high. Even in those specimens that were considered by the collector to be hybrids, good pollen was usually the rule. It was evident that sterility could not be attributed to poor pollen.

This led to the questions: Were the flowers being pollinated? Is self- or cross-pollination required for production of seeds? To obtain some answers to these questions 50 flowers from each of the species *D. diphylla*, *D. maxima*, and *D. laciniata* were self-pollinated, and 50 flowers of each were cross-pollinated with pollen from what were considered to be different clones. Not one seed was obtained from these pollinations. This would confirm observations that these three species are highly sterile.

Sections of ovules of the same three species were studied, and it was observed that shortly after the eight-celled stage was reached in the embryo sac, disintegration of the cells of the embryo sac took place and the ovules finally aborted and died. The eastern North American species of *Dentaria* proved to be another example of a polyploid series being sexually sterile. Undoubtedly they reproduce mostly, if not entirely, apomictically by vegetative reproduction, for which the nature of the rhizome seems admirably suited. In this respect they resemble *D. bulbifera* as discussed by Ernst (l.c.), *D. glandulosa* by Schulz (l.c.).

Discussion

This study of the eastern North American species of *Dentaria* indicates that there is great difficulty in determining the species by morphology alone. Numerous plants with intermediate characters appear and there is an intergradation of characters in most of the species. Cytological investigations indicate that the species in the area being considered have high polyploidy, 2n = 64, 96, 112, 128, 208, and 240, and these numbers support the separation of the species. Normal pollen, with few exceptions, throughout the range of the genus is high. It has been found, in at least three species, that disintegration of the contents of the embryo sacs takes place shortly after they have reached the 8-celled stage. The same three species are sexually sterile and reproduce vegetatively by rapid development of the rhizomes, particularly in the early spring and during the time of flowering.

It is apparent that we have in this group of plants, an agamic complex similar to that described by Babcock and Stebbins (l.c.) in western American members of the genus *Crepis*. However, we have not yet discovered the diploid ancestors of this eastern North American complex. Probably they have been overlooked, or, they may no longer be in existence. As Stebbins (1941) has pointed out, "The systematic structure of an agamic complex can be understood only when its diploid sexual members are all known, and the limits of their variability have been determined." We are, therefore, compelled to discuss our representatives from the data that are available.

It is well known that in genera such as *Taraxacum*, *Hieracium*, and *Crepis* certain groups are highly polymorphic. This polymorphism may be attributed to hybridization, polyploidy, and apomixis. Stebbins (l.c.) has pictured the development of the agamic complex, and *Dentaria* seems to fit well into this picture. The diploid species, which were well defined systematically, by hybridization and polyploidy produced many new forms which because of their adaptability were able to invade habitats unsuited to their diploid parents. They may even have crowded out the diploid parents, if they ever existed on this continent. The numerous variations that were produced were finally reduced by the process of natural selection to the few remnants which represent our present species, and the many intermediates that cause so much taxonomic difficulty.

Gustafson (1947) showed that hybridization and polyploidy contribute to the production of apomicts. Hybridization may bring together genes responsible for sexual sterility, and polyploidy builds up the numbers of these genes, and may also alter the physiological condition of the cells so that the sterility factors may have full expression. In our highly polyploid members of the genus *Dentaria*, there has been a great accumulation of these sterility factors, and the genus has reached the stage of evolution where there is complete sexual sterility. The genus, therefore, depends for its existence on vegetative reproduction. According to Stebbins this is the last stage in the evolution of apomicts. Having lost their sexuality, they can produce nothing new and eventually die out.

The distribution of *Dentaria maxima* north of the southern limits of the glaciation is an interesting phytogeographical problem. That it is a hybrid between two of our species, *D. diphylla* and *D. laciniata,* as suggested by Wiegand and Eames, is excluded for several reasons. These two species are usually found in dry mesophytic woodlands, but *D. maxima* has been found most frequently in low, moist, wooded areas or on moist, wooded hillsides. The chromosome number, 2n = ± 208 does not indicate a hybrid origin with these two species as parents. The sexual sterility of *D. diphylla* and *D. laciniata* also argues against its being a direct hybrid between these two species; and for similar reasons it seems highly improbable that it can be a hybrid between any species of *Dentaria* now known in eastern America.

It would seem then, that *D. maxima* is a member of the agamic complex that originated before complete sexual sterility was effected in the members of the complex. It may have been derived during some interglacial period of the Pleistocene glaciation. During the Wisconsin glaciation the species survived near the border of the ice sheet, and with the return of temperate conditions found the glaciated soils a more suitable habitat than the Tertiary soils to the south.

Conclusions

1. The species of the genus *Dentaria* in eastern North America are highly polymorphic, and sharp morphological lines of distinction between species cannot be drawn.
2. The species *D. diphylla, D. multifida, D. heterophylla, D. maxima,* and *D. laciniata* can be distinguished cytologically on the basis of chromosome numbers. All species are high polyploids.
3. Sexual sterility is known to occur in three species, *D. diphylla, D. maxima* and *D. laciniata.* Examination of specimens of *D. heterophylla* and *D. multifida* indicates that sterility also occurs in these species. Sterility has been shown to be the result of incomplete development in the embryo sac.
4. The genus is considered to be of ancient origin, and the polymorphic character of the species is the result of hybridization, polyploidy and apomixis.

5. *Dentaria maxima* occurs only in the glaciated regions of eastern North America, and is thought to have originated during some interglacial period. After the Wisconsin glaciation it migrated north into the glaciated areas rather than south into the tertiary soils.

Key to the Eastern North American Species of Dentaria

a. Rhizome not segmented or with alternately enlarged and slightly constricted regions; rachis glabrous (rarely pubescent).
  b. Diameter of rhizome constant along its entire length; cauline leaves mostly 2, opposite or alternate; trichomes on margins of leaflets 0.1 mm. long and appressed . . . . *D. diphylla.*
  b. Rhizome with alternately enlarged and slightly constricted regions; number of cauline leaves and arrangement variable but most frequently 3 and alternate; trichomes on margins of leaflets 0.2–0.3 mm. long and spreading . . . . *D. maxima.*
a. Rhizome definitely formed of segments united by fragile connectives.
  c. Rachis pubescent (rarely glabrous); trichomes of rachis and margins of leaflets 0.2–0.3 mm. long and spreading . . . . *D. laciniata.*
  c. Rachis glabrous (rarely pubescent).
    d. Cauline leaves usually 2, opposite or alternate; leaflets 3; trichomes on margins of leaflets 0.1 mm. long and appressed . . *D. heterophylla.*
    d. Cauline leaves most frequently 2; leaflets dissected into 3–7 linear segments 1–3 mm. broad; margins of leaflets without trichomes . . . . *D. multifida.*

Acknowledgments

My sincere thanks are extended to the Curators of all the herbaria from which study material was received; to Dr. L. O. Gaiser for her advice in the preparation of the manuscript; to Dr. Reed C. Rollins for his encouragement during the progress of the work, and to many others who have contributed materials and information without which the study could not have been completed.—department of botany, ontario agricultural college, guelph, ontario.

Literature Cited

Babcock, E. B. and G. L. Stebbins, Jr. 1938. The American species of *Crepis*. Carneg. Inst. Wash. Pub. No. 504.

Brown, Robert 1812. Genera et species plantarum. In Aiton Hortus Kewensis. Ed. 2. **4**: 101.

Coulter, J. 1875. Botany Bulletin **1**: 8.

Crantz, H. J. 1769. Classis Cruciformium. p. 66.

Darlington, C. D. and E. K. Janaki Ammal, 1945. Chromosome atlas of cultivated plants. George Allen & Unwin, Ltd. London.

Downs, W. G. 1943. Polyvinyl alcohol—a medium for mounting and clearing biological specimens. Science **97:** 539–40.

Eames, E. H. 1903. The Dentarias of Connecticut. Rhodora **5:** 202.

Ernst, A. 1918. Bastardierung als Ursache der Apogamie im Pflanzenreich. Jena.

Farwell, O. A. 1931. Botanical gleanings in Michigan, VII. Amer. Mid. Nat. **12:** 58.

Fernald, M. L. 1908. Notes on some plants of northeastern America. Rhodora **10:** 84.

————. 1938. Noteworthy plants of southeastern Virginia. Rhodora **40:** 421.

————. 1950. Gray's manual of botany, ed. 8. American Book Co. N. Y.

Fritsch, K. 1922. Ist *Cardamine bulbifera* als Abkömmling eines Bastardes aufzufassen? Ber. Deutsch. Bot. Ges. **40:** 193–195.

Gams, H. 1922. Noch einamal über die Herkunft von *Cardamine bulbifera* (L.) Crantz und Bermerkungen über sonstige halb- und ganzwaisen. Ber. Deutsch. Bot. Ges. **40:** 362–367.

Gustafsson, Åke. 1947. Apomixis in higher plants. Lunds Universitets Årsskr. N. F. **43:** Nr. 2; 70–349.

House, H. D. 1923. Report of the State Botanist for 1921. N. Y. State Mus. Bull. 243–244: 44.

Leavenworth, M. C. 1824. Notice of four new species collected in Alabama. Amer. Jour. Sci. **7:** 62.

Leopold, W. 1928. Beiträge zur Kenntnis der Gattung *Cardamine* mit besonderer Berücksichtigung der hybridenfrage in der Sektion *Dentaria*. Acad. d. Wiss. in Wien Mat. Nat. Klasse. **101:** 325–360.

Michaux, A. 1803. Flora Boreali-Americana **2:** 30.

Muhlenberg, H. 1813. Catalogus Plantarum Americae Septentrionalis, **63:** 60.

Nuttall, T. 1818. The genera of North American plants and a catalogue of the species to year 1817. **2:** 66.

Sax, K. and H. J. Sax. 1937. Stomata size and distribution in diploid and polyploid plants. Jour. Arnold Arboretum, **18:** 164–172.

Schulz, O. E. 1903. Monographie der Gattung *Cardamine.* Bot. Jahrb. **32:** 280–623.

Schwartzenbach, F. 1922. Untersuchungen über die sterilität von *Cardamine bulbifera* (L.) Crantz. Flora **115:** 393–514.

Small, J. K. 1903. Manual of the southeastern flora. Published by the author. New York.

Stebbins, G. L. Jr. 1941. Apomixis in Angiosperms. Bot. Rev. **7:** 507–542.

Wiegand, K. M. & A. J. Eames, 1926. The flora of the Cayuga Lake Basin, New York. Cornell Univ. Agri. Expt. Sta. Mem. 92.

Willdenow, C. L. 1800. Species Plantarum. III: 479.

Wood, A. 1870. American Botanist & Florist. Part 4, p. 37. A. S. Barnes & Co., N. Y.

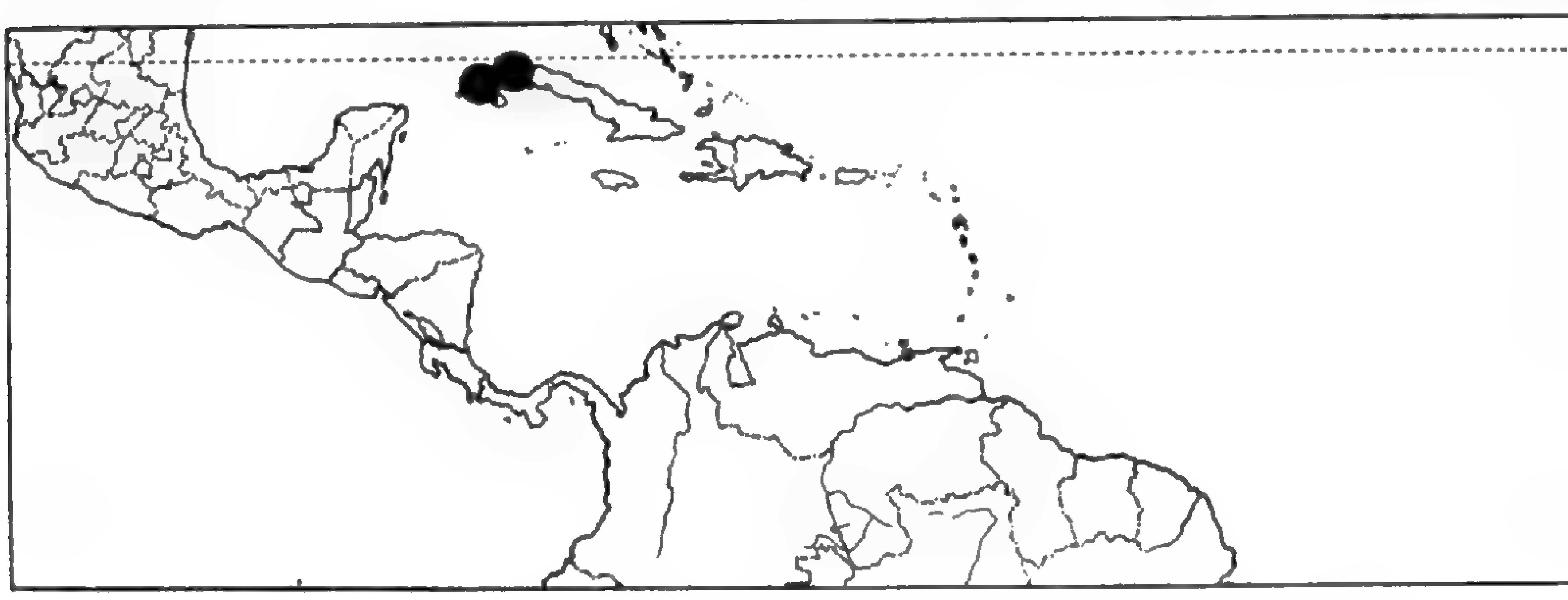
ECHINODORUS IN THE AMERICAN TROPICS

Norman C. Fassett

(*Continued from p. 156*)

7a. E. bracteatus Micheli var. bracteatus. Blades with stellate tuberculate-based hairs toward the base, and with pellucid dots and very short lines (Fig. 60).

Panama: around El Paraiso, Canal Zone, alt. 30–100 m., 24 January 1911, *Pittier 2531* (gh, ny, us); Gatun, November 1859, *Hayes 130* (gh); open swamp, between France Field, Canal Zone, and Catival, Prov. Colón, 9 January 1924, *Standley 30444* (us); wet forest, near the big swamp east of the Río Tecumen, Prov. Panamá, 11 December



Map 6. Echinodorus ovalis.

1923, *Standley 26724* (us); Mindi, 28 February 1905, *Cowell 177* (ny); Colón, Monkshill, 5 June 1874, *Kuntze* (ny). **Ecuador:** in water of swamp and mud, Prov. Guayas, Oil Camp between Guayaquil and Salinas, alt. 0–100 m., 21–24 June 1923, *Hitchcock 20084* (us, ny; sheet in gh is the variety below); in paludosis, Balao, January 1892, *Eggers 14216* (us); moist sandy creek bed, alt. 40 m., 20 km. southweast of Guayaquil, 29 August 1938, *Worth, Morrison & Horton 8935* (us).

7b. E. bracteatus Micheli, var. **efenestratus** Fassett, n. var., foliorum laminis glabris, punctis lineisve pellucidis destitutis.—Leaf blades glabrous and without pellucid markings.—**Ecuador:** coast plain, on marshy ground, near water. Stem 2½ m. high. Flowers white. *A. Rimbach 90* (type in f); coast plain, in swampy ground or open places. Perennial herb, 2½ m. high. Leaf blade as much as 40 cm. long and 30 cm. broad. Flowers white. July. *A. Rimbach 287* (us); swamp, in water, and in mud along edge, Prov. Guayas, Oil Camp between Guayaquil and Salinas, 21–24 June 1923, *Hitchcock 20084* (gh).

8. Echinodorus ovalis Wright in Sauvalle, Fl. Cub. 564. 1871; Buch. in Engler, Pflanzenr. 4, fam. 15; 31. 1903; Small, N. Am. Fl. **17:** pt. 1: 48. 1909.

I have seen but two collections of this little-known Cuban species. The pellucid marking of the blades (Fig. 61) is much like that of *E. cordi-*

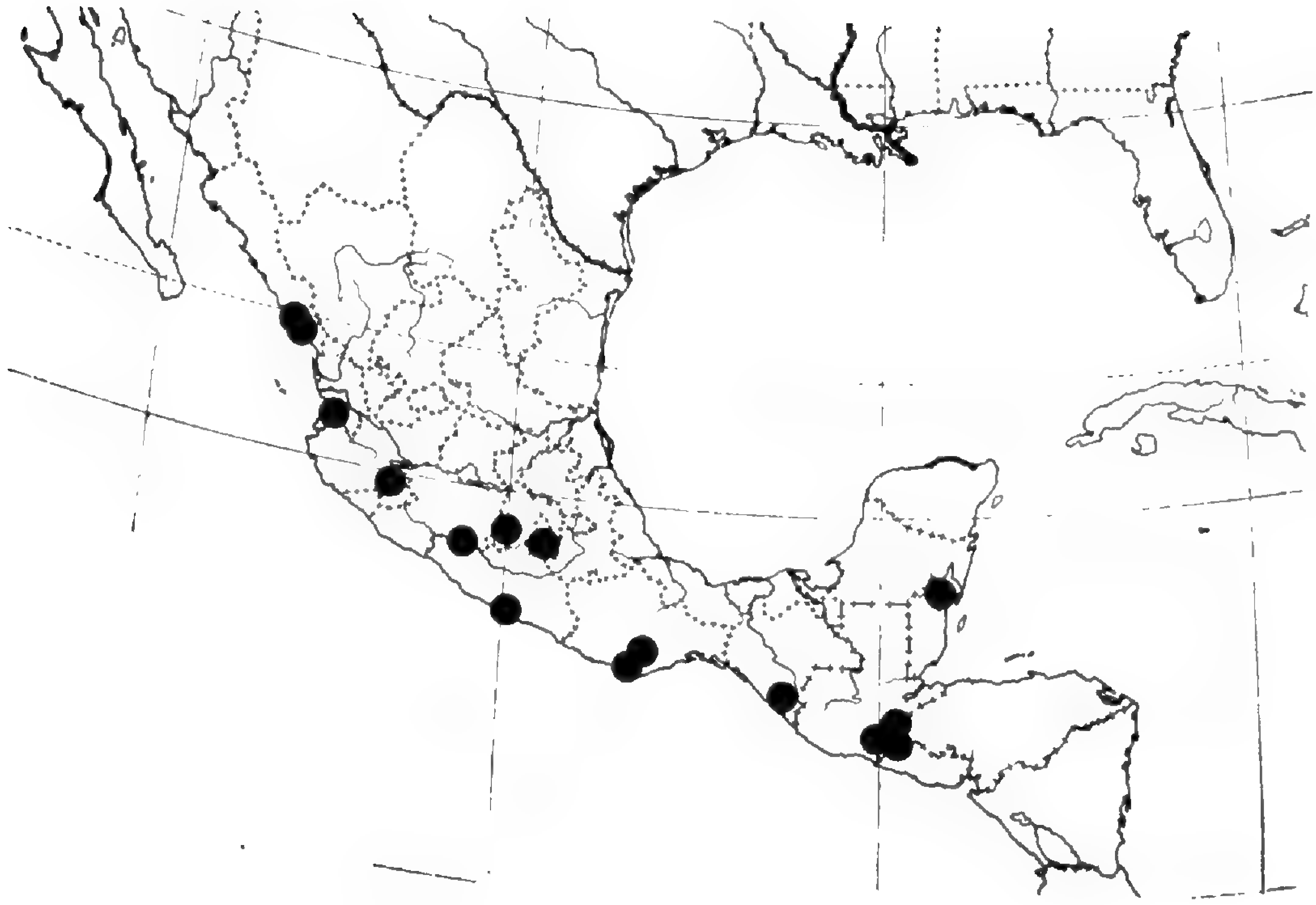
folius (Fig. 54), but the pellucid lines are more abundant and the venation appears to be a little finer and more complex. The scape, also, is much like that of *E. cordifolius* and looks as if it might become prostrate as in that species. The sepals of *E. ovalis*, however, have smooth ribs quite unlike the muricate ribs of *E. cordifolius*. An immature nutlet is shown in Fig. 40; it looks as if it would be short beaked, with several ribs and facial glands.

Western Cuba (Map 6). **Cuba:** *Wright*, without data (US); *Wright 3713*, without other data (GH); pond west of Batabanó, Habana, 8 November 1928, *León 13707* (GH). *E. ovalis* is listed by Buchenau from Pinar del Rio and Hato Salado, and these localities have also been plotted on Map 6.

9. Echinodorus Andrieuxi (Hook. & Arn.) Small, N. Am. Fl. 17, pt. 1: 46. 1909. *Alisma Andrieuxi* Hook. & Arn., Bot. Beech. Voy. 311. 1839. *Echinodorus ellipticus* γ, *ovata* Micheli in DC., Monogr. Phan. **3:** 52. 1881, not *E. ellipticus* var. *ovatus* Hauman, Anal. Mus. Nac. Buenos Aires **27:** 309. 1925. *E. ellipticus* f. *ovata* F. J. Meyer, Bot. Centralbl. Beihefte **49** (1): 331. 1932.

Leaves erect, long-petioled; blades narrowly elliptic (Fig. 14), to ovate (Fig. 15), mostly tapered to truncate at base, usually 15–20 cm. long but sometimes reaching 30 cm. or more, usually with very obscure pellucid lines; petiole 2-winged; inflorescence simple and wand-like or rarely with short weak branches at base, with many rather compact verticels; bracts slightly connate at base, long-acuminate at tip; pedicels from nearly lacking to 2 cm. in length; nutlets with body about ½ as wide as long, 4–7-ribbed, with usually one facial gland (Figs. 41–43); beak about ½ as long as the body.

Western Mexico to El Salvador (Map 7), and Nicaragua according to Micheli. **Sinaloa:** Bellavista, Mazatlán, March 1931, *Gonzales 6846* (F, US); Río Piaxtla, San Ignacio, alt. 20 m., 13 March 1918, *Narvaez 199* (US); Mazatlán, 6 April 1910, *Rose 14100* (NY, US); moist field, Villa Union, 2 April 1910, *Rose 13963* (US); Balboa, January 1923, *Ortega 4994* (US). **Nayarit:** Tepic, *Beechey*—TYPE (drawing in NY; fragment in MO); Tepic, 5 January—6 February 1892. *Palmer 1844* (F, GH, NY, US); Tepic, 12 February 1927, *Jones* (MO). **Jalisco:** in rain pools, forms dense clumps, 1 m., fl. white, alt. 20 m., Tuxpan, Palapar Redondo, 6 November 1926, *Mexia 1065* (F, GH, MO, NY, US). **Michoacán:** Tacupa, Huetamo, 22 March 1934, *Hinton 5817* (GH, NY). **Morelos:** swamps near Cuernavaca, 5000 ft., 29 September 1899, *Pringle 8256* (F, GH, MO, PH, NY, US); Tetecala, 7 October 1890, *Maury 4922* (NY). **Guerrero:** swamp, Acapulco, February 1895, *Palmer 530* (US). **Oaxaca:** Temascaltepec, 21 November 1932, *Hinton 2667* (GH, US); Juquila, 24 December 1921, *Conzatti 4512* (US); Tehuantepec, *Andrieux 91* (drawing in NY; fragment in MO). **Chiapas:** in marshy lakeside, 2 m. high, Acacoyagna, 28 September 1947, *Matuda 17014* (F). **Guatemala:** Dept. Chiquimula, valley of Río Chiquimula, 1½ mi. northeast of Chiquimula, alt. 400 m., 21 October 1939, *Steyermark 30150* (F); Dept. Jutiapa, in



Map 7. Echinodorus Andrieuxi.

marsh on plain, between Jutiapa and La Calera, southeast of Jutiapa, alt. about 850 m., 2 November 1940, *Standley 76103* (F); Dept. Jutiapa, open marsh, between Jutiapa and La Burrere, northeast of Jutiapa, alt. 800–850 m., 1 November 1940, *Standley 75999* (F). **British Honduras:** Corozal district, *Gentle 373* (US). **El Salvador:** Dept. Santa Ana, shallow open pool, south of Texistepeque, 14 km. north of Santa Ana, alt. 1266 ft., 13 October 1950, *Fassett 28281* (F).

In the herbarium of the New York Botanical Garden are two beautifully detailed pencil drawings of specimens in the Kew Herbarium. One is *Andrieux 91*, "circa Tehuantepec, in ditione Oaxacana, Septembr." The other is the *Beechey* collection from Mexico. Both are marked as TYPE. "When no habitat is mentioned, the specimens are understood to have been collected at Tepic" (Hook. & Arn., p. 275), so the Beechey collection presumably came from there. Following the description of *Alisma Andrieuxi* is a citation of *Andrieux 91*, which would at first sight appear to be the type. But the next paragraph, stating that "the same species was found by M. Andrieux about Tehuantepec of Oaxaca," distinctly implies that the species is primarily based on the Beechey collection from Tepic, and that M. Andrieux also collected the same species. The Beechey collection should therefore be taken as type.

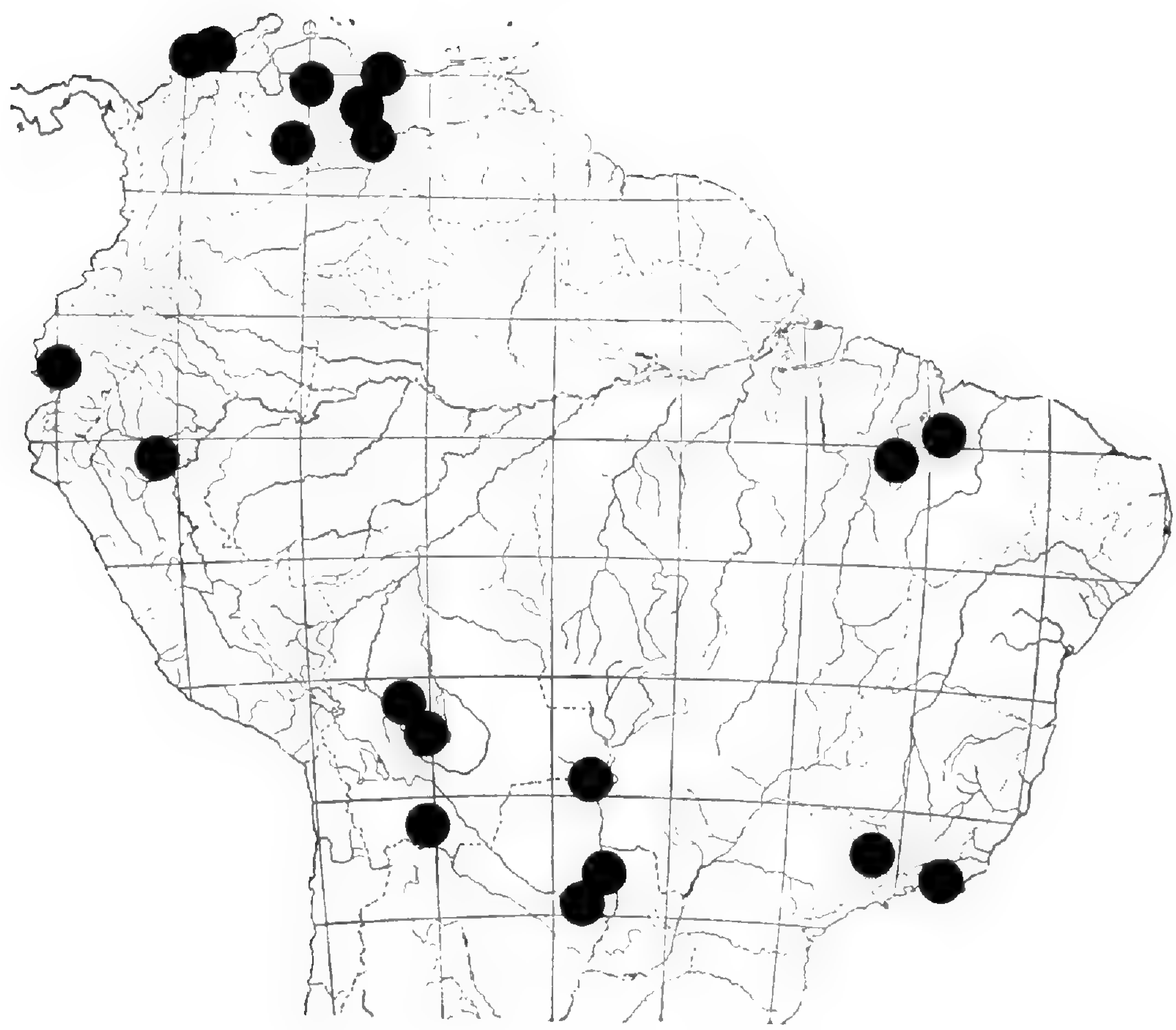
Micheli places *E. Andrieuxi* under *E. ellipticus* as γ, *ovata*, citing collections from Mexico, Nicaragua and Brazil, but I have seen nothing from South America that appears conspecific with the Mexican plants. Macbride, Field Mus. Pub. Bot. Ser. **11:** 4. 1931, states that *E. palaefolius* (Nees. & Mart.) Macbr. (= *E. ellipticus* (Mart.) Micheli) occurs in Mexico, probably basing this statement on that of Micheli. Actually, *E. ellipticus* and *E. palaefolius* are both described as having leaves with deeply cordate blades and angled petioles, while *E. ellipticus* γ, *ovata* (= *E. Andrieuxi*) is distinguished by having blades decurrent on the petiole. Its relationships are, then, rather with the *E. paniculatus*—*E. subalatus* complex.

Micheli described the leaves of *E. ellipticus*, including *E. Andrieuxi*, as having "lineis pellucidis longis, raris, saepe fere inconspicuis." He was quite correct, but I find myself wondering just how he managed to see the lines. My own apparatus is without doubt better than any he had: my work-table has a 2½ inch square hole cut in the top, with a 60-watt bulb in the drawer below, shining up through the herbarium sheet into a modern binocular microscope. Only by waiting until after dark and turning off all overhead lights was I able to see dimly the pellucid lines in *E. Andrieuxi*. Micheli was right—they are there in most individuals. He must have been a very painstaking and thorough observer. Recently I have had opportunity to examine living plants in El Salvador; the pellucid lines are nearly invisible.

10. Echinodorus paniculatus Micheli in DC., Monogr. Phan. **3:** 51. 1881.

Blades varying from elliptic (Fig. 18) or ovate (Fig. 17) to linear-lanceolate (Figs. 19, 20), broadly cuneate or truncate to narrowly cuneate at base, acute at tip, sometimes reaching 30 cm. in length; petiole with a distinct wing on each side; inflorescence sometimes simple, but often with branches 20 cm. long; flowers long-pedicelled; nutlets (Figs. 44–49) very flat, mostly more than half as wide as long, with several narrow wing-like ribs, broadly keeled dorsally and ventrally, without facial glands, the beak short and stout or sometimes nearly absent.

10a. E. paniculatus Micheli var. paniculatus. Leaves ovate to linear-lanceolate, with pellucid lines very obscure or absent, and without pubescence. Colombia and Venezuela to Peru, Paraguay and southern Brazil (Map 8). **Colombia:** Santa Marta, 1899–1901, *Smith 2326* (F, GH, MO, NY, PH, US); Baranquilla, along shores of the Magdalena River, June, 1927, *Elias 202* (US); La Rubiera near Calabozo, Guárico, *Grisol 1*—



Map 8. Echinodorus paniculatus.

mixed with *E. muricatus* (NY, US). **Venezuela:** Sanare, 1358 m., Lara, May 1930, *Saer 489* (F); Hato de Matapalo, in swamp, Llanos del Alto-Apure, alt. 150 m., 7 May 1911, *Jahn 206a* (US); Dist. Fed., Laguna Conejo Blanco, El Valle, 900 m., 17 August 1941, *Fernandez 71* (US). **Ecuador:** dried up pond, Province Guayas, Milagro, alt. 50 m., 30 June—2 July 1923, *Hitchcock 20278* (GH, NY, US). **Peru:** Alto Río Huallaga, alt. 360–900 m., Dept. San Martin, *Williams 5815* (F, US). **Bolivia:** Santa Cruz, Chiquitos, *Cárdenas 4466* (US); pampas near Lake Rogagua, alt. 1000 ft., 4 November 1921, *Rusby 1649* (NY); Potero Largo in from Velasco, 200 m., July 1892, *Kuntze* (NY). **Brazil:** Prov. Piaui, *Gardner 2741* (COTYPE—US); Province de Rio-Janeiro, *Glaziou 13221* (F; photo ex Museo Botanico Berolinense, F, GH, US); in open field, low land, flooded in rainy season, region of River Mearin, State of Maranhao, 9 March 1933, *Krukoff 2030* (GH, NY, US); Minas Geraes, 16 December 1864, *Regnell 418* (US); Matto Grosso, 1891, 92, *Moore 969* (NY). **Paraguay:** Pilcomayo River, *Morong 1039* (NY, PH).

The nutlets are unmistakable (Figs. 44–49) and one can be reasonably sure of the conspecificity of fruiting individuals, despite variation in leaf-width and type of inflorescence. Micheli described the nutlets as being multiglandular, but he had only young fruits which sometimes have a gummy appearance that falsely promises later development of glands.

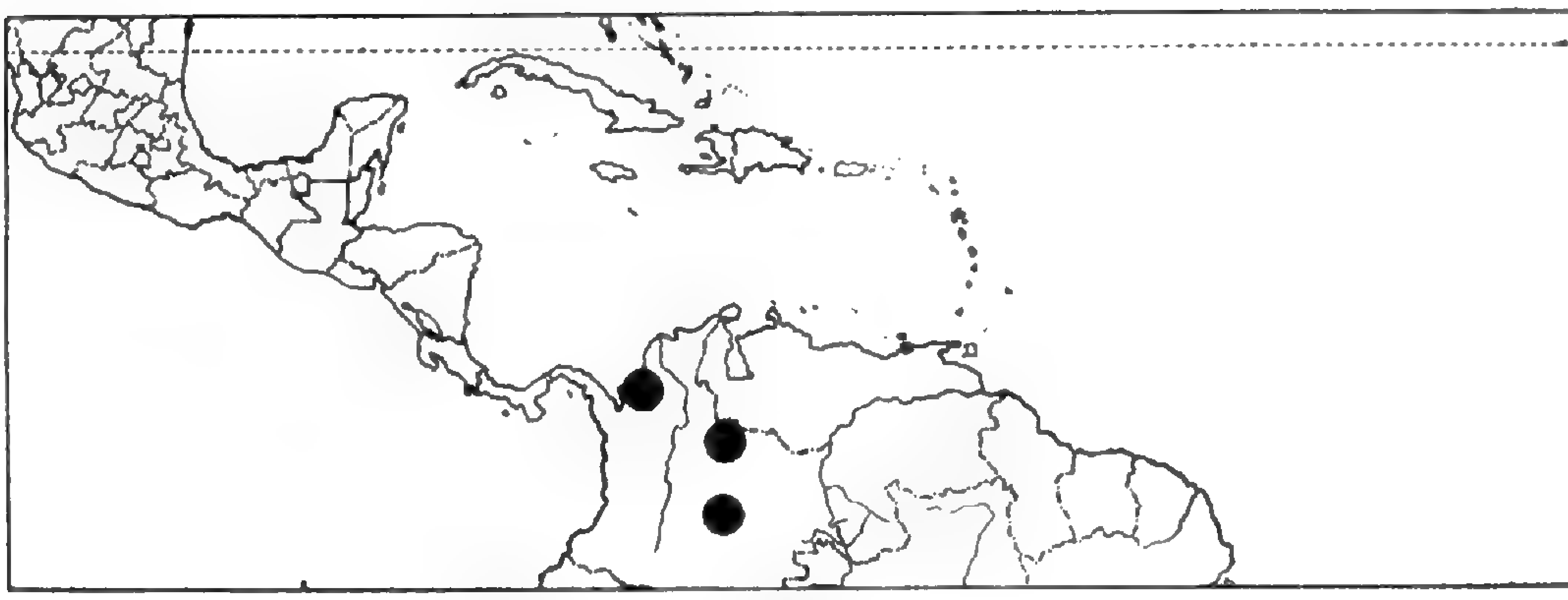
I have placed in this group collections of heterogeneous aspect, and cannot be certain that a single entity is represented. There is variation in stamen number, from 9 to 20 or more. Two sheets show leaves slightly pseudopenninerved, while the rest are nerved from the base of the blade. Some plants have obscure pellucid lines in the leaves, and others no lines at all.

Of course, with such uncertainty concerning the taxonomic status of the sheets cited above, application of the name cannot be at all certain. I find great difficulty in placing some names used by Martius in R. & S. Syst. Veg., and Martius himself expresses some doubts as to such names as *Alisma ellipticum*, *A. intermedium* and *A. subalatum*. Similar difficulties appear with Micheli's treatment of *Echinodorus Martii*, *E. intermedius*, *E. paniculatus*, *E. ellipticus* and *E. subalatus*.

10b. E. PANICULATUS Micheli, var. **dubius** Fassett, n. var., foliis laminis ovatis, ad basim obtusis vel truncatis, coriaceis, punctis pellucidis instructis; petiolis ad apicem et laminis ad basim cum pilis stellatis instructis; scapis paniculatis; fructus ignotus.—**Colombia:** Guanabanal, Dept. El Valle, 2 June 1922, *Killip 6218* (TYPE in US; GH, NY, PH).

This individual, of uncertain status, is appended to *E. paniculatus* because its winged petiole and scarcely cordate blades will key it to that species. It could as well be placed with *E. grandiflorus* on account of its leathery blade with pin-point pellucid dots and stellate hairs. There are no fruits in the ample paniculate inflorescence. If future collectors do not show it to be a population in southern Colombia, with fruiting individuals to indicate its true relationships, it may then be considered as a hybrid of the two species whose characters it shares.

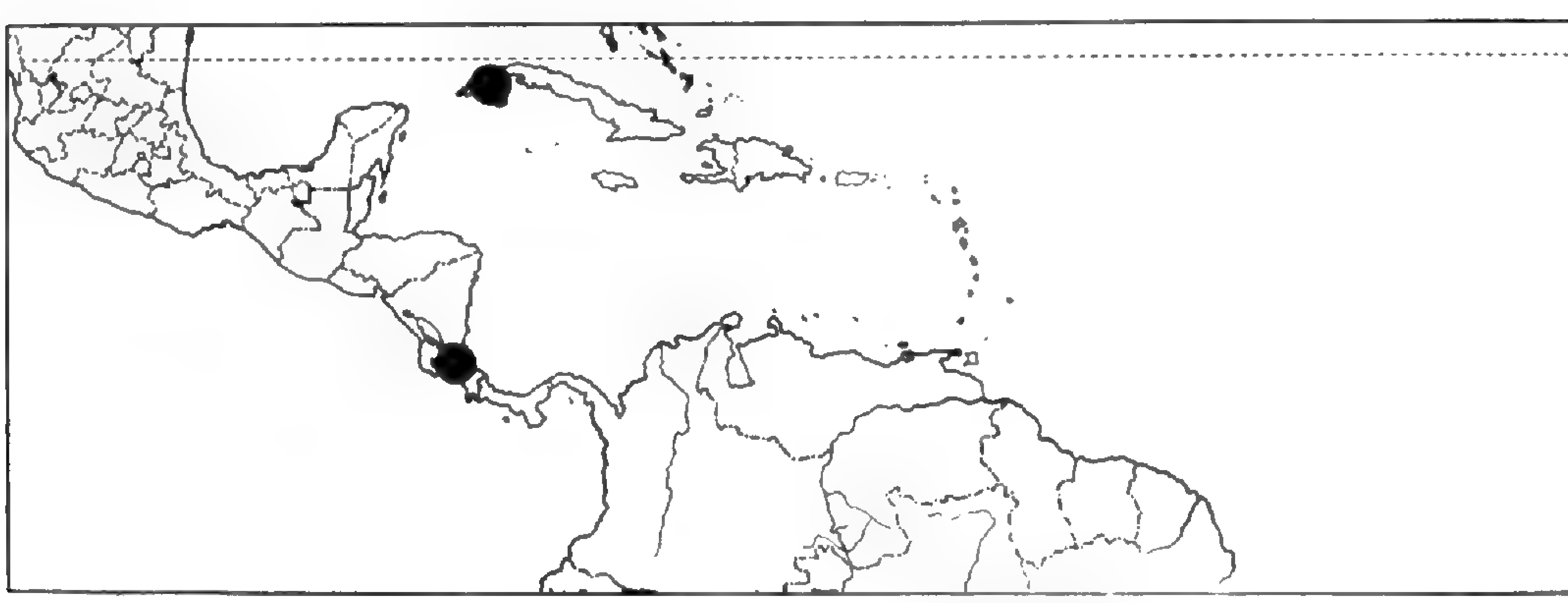
11. ECHINODORUS **trialatus.** Fassett, n. sp., foliorum petiolis alatis, laminis acuminatis subaequantibus, venis laminarum pseudopinnatis; scapi internodis late 3-alatis; pedicellis 3–6 mm. longis; fructibus subrostratis, costis filiformibus alatis ad apicem.—Leaves with blades about as long as the winged petioles and tapering into them (Fig. 21), long-tapered at tip, with the upper pair of veins paralleling the midrib and leaving it at some distance from the base; pellucid markings lacking (Fig. 62); inflorescence simple, its rachis with 3 green wings about 2 mm. wide; flowers subsessile or on pedicels up to 6 mm. long; fruit short-



Map 9. Echinodorus trialatus.

beaked (Fig. 50), with about 5 ribs winged toward the summit, and without facial glands.

Lowlands of Colombia (Map 9). **Colombia:** Río Casanare, Barranco de Atahuarpa, alt. 120 m., 30 October 1938, *Cuatrecasas 4283* (TYPE—US); Sabanas de Santa Isabel, Meta, January 1937, *Gamía 5117* (US); hierba sumergida, Comisaría del Vaupés, San José del Guaviare, en matas de monte, 240 m. alt., 4 November 1939, *Cuatrecasas 7391* (US); desiccated pool, alt. 200–250 m., Chinu, Dept. Bolivar, *Pennell 4096* (NY).



Map 10. Echinodorus Grisebachii.

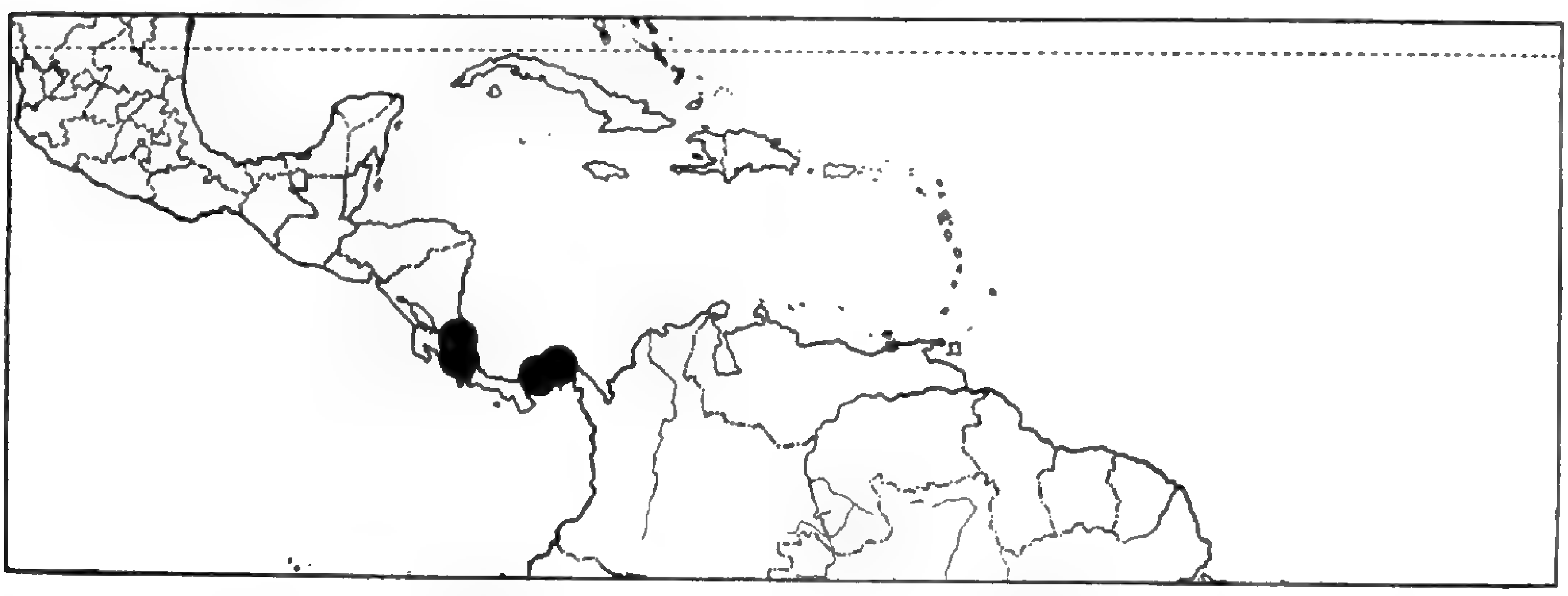
12. E. Grisebachii Small, N. Am. Fl. **17,** pt. 1: 46. 1909. *E. intermedius* "var.," Griseb. Cat. Pl. Cub. 218. 1866. *E. intermedius* Micheli in DC., Monogr. Phan. **3:** 54. 1881, in part; not *Alisma intermedium* Mart.

Leaves rather small, the winged petioles only slightly exceeding the blades which are 7–10 cm. long, ovate-oblong, with the upper pair of veins paralleling the midrib for some distance (Fig. 16), abundantly furnished with pellucid dots and lines of varying lengths (Fig. 63); scape simple or slightly branched, with close verticels of nearly sessile flowers; nutlet short-beaked (Fig. 51), more broadly winged on the dorsal edge than the ventral, with few ribs of which the outermost is wing-like, and with several glands.

Cuba and Costa Rica (Map 10). **Cuba:** Prov. Pinar del Rio, vicinity of Coloma, 8 March 1911, *Britton & Cowan 9849* (US); *Wright 3198*, without further data (TYPE number—US). **Costa Rica:** Colorado de Coto, 20 February 1936, *Valerio 1389* (F).

The name *E. intermedius* was applied to this plant by Micheli, who thought the same species grew in Brazil. Grisebach, transferring *Alisma intermedium* Mart. to *Echinodorus*, added "var.: lineolae folii pellucidae conformes; Wr. 3198"; this forms the basis for *E. Grisebachii* Small.

13. Echinodorus tunicatus Small, N. Am. Fl. **17,** pt. 1: 48. 1909. *E. longipetalus* sensu Woodson & Schery, Ann. Mo. Bot. Gard. **30:** 101. 1943, not Micheli.



Map 11. Echinodorus tunicatus.

Leaves with blades 15–30 cm. long, 10–20 cm. wide, deeply cordate at base, glabrous or sparsely muricate to somewhat pubescent with spreading flattened hairs toward the junction with the terete or costate petiole, the pellucid lines forming a network that is unrelated to the pattern of veins (Fig. 64); sepals pale yellow, firm, thick and brittle, about 30-ribbed or sometimes nearly smooth, enlarging and closely cupped about the fruiting head and about each other, the whole forming a flattened-globose head 1–1.5 cm. in diameter, the calyx much depressed at base about the pedicel; petals 5–6 mm. long (fide Woodson & Schery); stamens about 30; achenes wedge-shaped, 3 mm. long, 1 mm. wide at summit and 0.3–0.4 mm. wide at base, the corky summit narrowed to an erect or ascending beak that is nearly 1 mm. long (Fig. 52); facial ribs 3–4; glands several.

Panama and Costa Rica (Map 11). **Costa Rica:** Limón Province, palm swamp between Río Reventazón and Río Parismina on Castilla Farm, 10 m., 2 April 1930, *Dodge & Neverman 7185* (MO); from near sea-level creeks, Reventazón, *Lankester 947* (US). **Panama:** in low hollow, Marraganti and vicinity, alt. 10–100 ft., 3–9 April 1908, *Williams 991* (TYPE in NY); Agricultural Experiment Station at Matías Hernandez, Prov. Panamá, 25 December 1914, *Pittier 6894* (GH, NY, US); Old Experiment Station, 3 miles east of Panama City, 13 June 1923, *Maxon 7095* (GH, US); in mud, acaulescent, common, near the big swamp east of the Río Yecumen, Prov. Panamá, 11 December 1923, *Standley 26525* (US);

between Las Sabanas and Matías Hernández, Prov. Panamá, 21 January 1924, *Standley 31898* (US); Juan Díaz, Prov. Panamá, 11 January 1924, *Standley 30506* (US).

Woodson & Schery, l.c., include this under the Brazilian *E. longipetalus* Micheli. But *E. longipetalus*, while sharing the accrescent sepals and pellucid network of *E. tunicatus*, is a very different species with narrow elliptic-oblanceolate leaves, sepals not cupped together, and petals 3–3.5 cm. long.

A third species with accrescent sepals, also from Brazil, is *E. brevipedicellatus* (Kuntze) Buch. It has the general aspect of *E. longipetalus* but its much narrower leaves are obviously different. Buchenau separated these two species on fruiting characters; I have not seen mature fruit. *E. brevipedicellatus* is keyed by Buchenau under "lineae et puncta pellucida desunt"; actually it has a pellucid network like that of *E. tunicatus* and *E. longipetalus*, obscured by the thickness of the leaf, but becoming visible in a piece of leaf that has been boiled in alcohol.[4]

From Peru, *Schunke 279* (US), determined as *E. intermedius* by Standley, has a well-marked pellucid network, but the sepals are thin, about 16-nerved, and not accrescent; it is without doubt an undescribed species.

14. Echinodorus nymphaeifolius (Griseb.) Buch. Bot. Jahrb. **2**: 483. 1882. *Alisma nymphaeifolium* Griseb. Cat. Pl. Cub. 218. 1866; Micheli in DC. Monogr. Phan. **3**: 36. 1881. *Helianthium nymphaeifolium* Small, N. Am. Fl. **17**, pt. 1: 45. 1909.

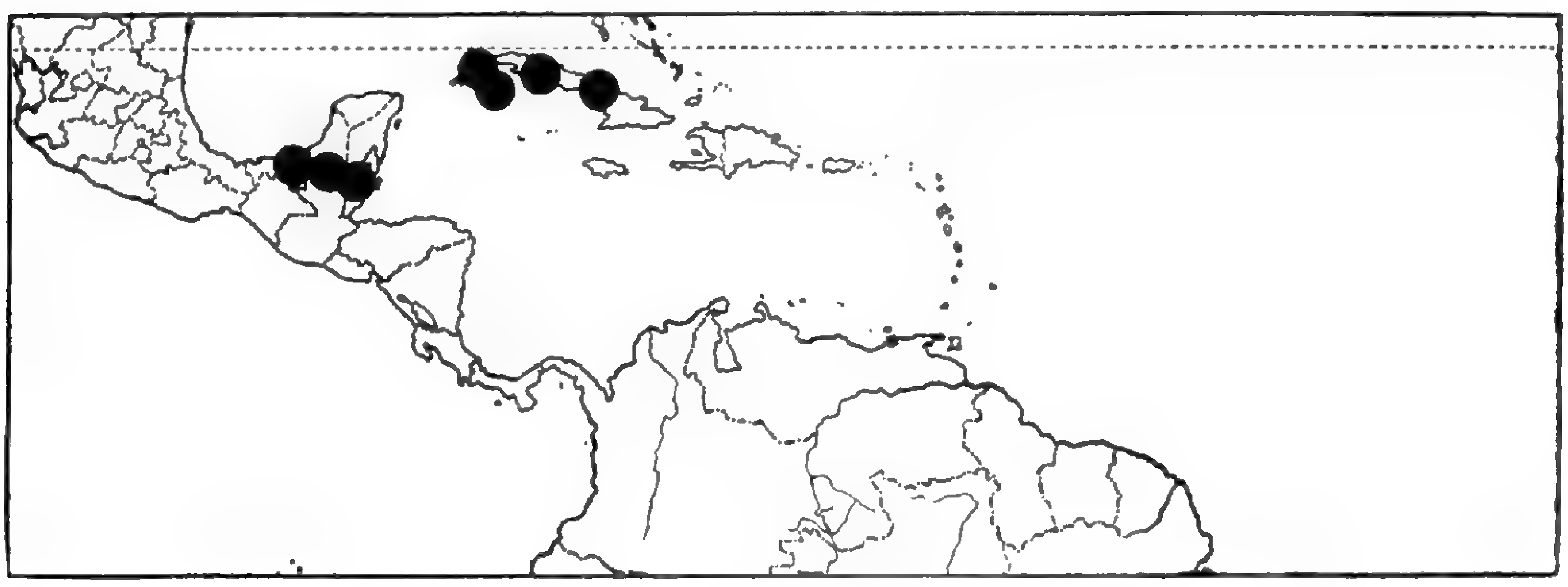
Submersed leaves ribbon-like, thin and flaccid, 15–20 cm. long, about 1 cm. wide; emersed leaves long-petioled, the blades oval and deeply cordate, 3–12 cm. long and 1.5–9 cm. wide; pellucid markings scattered lines 0.2–0.8 mm. long (Fig. 65); inflorescence 2–4 times compound, forming an erect ovate or conic panicle; nutlets 1.4 mm. long, 1 mm. wide, with a beak 0.2 mm. long, flat-sided, with a broad crested keel, and with crested ribs and 1 or 2 long glands on each face (Fig. 53).

Cuba and Yucatan (Map 12). **Cuba:** without locality, *Wright 3196* (GH, US, MO); Los Palacios, Province of Pinar del Rio, 3, 4 January 1912, *Shafer 11664* (US); El Sábalo, Finca Salanalamar, near sea level, 22 December 1937, *Killip 32286* (US); La Gloria, Camaguey, 3 February 1909, *Shafer 260* (F); Columbia, Isle of Pines, 19, 21 March 1916, *Britton, Britton & Wilson 15703* (US, F). **Mexico:** Ciudad del Carmen, Campeche, 15 April 1933, *Mell 2090* (US); Tuxpeña, Campeche, 30 January 1932, *Lundell 1270* (MO, US, GH, NY, F). **British Honduras:** Maskall Pine Ridge, January 1934, *Gentle 1109* (F, GH, MO, NY).

[4] I am indebted to my collegue, Prof. R. I. Evans, for help in this and other like problems.

15. ECHINODORUS TENELLUS (Mart.) Buch. Abh. Nat. Ver. Bremen **2:** 21. 1868; Micheli in DC. Monogr. Phan. **3:** 47. 1881; Buch. in Pflanzenreich **4**, pt. 15: 1903. *Alisma tenellum* Mart. in Roem. & Schultes, L., Syst. **7**, pt. 2: 1600. 1830; Kunth, Enum. **3:** 149. 1841.

Robinson, Rhodora **5:** 85–89. 1903, points out a seeming inaccuracy in the illustration of this species in the Flora Brasiliensis: the carpels are shown in a single ring rather than in a head as they should be in the genus *Echinodorus*. However, some plants do give a definite impression of a ring of carpels, until closer examination shows them to be borne in a head, but being few in number they have been squeezed into a ring-like arrangement.



Map 12. Echinodorus nymphaeifolius.

VARIETIES OF E. TENELLUS

a. Nutlet 0.9–1.1 mm. long; stylar beak absent or nearly so (Figs. 66–68); anther 0.2–0.6 mm. long; umbel usually single and terminating the scape.
  b. Blade of leaves tapered at each end so that the sides are slightly concave toward the tip (Fig. 75); anther 0.2–0.6 mm. long.
    c. Facial ribs well-developed (Fig. 66) . . . . . 15a. *E. tenellus* var. *tenellus*.
    c. Facial ribs nearly or quite suppressed (Fig. 68). 15b. *E. tenellus* var. *ecostatus*.
  b. Blade of leaves narrowed from the middle to an acute or obtuse base and tip (Figs. 73, 74); anther 0.2 (–0.3) mm. long. 15c. *E. tenellus* var. *parvulus*.
a. Nutlet 1.4–1.8 mm. long; stylar beak 0.2–0.5 mm. long (Fig. 76); anther 0.5–1.0 mm. long; umbels often 2, the terminal 3–6 cm. above the lower. 15d. *E. tenellus* var. *latifolius*.

Two phases of *E. tenellus* appear in southern Brazil, the type region for this species. The smaller plant has a nearly beakless nutlet about 1 mm. long (Fig. 66) and leaves 1–3 mm. wide and long-tapered to both ends (Fig. 75); it is illustrated in Fl. Bras. 3, pt. 1: pl. 13, fig. 2, plant to the right. The larger plant has a nutlet about 1.5 mm. long and a well-developed beak (Fig. 70), and leaves often with an elliptic blade (Fig. 76); this is illustrated in Fl. Bras., l.c., plant to the left.

In the original description of *Alisma tenellum* but one collection is cited, so this can be considered as TYPE: *In palmetis udis depressis Provinciae Minas geraës Brasiliae: Martius.* The description says "capsulis obsolete mucronulatis" and "Folia . . . utrinque angustata . . . ½–1 pol., ¾–1¼ lin. lata," so it is presumably the phase with beakless nutlets and narrow leaves, to be taken up in this treatment as var. *tenellus.*

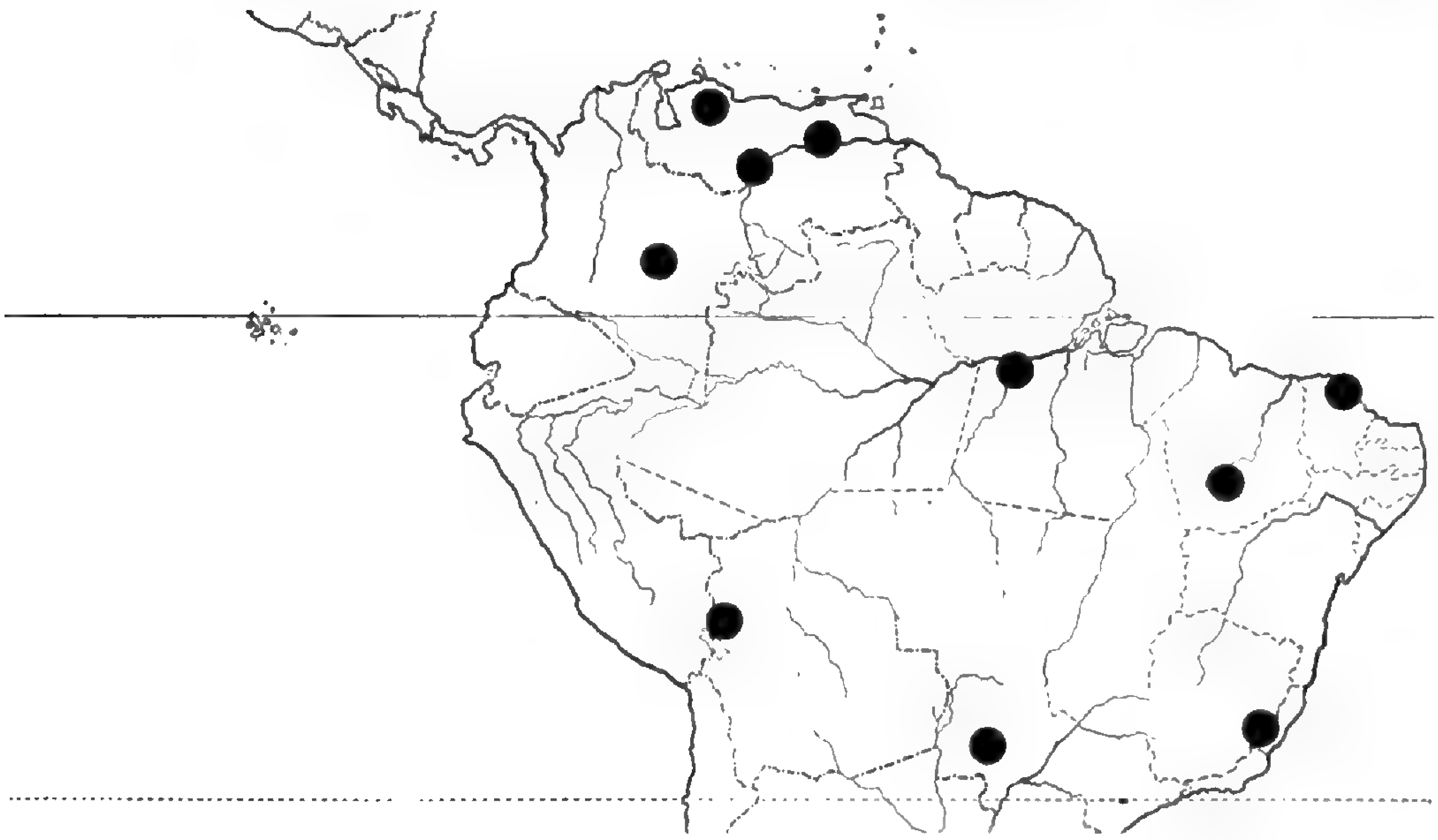
In the Flora Brasiliensis some 5 collections are cited and the description is expanded to include forma *latifolia* with leaves up to 4 lines long. This is presumably what is illustrated by the drawing to the left on plate 13 referred to above. The only nutlet shown in detail is definitely beaked, in contradistinction to the original description, and is also presumably forma *latifolia.* Differing in leaves, fruit, anthers and inflorescence, forma *latifolia* will be taken up as a variety in the present treatment.

15a. E. TENELLUS var. TENELLUS. *Alisma tenellum* Mart. l.c.; Seubert in Mart. Fl. Bras. **3,** pt. 1**:** 105, t. 13, fig. 2, plant to right. 1848. *A. ranunculoides* L. var. *brasiliense* A. de St. Hilaire, Voy. Distr. Diam. **2:** 432. 1833.

South America, mostly in the Amazon basin, but occurring from Venezuela to southern Brazil (Map 13a). **Venezuela:** Laguna de la Culebra, near S. Carlos, Cojedes, in half-dried places, 6 April 1925, *Pittier 11707* (NY); Anzoátegui, Estanque de El Baño de El Tigrito, 26 January 1944, *Pittier 15168* (US); Apure, Cunavicha, 13 February 1941, *Chardon 252* (US). **Colombia:** low muddy bank of the Rio Muco, 150 m. alt., ca. 80 km. northwest of San José de Ocuné, Comisaria del Vichada, 13 January 1944, *Herman 10934* (GH, US); La Serranía entre los ríos Ariari y Meta, Llano Grande, 320 m. alt., 26 November 1939, *Cuatrecasas 7878* (US). **Brazil:** Santarem, Prov. Pará, July 1850, *Spruce* (GH, MO, NY); Minas Geraes, ex herb. Mart., probably fragments of TYPE (MO); Piauí, *Gardner 2740,* cited in Fl. Bras. (US); Lagoa Salgadinho, Sud-Piauí, 1913, *Luetzelburg 378* (NY); Ceará, low sandy flats about Açude João Lopez, Fortaleza, 10 September 1935, *Drouet 2453* (GH); Lagoinha, Campo Grande, Matto Grosso, 4 September (or 9 April?) 1936, *Archer & Gehrt 36327* (US); Habira do Campo, Prov. de Minas, 1887, *Glaziou 17299* (US). **Peru:** Prope Tarapoto, 1855–56, *Spruce 4491* (GH, NY). **Bolivia:** Reis, alt. 1500 ft., February 1886, *Rusby 555* (GH, MO, NY, US).

15b. E. TENELLUS var. **ecostatus**. Fassett, n. var., achaeneis 1.0–1.1 mm. longis, obsolete mucronatis, cum costulis obscuris aut nullus (Fig. 68).

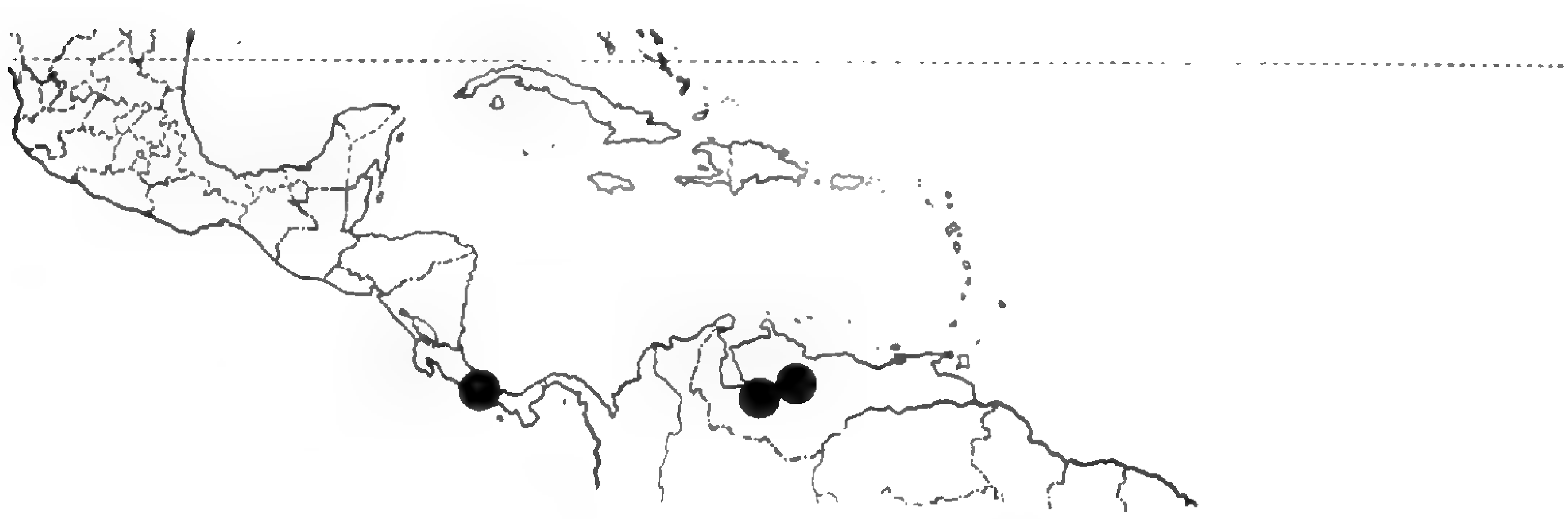
This appears to be an extreme derived from var. *tenellus,* occurring at and beyond its northern limits. Var. *ecostatus* grades into var. *tenellus,* and on some individuals the nutlets are variable as to development of ribs.



Map 13a. Echinodorus tenellus var. tenellus.

Panama to Venezuela (Map 13b). **Panama:** on clay in dried up bed of pond, Peronome and vicinity, 23 February—22 March 1908, *Williams 246* (US; NY). **Venezuela:** in drying lagoon near Ospino, Portuguesa, 26 December 1925, *Pittier 12018* (US—TYPE; NY); Culebra Lagoon near S. Carlos, Cojedes, in half dried places, 6 April 1925, *Pittier 11707* (US).

15c. E. TENELLUS var. **parvulus** (Engelm.) n. comb. *E. parvulus* Engelm. in Gray, Man. ed. 2; 438. 1856; Rand, Rhodora **5:** 83–85. 1903; Robinson, Rhodora **5:** 85–89. 1903. *E. subulatus* Engelm. in Gray,



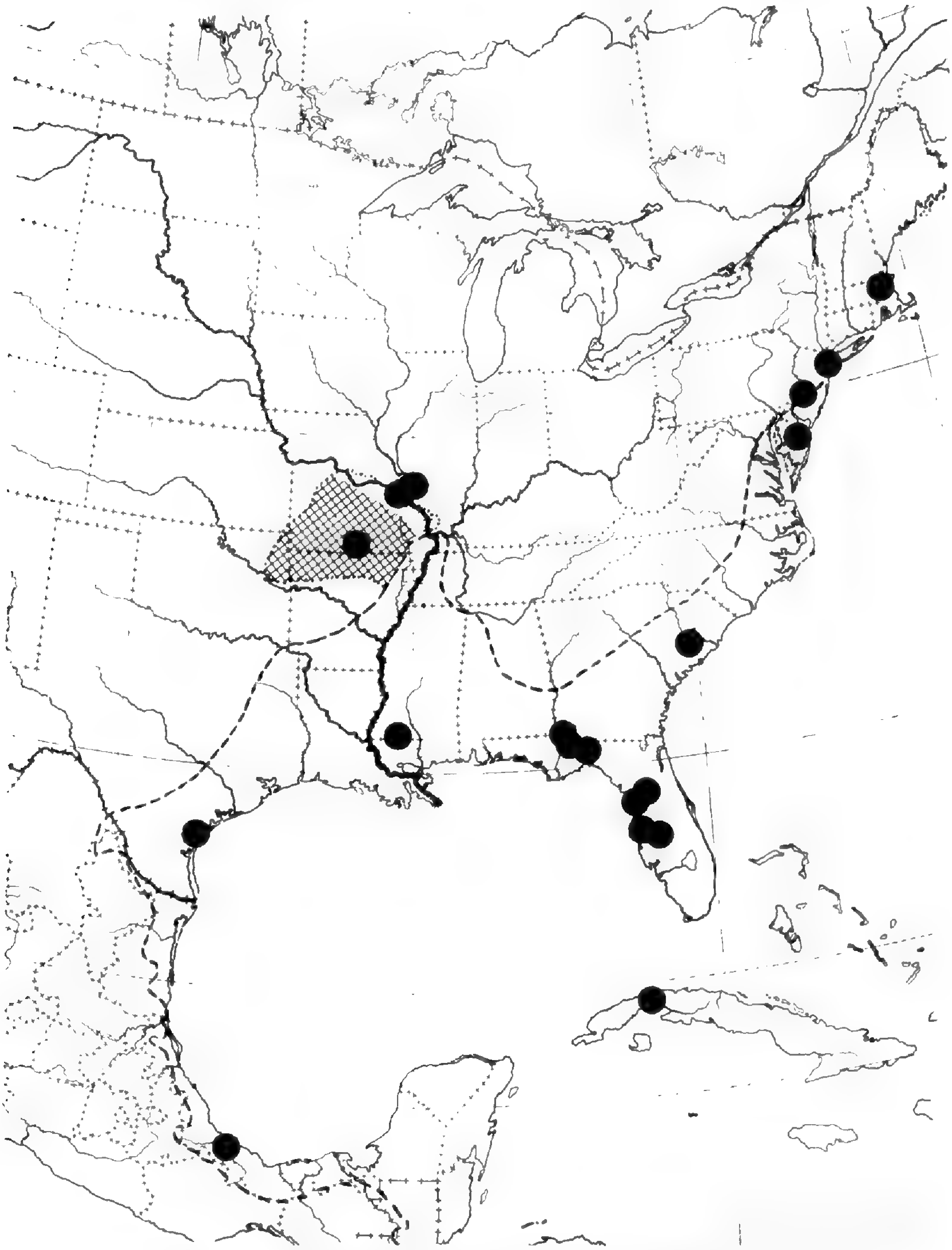
Map 13b. Echinodorus tenellus var. ecostatus.

Man. ed. 1; 460. 1848, not *Alisma subulatum* L., *Helianthium tenellum* Britton, Man. ed. 2; 54. 1904. *H. parvulum* Small, N. Am. Fl. **17,** pt. 1: 45. 1909.

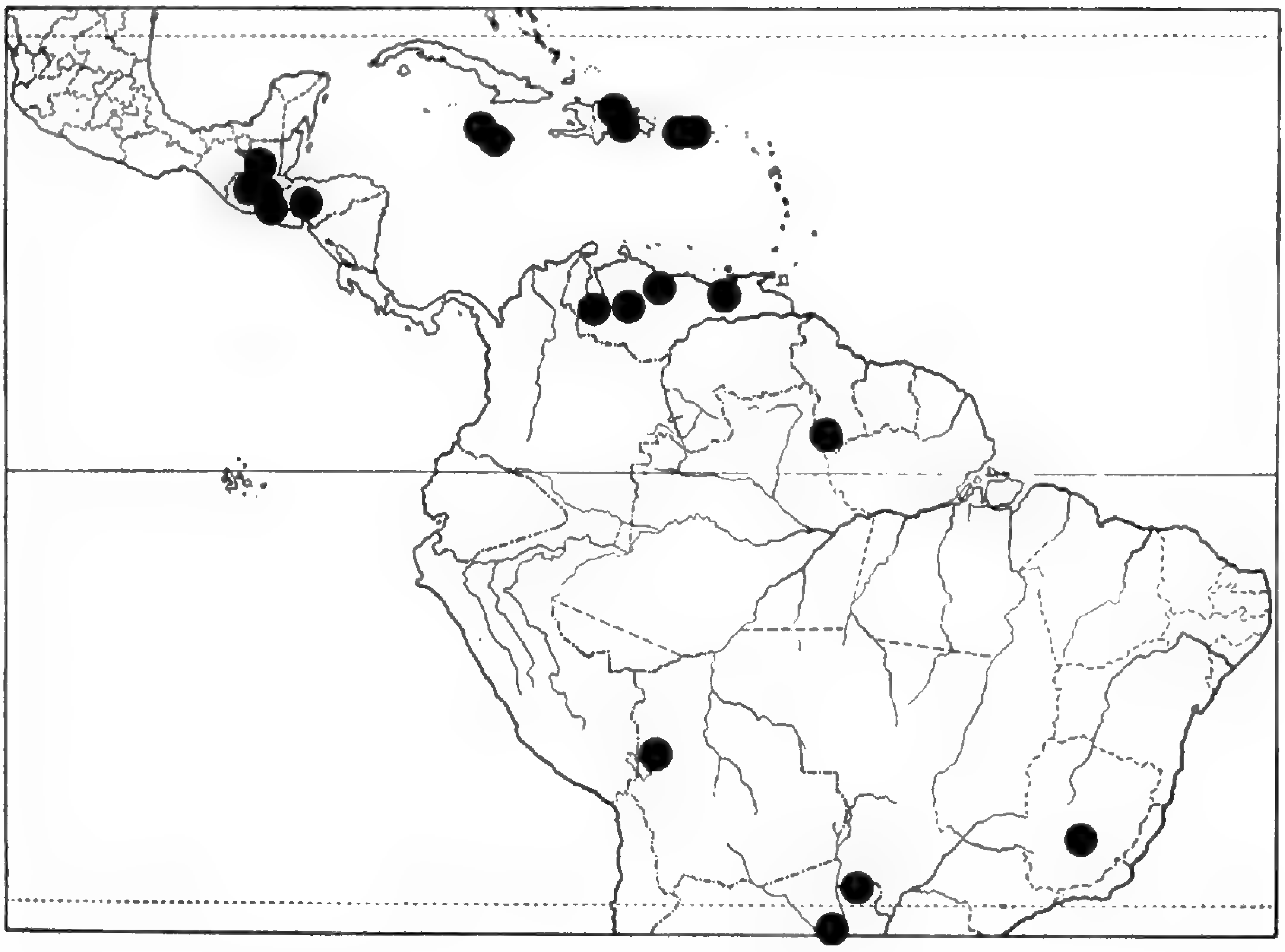
Rare and local, from southern Mexico to Texas, Florida and Cuba, northward to Missouri and on the Coastal Plain to Massachusetts (Map 13c). **Massachusetts:** Winter Pond, Winchester, 7 August 1876, *Morong* (F), 8 August 1876, *Morong* (MO), 17 August 1876, *Morong* (NY, US); 28 August 1878, *Faxon* (GH, MO, NY, US); September 1878, *Morong* (F), 27 September 1916, *Ware 6524* (US), 10 September 1902, *Churchill* (MO); Mt. Auburn, Cambridge, August 1868, *James* (GH), August 1869, *James* (MO, NY, US); September 1869, *James* (MO). **New York:** Maple Grove, Long Island, 4 July 1904, *Bicknell* (NY); Queens, Long Island, 16 September 1921, *Ferguson 934* (NY); Queens, Long Island, 25 October 1928, *Ferguson 7378* (NY, US). **New Jersey:** Nullys Pond, Delanco, 19 September 1918, *Pennell 9917* (NY); Delanco, Burlington Co., 17 August 1907, *Van Pelt* (GH), 11 August 1908, *Van Pelt* (NY). **Delaware:** Canterbury, August 1874, *Canby* (GH, US, F). **South Carolina:** Santee Canal, July, *Ravanel* (GH). **Georgia:** Open Pond, Decatur Pond, 12 August 1901, *Harper 1202* (GH, MO, NY, US). **Florida:** Quincy, *Chapman* (NY); Tallahassee, 31 May 1925, *Harper* (NY, US); Dunnellon, Marion Co., 11 June 1900, *Curtiss 6658* (GH, MO, NY, US); Tampa, April, *Curtiss 2739* (GH, MO, NY, US); Fort Meade, 20 March 1880, *Smith* (US). **Illinois:** East St. Louis, 4 August 1892, *Eggert* (NY); St. Clair Co., 11 August 1892, *Eggert* (MO). **Missouri:** margin of ponds on the hills north of St. Louis, August 1845, *Engelmann* (MO); margins of ponds back of St. Louis, August 1845, *Engelmann* (F); St. Louis, August 1845, *Engelmann* (NY); margins of ponds in the hills west of town, St. Louis, September 1845, *Engelmann* (MO); in ponds northwest of St. Louis, August 1848, *Engelmann* (MO); St. Louis, August 1848. *Engelmann* (NY); common along open sedgy shoreline, Adobesee Pond (sink-hole pond now ruined by artificial disturbance), 9 mi. southeast of West Plains, Howell Co., 4 September 1949, *Steyermark 69124a* (F). **Mississippi:** borders of ponds near Osyka, July 1899, *Cocks* (Tulane). **Texas:** Horseshoe Lake, Jackson Co., 9 August 1920, *Drushel 4143* (MO, US). **Cuba:** Rancho Boyeros, Provincia de Habana, 22 July 1904, *Baker & Wilson 375* (NY); Mazorra, 23 November 1904, *Baker & Abarca 4210* (GH). **Mexico:** Vera Cruz, 1855, *Müller 2142* (NY).

Most of the range of this variety is on the Atlantic Coastal Plain and on low ground, geologically youthful, around the Gulf of Mexico (outlined with a broken line on Map 13c). From the Coastal Plain it extends its range northeastward to Winter Pond, Winchester, Massachusetts, whose assemblage of rare or isolated southern plants has long been a subject of comment.[5] In the Mississippi Valley, also, its range extends north of the Coastal Plain to the region of St. Louis. The recent collection by Dr. Steyermark from southern Missouri in the heart of the Ozark Plateau (cross-hatched on Map 13c) may be the clue to the ancestral area from which the North American phase of *Echinodorus tenellus* invaded the Coastal Plain.

[5] Rand, Rhodora **5**: 83. 1903; Sears, Rhodora **10**: 42. 1908; Fernald, Rhodora **10**: 143. 1908; Rhodora **13**: 151. 1911.



Map 13c. Echinodorus tenellus var. parvulus.



Map 13d. Echinodorus tenellus var. latifolius.

E. TENELLUS var. PARVULUS f. **Randii** Fassett, n.f., plantae submersae, steriles aut fertiles; foliis linearibus, non petiolatis, membranaceis, 1–3 mm. latis.—**Massachusetts:** Winter Pond, Winchester, Oct. 10, 1901, *E. L. Rand* (TYPE in Gray Herbarium).

While it has been collected only at Winter Pond, the submerged form must surely be expected wherever the species grows. *E. tenellus* commonly grows on wet shores or at the water's edge; the leaves are more or less clearly petioled with blades narrowed to each end, of firm texture, feather-veined, narrowly callous-margined and callous-tipped. The submersed forms (see also var. *latifolius*) have leaves becoming linear, of thin membranous texture with lacunate tissue especially near the midrib, and more obscurely veined.

(*To be concluded*)

Volume 57, no. 677, including pages 133–160, was issued 9 June, 1955.

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Vol. 57 July, 1955 No. 679

CONTENTS:

The New England Botanical Club, Inc.

8 and 10 West King St., Lancaster, Pa.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of the Gray's Manual Range and regions floristically related. Price, $4.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) of not more than 24 pages and with 1 plate, 40 cents, numbers of more than 24 pages or with more than 1 plate mostly at higher prices (see 3rd cover-page). Back volumes can be supplied at $4.00. Some single numbers from these volumes can be supplied only at advanced prices (see 3rd cover-page). Somewhat reduced rates for complete sets can be obtained on application to Dr. Hill. Notes and short scientific papers, relating directly or indirectly to the plants of North America, will be considered for publication to the extent that the limited space of the journal permits. Illustrations can be used only if the cost of engraver's blocks is met through the author or his institution. Forms may be closed five weeks in advance of publication. Extracted reprints, if ordered in advance, will be furnished at cost.

Address manuscripts and proofs to Reed C. Rollins,
Gray Herbarium, 22 Divinity Ave., Cambridge 38, Mass.

Subscriptions (making *all remittances* payable to RHODORA) to

Dr. A. F. Hill, 8 W. King St., Lancaster, Pa., or, preferably, Botanical Museum, Oxford St., Cambridge 38, Mass.

Entered as second-class matter March 9, 1929, at the post office at Lancaster, Pa., under the Act of March 3, 1879.

Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 57 **July, 1955** **No. 679**

DISTRIBUTION AND ABUNDANCE OF SHORTIA GALACIFOLIA

P. A. Davies

From 1839, when Asa Gray found an unnamed specimen from the Carolinas in André Michaux's herbarium in Paris and named it *Shortia galacifolia*,[1] until 1877 when George M. Hyams rediscovered a small station of it on a hillside near a small stream which flowed into the Catawba River about five miles north of Marion in McDowell County, North Carolina,[2] the prime efforts of botanists and collectors was its rediscovery. Following Hyams rediscovery of *Shortia*, the effort shifted to determining its distribution and abundance. In 1879, Asa Gray and party, including Charles S. Sargent of the Arnold Arboretum, sought for additional plots without success on the west side of the Linville Mountains at North Cove and on the Iron Mountain Range, both in the region of Hyams' discovery.[3] No more extensive excursions or discoveries were made in this area until recently.

Nine years after Hyams' discovery, Charles S. Sargent, with his guide, Frank E. Boynton of Highlands, North Carolina, while seeking Michaux's *Magnolia cordata* at the headwater of the Keowee River, found *Shortia galacifolia* near the confluence of the Horsepasture and Toxaway Rivers in Oconee County, South Carolina.[4] Desiring additional specimens and information on its distribution and abundance, Sargent requested

[1] Gray, Asa, Amer. Jour. Sci. & Arts 42: 48, 1842.
[2] Letter, J. W., Congdon to Asa Gray, Oct. 18, 1878 (Gray Herb.).
[3] Redfield, J. H., Bull. Torrey Bot. Club 6: 331–336, 1879.
[4] Sargent, C. S., Amer. Jour. Sci. & Arts, Ser. III, 32: 466–473, 1886.

Boynton to return to the forks of the river, their collecting ground of the previous month, and explore the region. This Boynton did and found large quantities of *Shortia* on Bearcamp Creek, a lower tributary of the Horsepasture River.[5] Three years later (1889) Boynton found acres of it in the locale of the junction of the Whitewater River and Devilfork Creek and in the lower Jocassee Valley, all in Oconee County, South Carolina.[6] In the spring of 1890, T. G. Harbison found *Shortia* in great abundance on the Horsepasture River between its junction with the Toxaway River and Bearcamp Creek.[7]

The acres of *Shortia* that F. E. Boynton discovered along the Whitewater River in Jocassee Valley were easily accessible by roads and trails. Now that an abundant supply had been found, more than enough to meet the demands of botanists for herbarium specimens and nurserymen to supply the public with living plants, the scientific interest brought on by nearly fifty years of intensive search for it was lessened. Almost an equal amount of time was to pass before interest was again awakened for additional knowledge on its distribution and abundance.

Charles F. Jenkins sought information on the distribution of *Shortia* by assembling data from herbarium sheets in thirty-one of the leading herbaria in the United States. In all he found ninety-eight sheets and gave the distribution as follows: "Forty-four were collected along the banks of the Whitewater River in Oconee County, South Carolina. Fourteen more are listed as coming from the Jocassee Valley, also in Oconee County. Thirteen were found in McDowell County, North Carolina, more definite locations not being given. Eight were found in the Toxaway Gorge in Transylvania County, North Carolina, three along Bearcamp Creek and two along the Horsepasture River, both located in Transylvania County. One each from the mountains of N. W. Carolina, four miles N. W. Salem, South Carolina, and Macon County, North Carolina. The remainder are specimens with labels giving no definite locality or coming from cultivated plants."[8]

[5] Letter, F. E. Boynton to C. S. Sargent, Nov. 7, 1886 (Gray Herb.).
[6] Boynton, F. E., Garden & Forest, 2: 214–215, 1889.
[7] Clute, W. N., Amer. Bot. 32: 65–68, 1926.
[8] Jenkins, C. F., Arnoldia 2: 13–28, 1942.

In the library of the Botany Department, University of North Carolina, is a distributional map of *Shortia* prepared by William C. Coker from both herbarium sheets and field records. For McDowell County, North Carolina, he gives stations on Tom's Creek, branches of John's Creek, and several places on the east side of the lower part of Bald Mountain. Dr. Coker includes on his map the single station reported by F. M. Crayton on the Linville River west of Table Rock Mountain in Burke County, North Carolina. On the Keowee River and its sources in Pickins County, South Carolina, he lists two locations on the east side of the Keowee River below the entrance of Big Eastatoe Creek; in Oconee County, South Carolina, four stations above the entrance of Big Eastatoe Creek, sixteen places on the upper sources of Little River, and several plots along the Whitewater; and in Transylvania County North Carolina, three records along the Toxaway River and two on Toxaway Creek.[9]

The southernmost location is the one discovered by A. B. Massey in 1911 on the Keowee River below the entrance of Little River. In recording his discovery Massey relates, "This is a small station on the bank of the Keowee River at the foot of a wooded bluff. When I last visited the place, there were only a few plants; however, it may have increased in recent years."[10] On November 3, 1952, D. E. Wade visited Massey's station and explored the area adjacent to it. He describes his observations: "In a rocky ravine there are at least six clumps of *Shortia,* the largest [Massey station] was approximately 3 by 6 feet at an elevation of about 615 feet, while the highest was at about 680 feet. The entire ravine is cooled by a small stream which is fed by springs at various places. The woody plant life is marked by hemlock, rhododendron, laurel, holly and beech. It looks as if the stand had been there many hundreds of years. Most of the clumps are definitely above flood level."[11] In July 1953, D. C. Wade showed the writer the Massey station and the additional stands he found. The clumps were restricted and the plants were rather small but healthy.

[9] Map, W. C. Coker, Botany Dept. University of North Carolina, copy sent to P. A. Davies, May 18, 1948.

[10] Map, A. B. Massey to P. A. Davies, June 30, 1952.

[11] Map and letter, D. E. Wade to P. A. Davies, Nov. 7, 1952.

C. F. Moore of Brevard, North Carolina, located several stands on the Keowee River between Laurel Branch and Whitewater River, a single station near the source of Laurel Branch, a small area on the Bearwallow Creek about one-half mile from its mouth, and on subsequent visits with B. C. Olney observed many patches along the lower part of this creek. They also found *Shortia* on Rock House Creek, near the mouth of Laurel Fork Creek, on the Keowee River between Laurel Branch and the Toxaway River, along the Whitewater River in Jocassee Valley, on eastern branches of the Horsepasture River and along a ridge between the Horsepasture River and Bearwallow Creek.[12]

In April, 1917, W. W. Diehl saw *Shortia* in abundance and in full bloom on the northeast bank of the Whitewater River between the Thompson and Toxaway Rivers, and on three other occasions between 1921 and 1927 near the mouth of Bearwallow Creek.[13] In the Gray Herbarium is a specimen collected by E. T. Wherry on July 12, 1936 along Bearwallow Creek and another by H. J. Oosting on July 15, 1936 in the Toxaway Gorge, Transylvania County, North Carolina. During March, 1944, A. E. Prince, J. A. Berly and O. L. Cartwright found *Shortia* in flower along the road near the Whitewater River just below the entrance of Devilfork Creek and later (1946) Prince found it plentiful on the right bank of the Toxaway River above its confluence with the Whitewater River.[14] The Rev. A. Rufus Morgan, Franklin, North Carolina, found *Shortia* on the Toxaway River above the North Carolina border and on the Whitewater River just above its junction with the Thompson River.[15] W. H. Duncan reported a station in an open woods along a tributary of Middle Fork Creek in Oconee County, South Carolina.[16]

In March 1949, W. H. Duncan, Haskell Venard and G. W. McDowell discovered the first station in Georgia. It was a small colony (8 × 4 feet) near Reed Creek in Rabun County, and in August of the same year Duncan found a smaller colony near the original one.[17]

[12] Map, C. F. Moore to P. A. Davies, June 30, 1952. Also, letter, Aug. 2, 1954.

[13] Letter, W. W. Diehl to P. A. Davies, Sept. 23, 1952.

[14] Prince, A. E., Rhodora, 49: 159–161, 1947. Also, map and letter, May 24, 1953.

[15] Map, A. Rufus Morgan to P. A. Davies, Aug. 8, 1951.

[16] Letter, W. H. Duncan to P. A. Davies, May 23, 1952.

Several healthy and expanding patches of *Shortia* are present in Highlands, North Carolina and its environs. All available data indicate that these plantings were made from plants gathered by F. E. Boynton, T. G. Harbison and others along the sources of the Keowee River, particularly the Whitewater River. The writer has examined many streams and their smaller tributaries about Highlands that appear to offer suitable habitat without finding a single indication of *Shortia*.

Many sources of reference state that *Shortia galacifolia* is rare. These statements have probably arisen from the fact that Asa Gray and his colleagues sought for it without success for thirty-eight years (1839–1877) and the patch that G. M. Hyams finally discovered near a tributary of the Catawba River was too small to supply the demands for herbarium specimens. The recently discovered patches along the sources of this river are not numerous. On the sources of the Keowee River most collectors have observed *Shortia* on the fringe of its range or have made distributional judgments from the colonies within easy reach by roads or trails along the Whitewater River or Bearwallow Creek. In certain places on the drainage areas of the Toxaway and Horsepasture Rivers it is one of the most abundant plants, and F. E. Boynton, C. F. Moore, B. C. Olney, and the writer have observed patches containing one or more acres. Until recently the areas containing an abundance of *Shortia* on the sources of the Toxaway and Horsepasture Rivers were accessible only by a few strenuous trails and nonserviceable roads. Over the Poinsett Lumber and Manufacturing Co. road to these areas, *Shortia* may now be seen in abundance.

Shortia grows in various habitats: hanging from rocks near water falls (water dripping from its leaves) in sand at the edge of running water, on fallen decaying tree-trunks, in shady, deep, moist loam soils, and on dry hillsides. Its most favorable habitat is a cool, damp, shady stream bank, with moist circulating air, and a surface covering of two to six inches of loose organic debris with a fertile, moderately acid soil (pH 4.2–6.0) beneath. While *Shortia* is more frequently found beneath *Rhododendron maximum* it will grow equally as well under the shade of *Tsuga*

---

[17] Duncan, W. H., Haskell Venard and G. W. McDowell, Rhodora 52: 229–232, 1950.

canadensis, *Pinus Strobus*, *Pinus rigida*, *Liquidambar Styraciflua*, *Liriodendron Tulipifera* and other acid tolerating trees and shrubs. Plants found in the most favorable habitats have large leaves with long petioles and large flowers on long peduncles; while those growing under less favorable conditions (dry hillsides) have smaller leaves on short petioles and small flowers on shorter peduncles.

Fortunately for the preservation of *Shortia*, the largest percentage of it is confined to large private holdings and government land. Along the Toxaway and Horsepasture Rivers and their tributaries in Oconee and Pickens Counties, South Carolina, the Poinsett Lumber and Mfg. Co. holds the areas of greatest concentration of *Shortia*, while in Transylvania County, North Carolina, it is the Duke Power Co. which controls such areas. The writer, his colleagues and students are indebted to Thomas Mitchell and Furman Chastain of the Poinsett Lumber and Mfg. Co. and C. F. Moore of the Duke Power Co. for permission to seek *Shortia* on the company lands. On the sources of the Catawba River in McDowell County, North Carolina more than one-half the *Shortia* plants are in the Pisgah National Forest. Both the public and private organizations have the means of controlling the destroyers of it, so *Shortia* is safe for posterity.

The writer became interested in *Shortia* while preparing a paper on the life of Charles W. Short, first of the Kentucky born botanists and recipient of Asa Gray's honor, for the Filson Club History Quarterly.[18] Available references on *Shortia* did not present a unified picture of its distribution and little could be found about its abundance. In order to obtain more complete knowledge of its distribution and abundance, investigations were made which included extensive field excursions and the following of all significant leads through correspondence and conversations with persons who had collected *Shortia* or had heard of places where it could be found.

Explorations were made by working up or down the rivers, creeks, or branches. Not all the small tributaries were followed to their sources. In several places the terrain was too rough or the thickets so impenetrable that no explorations were made

[18] Davies, P. A., Filson Club Hist. Quart., 19: 131–155, and 19: 208–249, 1945.

for fear of bodily injuries. Most of the surveys were made in dry weather and at low water stages, so the explorers were able to wade the streams through most of the gorges and to escape the dense thickets.

It was the author's original intention to publish a full account of the distribution of *Shortia*, giving exact plot locations. Realizing that unscrupulous collectors might destroy the easily accessible small patches, particularly on the fringes of the range, he decided to publish only general locations, and to deposit in the library of the Gray Herbarium data on exact location, including maps, and the correspondence accumulated during the study. In this way *Shortia* may be protected and the information on exact locations be made available to anyone interested in checking various plots or continuing the study of its distribution.

The most southern extensive search by the writer and his colleagues was on the middle and eastern sources of Little River near the divide which separates its watershed from that of the Whitewater River. Along these small headwater streams many scattered patches were observed. A more complete survey of the smaller western branches would undoubtedly yield many new locations.

Jocassee Valley, located in Oconee County, South Carolina, extends from above the confluence of the Whitewater and Thompson Rivers to below the Chapman Bridge over the Keowee River. Many streams enter the valley. The largest are the Whitewater, Thompson and Toxaway Rivers and Devilfork Creek. The writer has carefully examined all parts of the valley. The acres of *Shortia* that Boynton discovered in 1889 have largely been destroyed by cultivation, grazing and road building. However, along many of the streams and on some of the steeper slopes where grazing has not taken place, *Shortia* is still plentiful. There is enough of it in the valley to meet the demands of nurserymen for hundreds of years. The author knows of one ravine near the Keowee River where nurserymen have been gathering *Shortia* for more than 30 years without greatly depleting it.

At the upper end of the valley, along the camp road on the south side of the Whitewater River, a few colonies of *Shortia* were observed. This river was explored all the way to the upper falls and no *Shortia* was found beyond the first road-bridge (elevation circa 1060 feet) above its confluence with the Thompson River.

Following the Thompson River from its junction with the Whitewater to approximately the North Carolina boundary numerous patches of *Shortia* were observed. This river was again examined above state highway 92 (Upper Whitewater Falls Road) without finding any indication of *Shortia*. Wright and Coley creeks, the two main eastern tributaries of the Thompson River in South Carolina were examined to their sources. As the elevation increased, *Shortia* became more abundant. Near the divide which separates the branches of Coley Creek from those of Mill Creek, the writer found on the Coley Creek side, a patch of *Shortia* on a moist, steep and shaded hillside. Below and near the patch were numerous young plants which were judged to be from one to three years old. In 1953, C. F. Moore and the writer found a similar condition below a patch and near the edge of Bearwallow Creek. This is a clear and encouraging indication that in certain places where conditions are favorable, *Shortia* is increasing rather than decreasing. No attempt was made to explore the tributaries of the Thompson River between the North Carolina boundary and state highway 92.

On Devilfork Creek, the large southern tributary of the Whitewater River, scattered stations were recorded along its banks, but many were present higher up on the mountain along the numerous branches of the lower tributaries. As the head-waters of the southern branches of this creek are separated by narrow ridges from the northern branches of Little River, the upper stations on each drainage area are in close proximity.

The Toxaway River ends in Jocassee Valley by joining the Whitewater to form the Keowee River and extends northward into its numerous branches above the old Lake Toxaway site in Transylvania County, North Carolina. Along its course many streams flow into it, but the majority are small and unnamed. On its banks and along its numerous tributaries *Shortia* is plentiful, some in small isolated patches, others in large areas extending up the mountainside. No *Shortia* was found one fourth mile above the entrance of Bearwallow Creek, although the river was examined into its sources. Only the larger creeks and branches of the Toxaway River which appear on topographic maps will be considered in this paper although a great many of the smaller branches contain an abundance of it.

The center of distribution of *Shortia* for the sources of the Keowee River basin appears to be along the Toxaway River below the entrance of Horsepasture (Green) River and near that of the Devil's Hole Creek. This position is approximately halfway between the stations to the south on the northern branches of Little River, along Devilfork Creek, on the Whitewater River and those to the north on Bearwallow Creek. In an east-west direction it is between the station on the upper part of Laurel Fork Creek and the Thompson River. It is interesting correlation that it was near this center of distribution, at the forks of the Toxaway and Horsepasture Rivers, that C. S. Sargent believed André Michaux, in the inclement weather of December 1788, collected the type specimen and that he almost a hundred years later (September, 1886) rediscovered it for this part of the Carolinas.

Several large and many small streams enter the Toxaway River from its junction with the Whitewater to the south and the Horsepasture to the north. All except Devils Hole Creek are unnamed and *Shortia* was found, varying in abundance, on nearly all of them. As one passes through the Toxaway watershed over the Poinsett Lumber and Mfg. Co.'s new road to the confluence of the Toxaway and Horsepasture Rivers, *Shortia* may be observed in abundance along the branches of Devil's Hole Creek and other streams in this area. Because of the recent cutting of trees along the upper branches, resulting in the drying of the surface debris, and the covering of the leaves with dust from the dirt road, a large part of these stands may not survive.

On the Horsepasture River between its junction with the Toxaway and Bearcamp Creek (main tributary of the Horsepasture in South Carolina), the great amount of *Shortia* that T. G. Harbison observed in 1890 was still there when the area was examined in March of 1951 by the author accompanied by L. M. Brown, and in June of the same year with Arland Hotchkiss. Both sides of the river were checked and the larger amount was found on the more gently, less exposed, southwestern slopes. Rocks and soil dumped on the lower side of a new logging road built around the mountain in the latter part of 1951 buried many large patches. Above the road *Shortia* can still be found in considerable quantities.

Along the Horsepasture River above the entrance of Bearcamp Creek, the amount of this plant diminishes as one moves northward. The farthest north *Shortia* was found on this river or its tributaries was in North Carolina, at an elevation of about 1600 feet, between the approach of the Duke Power Road to the river and Windy Falls. In this area C. F. Moore and B. C. Olney found an unusual station, and as Moore describes it, "This interesting location was high on a ridge between the Horsepasture River and Bearwallow Creek, but nearer the Horsepasture. *Shortia* was growing on the dry hillside far removed from any stream. It was not in a cove but on a well exposed crest. There appeared to be several acres of it."[19]

The lower part of Bearcamp Creek and its main north branch were explored well above the North Carolina boundary, and the large quantity of *Shortia* that F. E. Boynton discovered along the lower part of this creek in the fall of 1886 still remains. It was found hanging from the moist wall of the gorges, on decaying fallen trees and in the loose, fertile acid soil (pH 5.2) along the stream. Along Mill Creek, a southern branch of Bearcamp Creek, *Shortia* was frequently found, and in certain places extending up the mountain. As its sources near the divide (circa 1800 ft.), which separates the drainage areas of the Horsepasture River from those of the Thompson River, were reached, *Shortia* became less abundant.

Laurel Fork Creek, the lower main tributary of the Toxaway River above its junction with the Horsepasture River, entends into Pickens County, South Carolina. On this eastern branch, *Shortia* is growing near the lower bridge crossing, about one-fourth mile above its mouth. C. F. Moore and B. C. Olney previously recorded this location. At the old millsite, farther up the creek, it was found in abundance extending up the mountain sides. Numerous stations were observed along the creek and its branches in the two miles explored above the mill-site. In March of this year C. F. Moore and J. L. Kapp found it in

[19] Letter, C. F. Moore to P. A. Davies, June 30, 1952.

abundance further up this creek to an elevation of about 1600 feet.[20] On Jackies Branch, a northern tributary of Laurel Fork Creek, *Shortia* was found near its mouth. No attempt was made to explore the headwaters of this small stream.

Three creeks joining the river just below the North Carolina border were next examined. Cobb and Bear Creek rising in Transylvania County, North Carolina, flow southeast into Oconee County, South Carolina, while the third creek (unnamed) arises in Pickens County, South Carolina, and flows almost due west to the river. Cobb Creek, the smaller and more northerly branch on the west side of the river was explored along the lower two-thirds of its course. This creek had very little water, so conditions were not favorable. A few small patches were found near its mouth. Bear Creek was followed from its confluence with the river to the Duke Power Co. road. Habitats were favorable and many stations of *Shortia* were observed. No examinations were made above the Duke Power Co. road. The eastern unnamed branch was examined but a short distance and several small patches were found.

In the lower part of Transylvania County, three streams enter the Toxaway River at the Cane Brake: Rock and Toxaway Creeks from the east and a small unnamed one from the west. Along the lower and more gentle terrain of Rock (Rockhouse) Creek no *Shortia* was observed. At the narrows about three-fourths mile above its mouth, it was found but not in abundance. No further inspection of this creek was attempted. In 1948 C. F. Moore reported a station higher up near its sources. Toxaway Creek was explored as far as the falls. Again *Shortia* was found along its banks. Frozen Creek, a northern branch of Toxaway Creek, was explored above Frozen Lake without success. The farmers in this area had never seen or heard of it. The unnamed creek from the west was examined about one-half way up its course. Eight stations were counted.

Studies were made on the lower one-fourth mile of Auger Fork Creek. No *Shortia* was found except near the river. The small unnamed creek just above the Auger Fork Creek was examined near the road crossing. No *Shortia* was found at this place.

Bearwallow Creek is a main western division of the Toxaway

[20] Letter C. F. Moore to P. A. Davies Aug. 2, 1954.

River below the falls. With the exception of the Whitewater River area, more persons have observed and collected *Shortia* along the lower part of this creek than in any other part of the Keowee drainage basin. The writer has been along the lower part of this creek five times and has observed patches of *Shortia* each time. The fourth time, the creek was reached from a logging road and trail from F. O. Fisher's place between Rosman and Cashiers on highway 64. No *Shortia* was found along this creek until an elevation of about 1600 feet was reached. The stations along Bearwallow Creek and the one observed on the Toxaway River about one-fourth mile above the entrance of this creek mark the northern station of Shortia observed by the writer in the Keowee drainage area.

The amount of *Shortia* on the drainage areas of the Catawba River is exceedingly small when compared to that on the tributaries of the Keowee River. Except for one small station reported by F. M. Crayton on the Linville River, west Table Rock Mountain in Burke County, all locations are near streams with sources in the lower part of the Bald Mountain chain.

Although several streams, most of which are small and not indicated on available maps, rise from the lower part of the Bald Mountain chain, only three have received names: Toms Creek on the west, Johns Creek (Fish Hatchery Creek) on the southeast, and McGegers Branch to the east. W. C. Coker reports a station on Toms Creek. Milton Bowman and the writer in June 1952 located Coker's station and found one above and another below it. Three small stations were observed on a small unnamed branch of Toms Creek flowing from the southern tip of Bald Mountain. Unfortunately no record was made of the exact location of Hyam's station, although he stated it was on a mountain side near a small stream that flowed into the Catawba River about five miles north of Marion. The area at the southern tip of the Bald Mountain chain fits all known data as to the location of Hyam's station. Here the road from Marion to Turkey and North Coves runs close to the mountain, crossing several streams, and is about five miles north of Marion.

Johns Creek has three main branches, all with sources in the Pisgah National Forest. On the right branch no *Shortia* was found, probably due to heavy grazing. Along the left branch a small patch was observed on a hillside just above the old sawmill site. Many stations were found on its sources in the national forest. The middle branch, frequently called the fish hatchery branch, has all its sources in the national forest. Above the hatchery and along the main tributary, *Shortia* is growing almost to the top of the ridge.

The stations reported by W. C. Coker on the east side of the Bald Mountain, were checked and found to be in good condition. An examination of McGegers Branch and other streams between it and Johns Creek resulted in several small patches. No explorations were made above McGegers Branch on the east side of the mountains. Limekiln, Cox and Armstrong Creeks on the west side of the Bald Mountain chain were checked at various places without success.

Two attempts were made to reach the Crayton station on the Linville River below the Table Rock Mountains. On April 12, 1952, Milton Bowman and the writer descended the gorge between Hawksbill and Table Rock Mountains. Narrowness of the gorge and high water prevented us from reaching the area directly below Table Rock Mountain although the river was explored for some distance. No *Shortia* was found. Later the river was ascended from Lake James to a place below Chimney Gap before heavy rains forced a retreat. The part examined gave no indication of *Shortia*. A group of senior scouts ascending the river were given leaves and flowers of *Shortia* and instructed where to look. They were particularly asked to search the area directly below Table Rock Mountain. Although their main interest was to ascend the river to the Linville Falls, they did spend some time looking for *Shortia*. Their results were negative. From the writer's experience along this river, he is led to believe that the Crayton station is simply an outpost, and that if other patches are present they are few in number.—DEPARTMENT OF BIOLOGY, UNIVERSITY OF LOUISVILLE, LOUISVILLE, KENTUCKY.

ECHINODORUS IN THE AMERICAN TROPICS

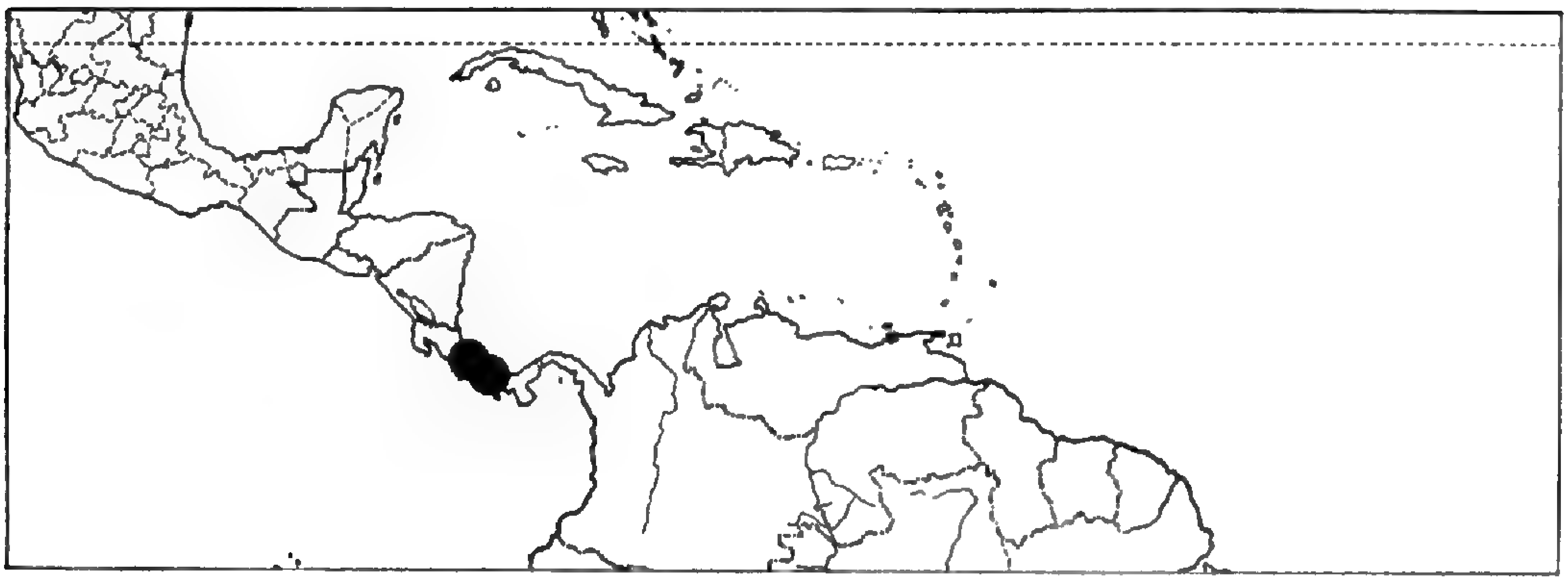
Norman C. Fassett

(*Continued from p. 188*)

15d. E. tenellus, var. **latifolius** (Seubert) Fassett, n. comb. *Alisma tenellum* forma *latifolia* Seubert in Mart. Fl. Bras. **3,** pt. 1: 195, t. 13, fig. 2, nutlet and plant to left. 1848.

Southern Brazil to Venezuela, West Indies, and northern Central America (Map 13d) **Guatemala:** Lake Zotz, Petén, 18 May 1933, *Lundell 3293* (F); Dept. Jalapa, Potrero Carrillo, 13 miles northeast of Jalapa, alt. 1500–1700 m., 12 December 1939, *Steyermark 33098* (F); Dept. Alta Verapaz, bogs near Santa Cruz, along road to San Cristóbal, alt. about 1350 m., 16 April 1941, *Steyermark 42754* (F); Dept. Alta Verapaz, large swamp just east of Yactic, alt. 1300 m., 20 February 1942, *Steyermark 43977* (F). **Honduras:** in bog, in pine forest, El Achote, near Siguatepeque, Dept. of Comayagua, alt. 1500 m., 18 February 1928, *Standley 56099* (US, F). **Jamaica:** growing in swamp, Cornwall, St. Elizabeth, 18 July 1915, *Harriss 12095* (GH, F, MO, NY, US); Cornwall swamp, near Locovia, 1915, *Perkins* (NY). **Dominican Republic:** Prov. de la Vega, prope Tarabacoa in paludosis 550 m. alt., June 1912, *Fuertes 1666* (F, GH, NY, US); Llano Costero, Prov. Sto. Domingo, Cuenca, edge of laguna, 6 January 1929, *Ekman 11025* (US). **Porto Rico:** Laguna Yeguada near Vega Baja, 24 March 1922, *Britton, Britton & Brown 6773* (F, NY, US); muddy marsh, vicinity of San Juan, 11 & 12 February 1914, *Britton & Cowell 1483* (GH, NY, US); Martin Peña, 12 February 1914, *Johnston 1314* (NY). **Venezuela:** Tovar, 1854–55, *Fendler 1358* (GH); La Trinidad de Maracay, at an altitude of 440 meters, State of Aragua, January–February 1913, *Pittier 5844* (NY, US); in morass, El Limón, near Maracay, Aragua, 19 January 1922, *Pittier 10104* (GH, NY, US); Anzoátegui, headwater of Río Guanipa, 28 December 1940, *Pittier 14637* (US). **British Guiana:** herb, on edge of drying pond, basin of Rupununi River, lat. about 2° 52′, 25 & 26 October 1937, *Smith 2285* (F, MO, NY, US). **Bolivia:** Reyes, alt. 1000 ft., October 1921, *Rusby 1540A* (NY, US). **Brazil:** Lagoa Santo, Minas Geraes, 3 August 1936, *Archer 3612* (US); Omolas, Matto Grosso, 6 August 1908, *Hoehne 30* (US). **Paraguay:** in regione lacus Ypacaray, May 1913, *Hassler 12654* (F, GH, MO, US); common in a dry lagoa, Tapytá, April 1931, *Jörgensen 4722* (NY, US, F, MO); fluminis Apa, February 1902, *Hassler 8453* (GH, MO).

This is often the largest phase of *E. tenellus*, some of the plants having a scape 35 cm. long, with leaves 20 cm. long and 12 mm. wide (Fig. 76). A collection from Honduras: El Achote, hills above the plains of Siguatepeque, Dept. Comayagua, *Yuncker, Dawson & Youse 6321* (F), has a slight development of a fourth lateral rib on some achenes. This may represent a

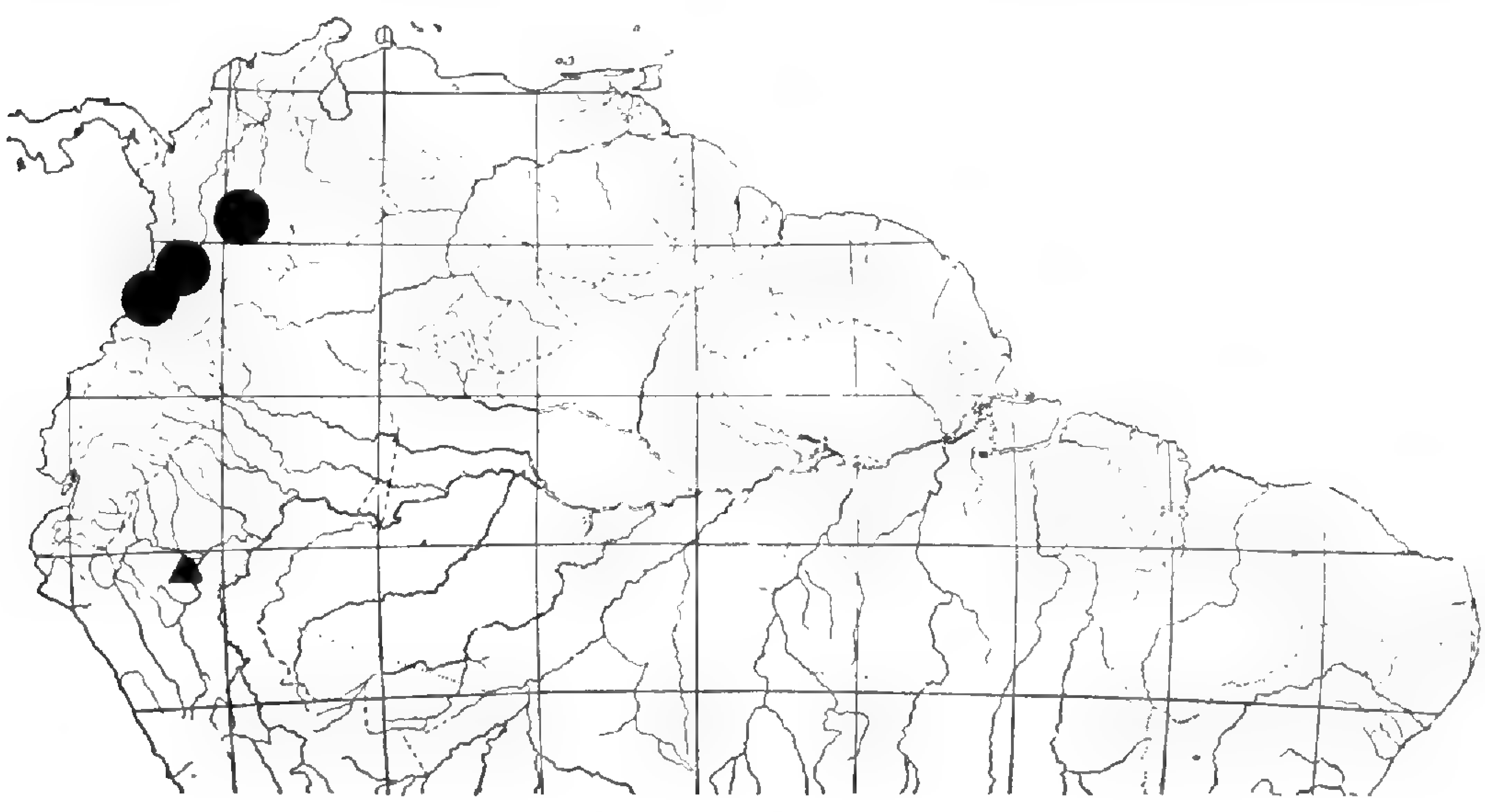


Map 14. Echinodorus isthmicus.

slight introgression from populations to the southeastward in Costa Rica, where that character is well-developed.

E. TENELLUS var. LATIFOLIUS f. **apanecae** Fassett, n.f., plantae in aqua vadosa; foliis linearibus longis-oblanceolatis, 12–22 cm. longis, flaccidis, membranaceis, ad basim attenuatis.—**El Salvador:** in about 1 foot of very cold water, Lagunita las Ninfas, Apaneca, alt. 5430 ft., 28 January 1951, *Fassett 28704* (GH, WIS); shallow water, mud bottom, Laguna Verde, Apaneca, alt. 5100 ft., 28 December 1950, *Fassett 28505* (TYPE in Chicago Natural History Museum, GH); same data, no. *28508* (F); same locality, 30 December 1950, *Fassett 28525* (F).

When the fertile terrestrial form is not found nearby the identification of submersed forms is more difficult. Since *E. tenellus* var. *latifolius* is the only one of this group that has been collected in Central America, these plants presumably belong to



Map 15. Echinodorus magdalenensis, dots; E. quadricostatus, triangle.

that variety. The leaves are much larger than in the terrestrial forms. A few leaves of no. *28508* are a little more like the terrestrial ones, and show the callous margin and tip characteristic of *E. tenellus*.

16. Echinodoras **isthmicus** Fassett, n. sp., foliis lanceolatis, 3–7 cm. longis, 2–5 mm. latis; scapis 6–12 cm. altis, saepi verticillatis; antheris 0.7 mm. longis; achaeniis 1.6 mm. longis, 4-costatis utrinque, rostro nullo aut 0.2 mm. longo (Fig. 69).

Costa Rica and Panama (Map 14). **Costa Rica:** Cienega da Agua Buena, Cañas Gordas, alt. 1100 m., February 1897, *Pittier 11126* (us). **Panama:** wet meadows along Río Caldera, south of El Boquete, alt. 1250 m., 1 March 1918, *Killip 3618* (us—type).

17. Echinodorus **quadricostatus** Fassett, n. sp., laminis foliorum 3.5–5 cm. longis, 3–6 mm. latis; achaeniis 1.8 mm. longis, 4-costulatis utrinque (Fig. 72); rostro 0.8 mm. longo; antheris 0.6 mm. longis.

Northern Peru (Map 15, triangle). **Peru:** Dept. Loreto, Balsapuerto, altitude about 220 meters, January 1933, *Klug 2875* (gh—type; us, f); Dept. Loreto, Yurimaguas, lower Río Huallaga, alt. about 135 meters, 22 August—9 September 1929, *Killip & Smith 27963* (us); lower Río Huallaga, Dept. Loreto, October–November 1929, *Williams 4698* (f).

18. Echinodorus **magdalenensis** Fassett, n. sp., laminis foliorum lanceolatis, 3–5 cm. longis, 5–9 mm. latis; achaeniis 1.6–1.7 mm. longis, costis obscuris aut obsoletis (Fig. 71); rostro 0.6–0.7 mm. longo; antheris 0.4–0.5 mm. longis.

In Colombia, in the basin of Río Magdalena and on the nearby Pacific coast (Map 15, dots). **Colombia:** Department of Antioquia, Puerto Berrio, alt. 130–140 m., 11–13 January 1918, *Pennell 3717* (gh, us), Department of El Valle, Cuchilla, east of Zarzal, alt. 1200–1600 m., 22 July 1922, *Pennell, Killip & Hazen 8523* (us—type); Department of Valle, costa del Pacifico, Isla del Guayabel, en lo desembocadura río Cajambre, 0–5 m. alt., 11 & 12 February 1944, *Cuatrecasas 16229* (us).

IX. Distribution of Characters in Section Tenelli

The morphological relationships as based on nutlets are shown in Figs. 66–72. Specific distinctions are shown by double lines and varietal by single lines; this is on a basis of how the characters act, not on how different they look. The rounded summit of the achene correlates with the beak poorly developed or absent, and plants with 3-ribbed nutlets are quite distinct from those with 4-ribbed nutlets, but the short beak grades imperceptibly into no beak at all and various intermediates are found between the ribbed achenes and the ribless ones. Nine different combinations of characters are theoretically possible, of which 5 have been found.

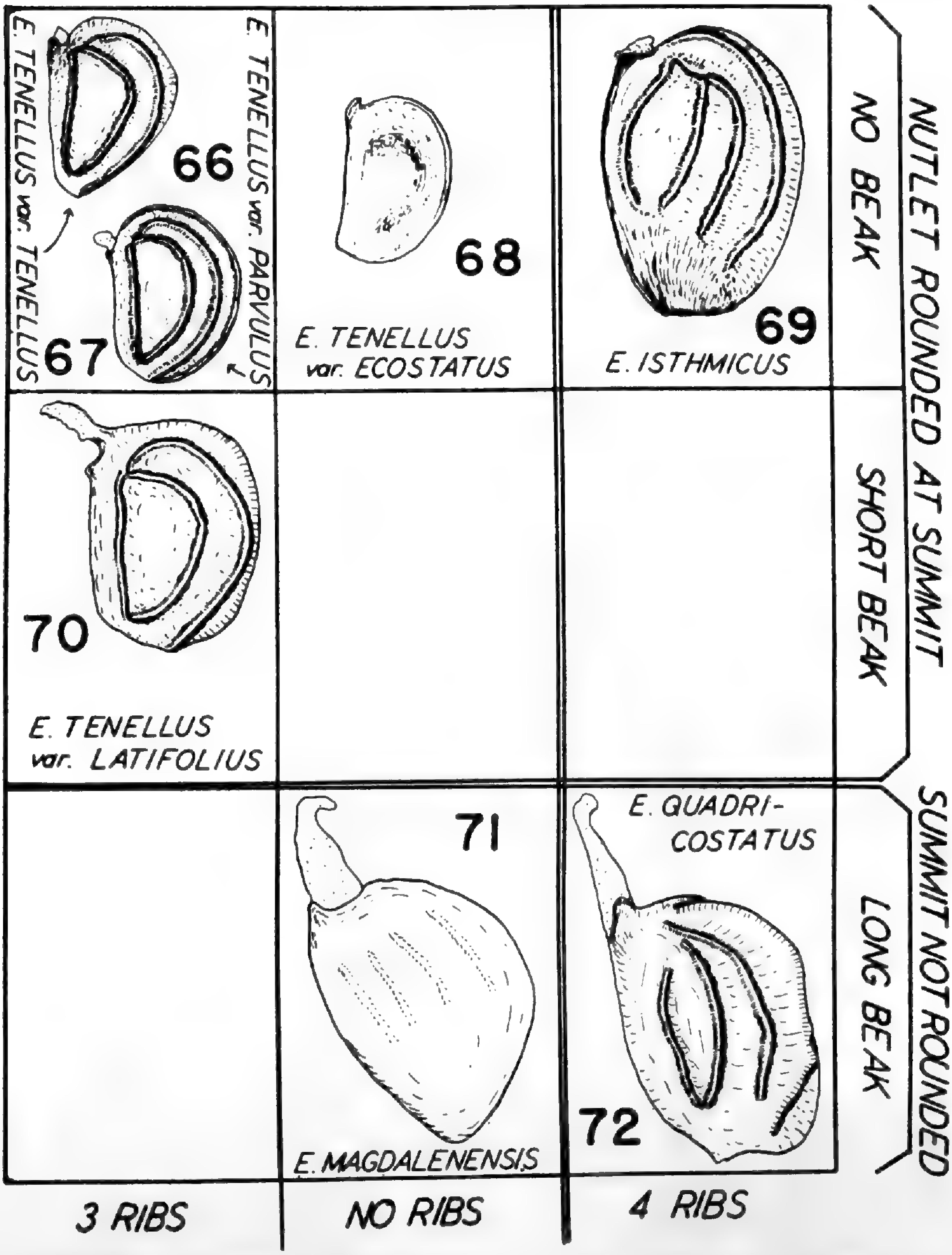


FIG. 66–72. NUTLETS OF SECTION TENELLI (× 20). Fig. 66. *E. tenellus* var. *tenellus*; Brazil, Gardner 2740. Fig. 67. *E. tenellus* var. *parvulus;* Massachusetts, Faxon. Fig. 68. *E. tenellus* var. *ecostatus;* Venezuela, Pittier 11707. Fig. 69. *E. isthmicus;* Panama, Killip 3618. Fig. 70. *E. tenellus* var. *latifolius;* Venezuela, Pittier 5844. Fig. 71. *E. magdalenensis;* Colombia, Pennell 3717. Fig. 72. *E. quadricostatus.* Peru, Killip & Smith 27963. Specimens in United States National Herbarium.

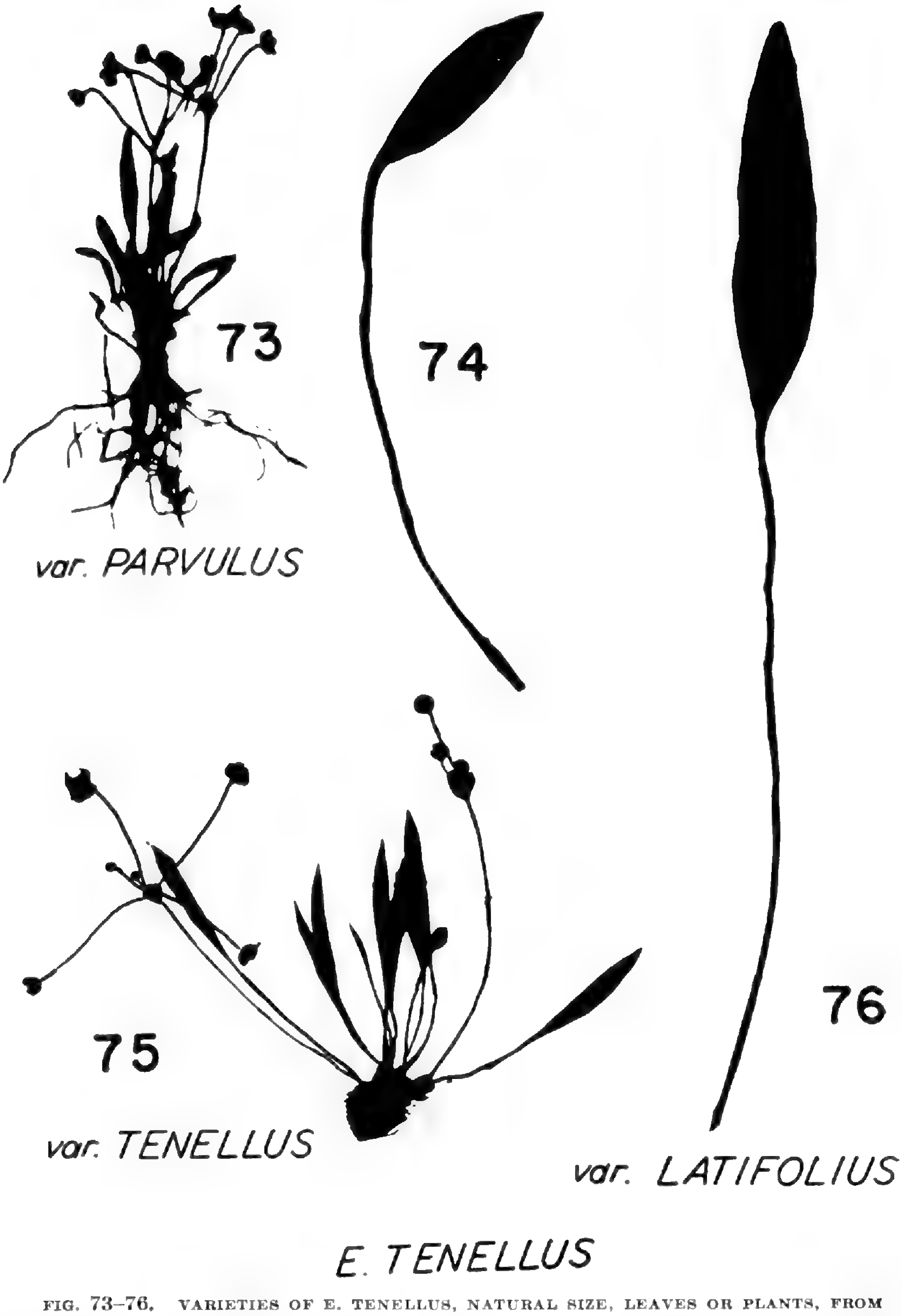


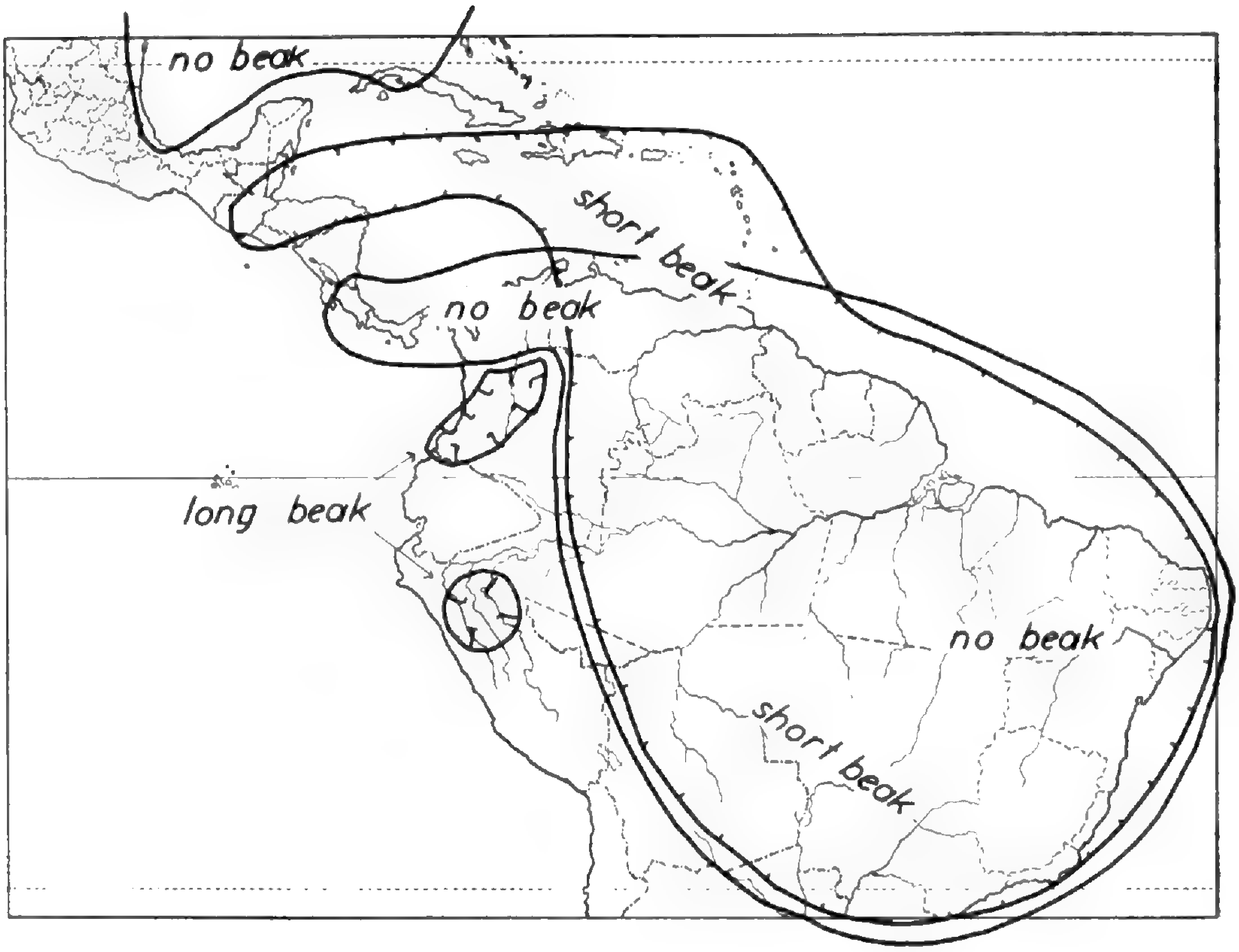
FIG. 73–76. VARIETIES OF E. TENELLUS, NATURAL SIZE, LEAVES OR PLANTS, FROM PHOTOGRAPHIC PRINTS OF SPECIMENS IN US. Fig. 73. Var. *parvulus:* Florida, Harper 39. Fig. 74. Var. *parvulus:* Missouri, Eggert. Fig. 75. Var. *tenellus:* Venezuela, Chardon 252. Fig. 76. Var. *latifolius:* Dominican Republic, Ekman 11025.

On Maps 16 & 17, characters are mapped, and on Map 18 the two previous maps are combined to give a map of the recognized taxa.

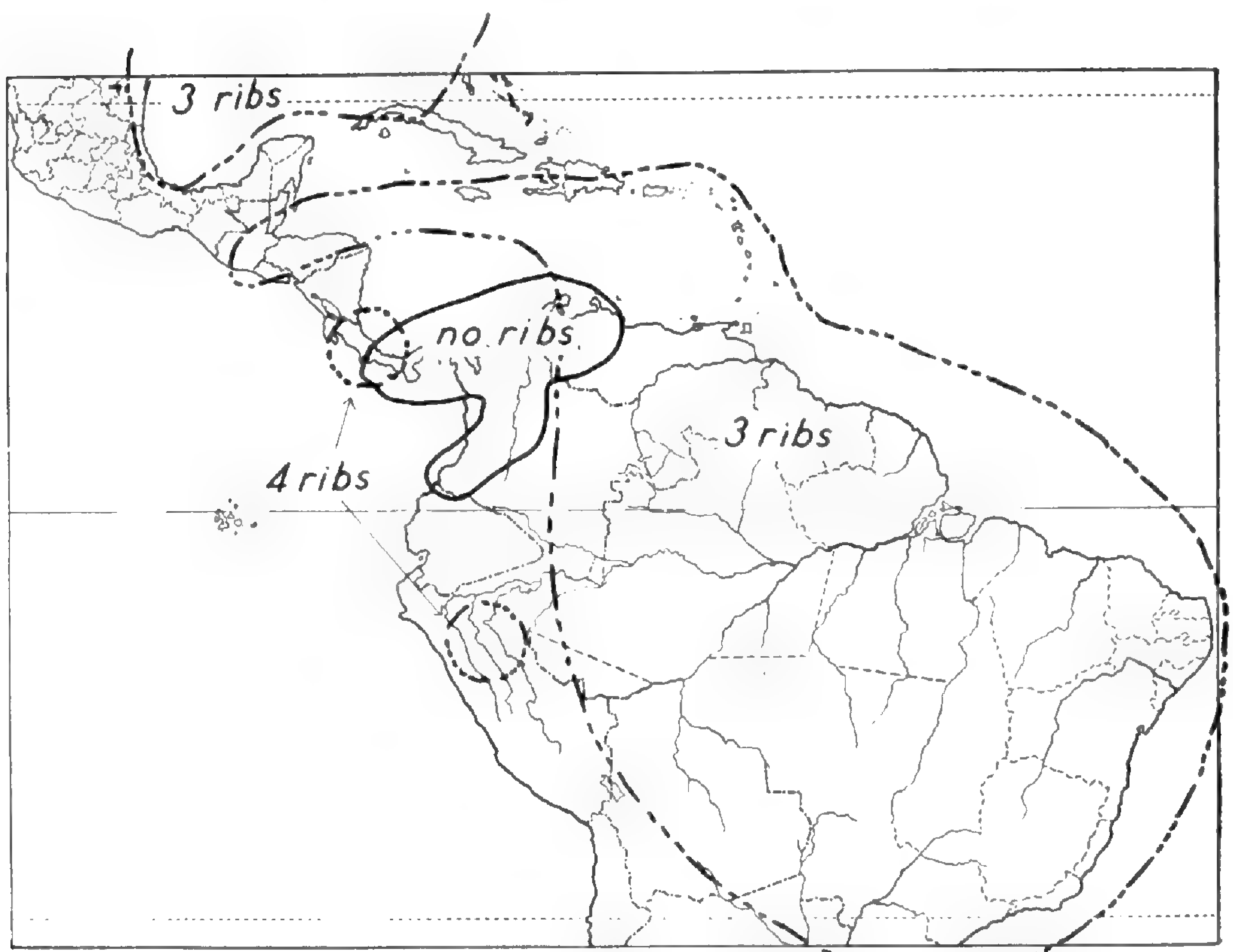
Map 16. The long beak, which is correlated with a sloping summit of the nutlet, is in a relatively small area in the northern Andean region. The short beak and undeveloped beak both occur in a great area centering on the Amazon basin, but from this region of coëxistence they reach out in slightly different directions; the short beak follows the geologically ancient route through the Antilles to northern Central America, while the undeveloped beak runs from northern South America into the younger lands of the Isthmus of Panama. The undeveloped beak then reappears in western Cuba and Mexico, ranging thence northward on the Atlantic Coastal Plain to Massachusetts and in the Mississippi embayment to Missouri.

Map 17. The species with 4 ribs on the nutlet have been found in Peru (altitude 135–220 meters) and in Costa Rica and Panama (1199–1250 meters). More widespread is the nutlet with 3 ribs. Lack of ribs is confined to the lowlands from Venezuela and Colombia to Panama; the ribless condition blends on the one hand with the 3-ribbed phase to produce *E. tenellus* var. *ecostatus* (Fig. 68) and combines on the other hand with the 4-ribbed long-beaked *E. quadricostatus* type to produce *E. magdalenensis* (Fig. 71).

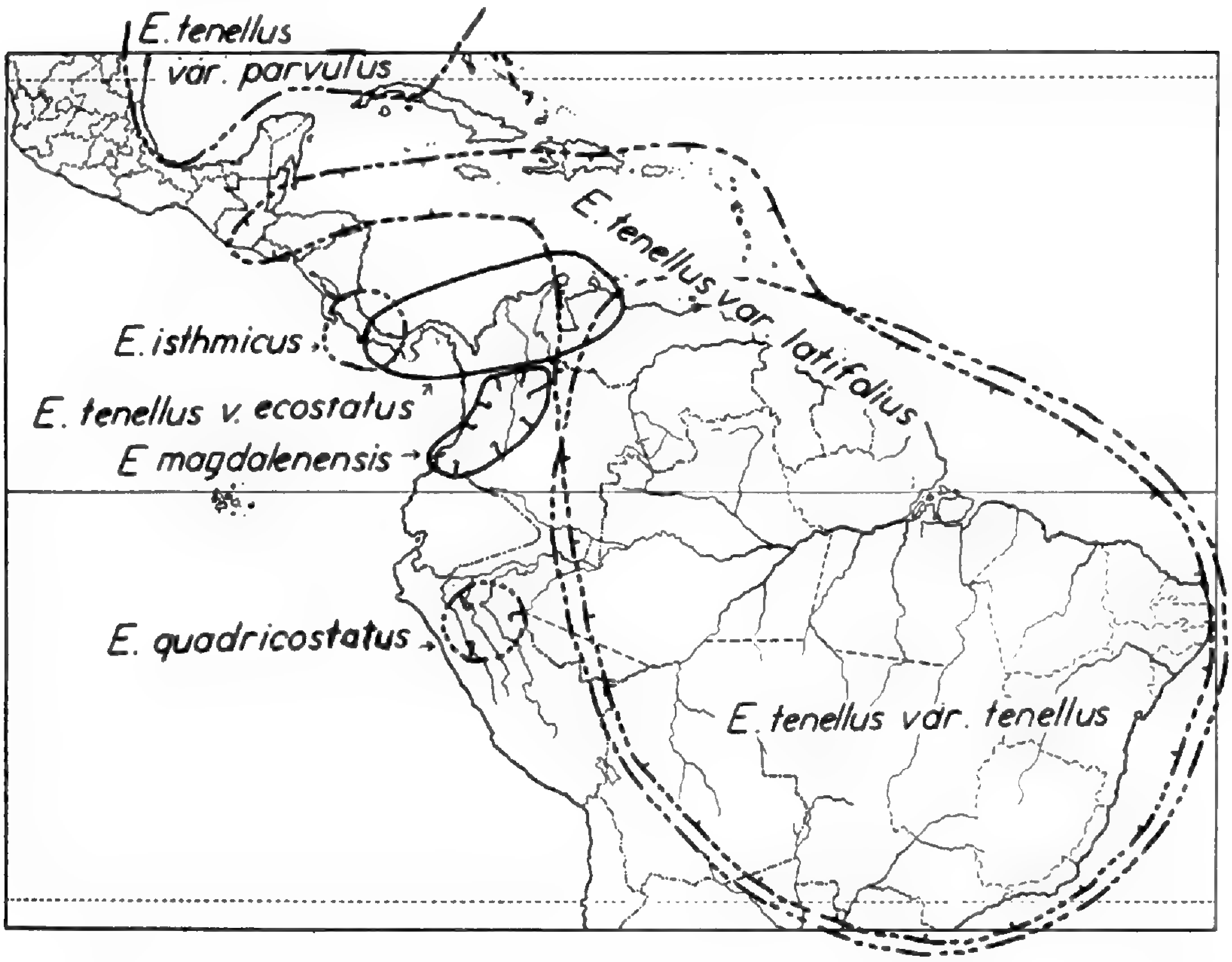
From the morphological relationships shown in Figs. 66–72, and the geographical relationships shown in Maps 16–18, we may speculate concerning phylogenetic relationships. Phylogeny is, as is so often the case, more susceptible to speculation than to proof. If we hypothesize as ancestral types *E. tenellus* var. *tenellus* (Fig. 66) mainly of the Amazon basin, and *E. quadricostatus* (Fig. 72) of the headwaters of the Amazon, we may then see *E. tenellus* var. *latifolius* (Fig. 70) as deriving its beak from *E. quadricostatus.* Var. *latifolius* then spreads through the range of var. *tenellus* and beyond it through the Antilles to Central America. As for *E. tenellus* var. *ecostatus* and *E. magdalenensis,* these occupy contiguous areas and are both characterized by partial or complete suppression of ribs; when there is some suggestion of ribs, *E. tenellus* var. *ecostatus* shows 3 and *E. magdalenensis* shows 4. It seems unlikely that



Map 16. Distribution of beak types.



Map 17. Distribution of rib types.



Map 18. Composite of maps 16 and 17 to show distribution of taxa.

the same habit of rib suppression should have originated independently in two species in adjacent areas. The greater constancy of rib suppression in *E. magdalenensis* suggests that that species arose first, perhaps by mutation from an *E. quadricostatus* stock, and that its character has subsequently been transmitted to an *E. tenellus* stock in the geologically young lowlands of Venezuela and adjacent Panama. *E. isthmicus* may be composed of another recombination of the characters of *E. tenellus* and *E. magdalenensis.*

Another hypothesis is suggested by my colleague Dr. Jonathan Sauer, involving *E. magdalenensis* (Fig. 71) as a primitive type, with a genetic make-up involving 4 ribs but with the factor for ribs suppressed; this would involve the origin of *E. quadricostatus* (Fig. 72) from *E. magdalenensis* and an *E. tenellus* stock to introduce expression of the factor for ribs, and of *E. isthmicus* (Fig. 69) and *E. tenellus* var. *ecostatus* (Fig. 68) from different combinations of characters of *E. magdalenensis* and *E. tenellus.*

V. KEYS FOR IDENTIFICATION IN LIMITED AREAS

ECHINODORUS IN THE UNITED STATES

a. Slender plants rarely 10 cm. high; carpels 20 or fewer in a loose head; stamens 6 or 9; anthers basifixed; nutlets beakless (Fig. 67).
E. tenellus var. *parvulus.*

a. Robust plants with ovate or cordate leaves (except for dwarfed individuals on drying shores); carpels many in dense heads; stamens 9–30; anthers versatile; nutlets beaked (23–29).

b. Sepals with smooth veins; profile of fruiting head appearing echinate to the naked eye, due to the long (0.5–1.8 mm.) beaks on the nutlets; each side of nutlet with 5 arching ribs of which the 2 wing-like ones are alternate with the others; glands of nutlet acuminate at the upper end and entering the base of the beak (Figs. 25–29); pellucid lines of leaves mostly less than 1 mm. apart and often several mm. long (Fig. 55); scape erect with whorled and usually compound branches.

c. Beak of nutlet 1.2–2.0 mm. long, ½–⅔ as long as the body (Figs. 25–27); anthers 0.8–1.2 mm. long. . . . . *E. Berteroi* var. *Berteroi.*

c. Beak of nutlet 0.5–0.8(-1.0) mm. long, ⅓–½ as long as the body (Figs. 28, 29); anthers 0.5–0.8 mm. long. . *E. Berteroi* var. *lanceolatus.*

b. Sepals with papillose ridges; profile of fruiting heads appearing nearly smooth due to the short (0.2–0.8 mm.) beaks on the nutlets; each side of nutlet with 3–4 abruptly curved and sometimes joining ribs of which the 1 or 2 toward the dorsal edge are wing-like toward the tip (Figs. 23, 24); glands of nutlet rounded at both ends and not closely approaching the beak; pellucid lines of leaves mostly 1 mm. or more apart and rarely exceeding 1 mm. in length (Fig. 54); scape erect when young but soon procumbent, with verticillate peduncles at the nodes. . . . . *E. cordifolius.*

ECHINODORUS IN THE WEST INDIES

a. Carpels 20 or fewer in a loose head; stamens 6–9; anthers basifixed.

b. Leaves narrowly lanceolate or elliptic (Fig. 76); ribs of nutlets not crested (Fig. 70). . . . . *E. tenellus* var. *latifolius.*

b. Leaves cordate; ribs of nutlets crested (Fig. 53). . . . *E. nymphaeifolius.*

a. Carpels many in a dense head; stamens 9–30; anthers versatile.

c. Veins of leaf radiating from base of the blade (Figs. 2, 3, 10); petiole terete or fluted, not 2-winged.

d. Beak more than ½ as long as the body of the nutlet (Figs. 25–27), with tapering apex of glands entering its base; pellucid lines of leaves crowded, often several mm. long (Fig. 55). . . *E. Berteroi* var. *Berteroi.*

d. Beak shorter, the rounded ends of the glands not reaching its base (Figs. 30, 31, 40); leaves with more scattered pellucid short lines (Figs. 57–58) or dots (Fig. 56).

e. Blades with stellate hairs toward the base, about as wide as long (Fig. 10).

f. Blades with pellucid dots and few or no very short lines (Fig. 56), petals white. . . . . *E. grandiflorus* var. *grandiflorus.*

f. Blades with pellucid lines 0.2–0.5 mm. long; flowers yellow.
E. grandiflorus var. *aureus.*

e. Blades glabrous, about twice as long as wide (Fig. 13). . . . *E. ovalis.*

c. Upper pair of veins paralleling the midrib for some distance (Fig. 16); petiole winged. . . . . *E. Grisebachii.*

ECHINODORUS IN MEXICO

a. Carpels 10 or fewer in a loose head; stamens 6–9; anthers basifixed.
b. Leaves narrowly lanceolate or elliptic (Fig. 73, 74); ribs of nutlet not crested (Fig. 67) . . . . *E. tenellus* var. *parvulus*.
b. Leaves cordate; ribs of nutlet crested (Fig. 53) . . . . . . *E. nymphaeifolius*.
a. Carpels many in a dense head; stamens 9–30; anthers versatile.
c. Petiole terete or fluted, not winged (Figs. 1–5), blades with clear pellucid dots or lines.
d. Leaves glabrous, with pellucid lines (Fig. 55).
e. Nutlets about ⅔ as wide as long, the summit rounded on one side (Fig. 22), with very short beak and round facial glands. . . . *E. virgatus*.
e. Nutlet twice as long as wide, tapered to the very long beak (Figs. 25–27), the facial glands tapered at apex to enter the base of the beak . . . . *E. Berteroi* var. *Berteroi*.
d. Leaves with stellate hairs and pellucid dots (Fig. 56). *E. grandiflorus* var. *grandiflorus*.
c. Petiole winged (Figs. 14, 15); blades with very obscure pellucid lines or none . . . . *E. Andrieuxi*.

ECHINODORUS IN CENTRAL AMERICA

a. Carpels 20 or fewer in a loose head; stamens 6–9; anthers basifixed.
b. Leaves narrowly lanceolate or elliptic (Figs. 75, 76); ribs of nutlet not crested (Figs. 68–70).
c. Facial ribs 3 on each side (Fig. 70), or absent (Fig. 68).
d. Facial ribs nearly or quite suppressed (Fig. 68); nutlets 0.9–1.1 mm. long; stylar beak absent or nearly so . . . . . . *E. tenellus* var. *ecostatus*.
d. Facial ribs well developed (Fig. 70); nutlets 1.4–1.8 mm. long; stylar beak 0.2–0.5 mm. long . . . . *E. tenellus* var. *latifolius*.
c. Facial ribs 4 on each side (Fig. 69) . . . . *E. isthmicus*.
b. Leaves cordate; ribs of nutlets crested (Fig. 53) . . . . . . *E. nymphaeifolius*.
a. Carpels many in a dense head; stamens 9–30; anthers versatile.
e. Sepals 12–20-nerved, thin, withering, not accrescent, reflexed or loosely ascending in fruit, pellucid markings of leaves, if present, not reticulate.
f. Leaves with blades cordate at base (Figs. 10–12); petioles terete or fluted, not winged; base of blades and summit of petioles with stellate hairs or muricate (Fig. 11).
g. Flowers pedicelled; blades with few or no pellucid lines, sometimes with pellucid dots.
h. Blades with copious pellucid dots (Fig. 56) *E. grandiflorus* var. *grandiflorus*.
h. Blades without pellucid markings . . . . *E. muricatus*.
g. Flowers sessile; blades with very short pellucid lines (Fig. 60). *E. bracteatus* var. *bracteatus*.
f. Leaves glabrous, with blades tapered (Figs. 14, 16) or subcordate (Fig. 15) at base; petioles 2-winged.
i. Veins radiating from the base of the blade (Figs. 14, 15); leaves with pellucid lines very obscure or absent; nutlets long-beaked, with 1 facial gland (Figs. 41–43) . . . . *E. Andrieuxi*.
i. Upper pair of veins paralleling the midrib for some distance (Fig. 16); leaves with well-marked pellucid lines (Fig. 63); nutlets short-beaked, with several facial glands (Fig. 51) . . . . *E. Grisebachii*.
e. Sepals about 30-nerved, thick and brittle, enlarging in fruit to cover the fruiting head; pellucid markings reticulate (Fig. 64) . . . . *E. tunicatus*.

ECHINODORUS IN TROPICAL SOUTH AMERICA

a. Slender plants rarely 10 cm. high; carpels 20 or fewer in a loose head; stamens 6 or 9; anthers basifixed.
  b. Summit of nutlet rounded above the beaklet (Figs. 66, 68, 70); stylar beak 0.5 mm. or less long; facial ribs of nutlet present or absent.
    c. Nutlet 0.9–1.1 mm. long; stylar beak nearly absent; anther 0.2–0.6 mm. long.
      d. Facial ribs well developed (Fig. 66) .... *E. tenellus* var. *tenellus*.
      d. Facial ribs nearly or quite suppressed (Fig. 68). *E. tenellus* var. *ecostatus*.
    c. Nutlet 1.4–1.8 mm. long; stylar beak 0.2–0.5 mm. long (Fig. 70); anther 0.5–1.0 mm. long .... *E. tenellus* var. *latifolius*.
  b. Summit of nutlet horizontal or sloping downward from the beaklet (Fig. 71); stylar beak 0.6–0.7 mm. long; facial ribs of nutlet nearly or quite obsolete .... *E. magdalenensis*.
a. Robust plants usually 50 cm. or more high; carpels many in dense heads; stamens 9–30; anthers versatile.
  e. Leaves with blades more or less cordate at base (Figs. 10–12); petiole terete or fluted but not 2-winged; leaves mostly stellate-pubescent or muricate about summit of petiole and base of blade.
    f. Flowers long-pedicelled.
      g. Blades with pellucid dots (Fig. 56). . *E. grandiflorus* var. *grandiflorus*.
      g. Blades without pellucid markings.
        h. Inflorescence erect, often compound, with pedicels reaching 3 cm. in length .... *E. muricatus*.
        h. Scape creeping, simple, sometimes 2 m. long, rooting at nodes and sometimes proliferous, with erect pedicels sometimes reaching 7 cm. .... *E. fluitans*.
    f. Flowers nearly sessile.
      i. Leaves with very short pellucid lines (Fig. 60) and stellate hairs. *E. bracteatus* var. *bracteatus*.
      i. Leaves glabrous and without pellucid markings. *E. bracteatus* var. *efenestratus*.
  e. Blades tapered (Figs. 18–21) or truncate (Fig. 17) at base; petioles 2-winged.
    j. Veins radiating from the base of the blade (Figs. 17–20); internodes of inflorescence sharply keeled but not winged .... *E. paniculatus*.
    j. Upper pair of veins running parallel to the midrib for some distance (Fig. 21); internodes of inflorescence with 3 herbaceous wings about 2 mm. wide .... *E. trialatus*.

Volume 57, no. 678, including pages 161–188, was issued 11 July, 1955.

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Vol. 57 August, 1955 No. 680

CONTENTS:

The New England Botanical Club, Inc.

8 and 10 West King St., Lancaster, Pa.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of the Gray's Manual Range and regions floristically related. Price, $4.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) of not more than 24 pages and with 1 plate, 40 cents, numbers of more than 24 pages or with more than 1 plate mostly at higher prices (see 3rd cover-page). Back volumes can be supplied at $4.00. Some single numbers from these volumes can be supplied only at advanced prices (see 3rd cover-page). Somewhat reduced rates for complete sets can be obtained on application to Dr. Hill. Notes and short scientific papers, relating directly or indirectly to the plants of North America, will be considered for publication to the extent that the limited space of the journal permits. Illustrations can be used only if the cost of engraver's blocks is met through the author or his institution. Forms may be closed five weeks in advance of publication. Extracted reprints, if ordered in advance, will be furnished at cost.

Address manuscripts and proofs to Reed C. Rollins,
Gray Herbarium, 22 Divinity Ave., Cambridge 38, Mass.

Subscriptions (making *all remittances* payable to RHODORA) to

Dr. A. F. Hill, 8 W. King St., Lancaster, Pa., or, preferably, Botanical Museum, Oxford St., Cambridge 38, Mass.

Entered as second-class matter March 9, 1929, at the post office at Lancaster, Pa., under the Act of March 3, 1879.

Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 57 **August, 1955** **No. 680**

CHROMOSOME NUMBERS IN THE GENUS SESBANIA (LEGUMINOSAE): EVIDENCE FOR A CONSERVATIVE TREATMENT

B. L. TURNER

Sesbania is a genus with approximately 50 species occurring in the warmer areas of both hemispheres, particularly in wet habitats. In many parts of the world some of the species are used extensively as green manures for soil improvement. In Texas the native species have become troublesome weeds in irrigated rice fields.

The genus has been treated in various ways by taxonomists ever since its initial description in 1777. Pollard (1897), Rydberg (1923), and Jacobs (1941) have reviewed some of the pertinent literature, hence only a brief summary of its taxonomic history will be given here.

Bentham and Hooker (1865) recognized the genus as having three distinct subgenera or sections: (1) Eusesbania, (2) Daubentonia, and (3) Glottidium. Taubert (1891) treated *Sesbania* in Engler and Prantl's Pflanzenfamilien in the same fashion, recognizing these three subgenera. A similar treatment was followed by most workers until Small (1903), in treating the four species found in the United States, recognized the subgenera as distinct genera, thus re-establishing the names *Sesban* (= *Sesbania* proper—composing the subgenus Eusesbania as treated above), *Agati* (included by most workers in Eusesbania), *Daubentonia*, and the monotypic genus *Glottidium*.

Small's treatment was based primarily on fruit differences among the various taxa: *Sesbania* (including *Agati*) with linear, many-seeded, non-winged legumes; *Daubentonia* with thickened, several-seeded, four-winged legumes; *Glottidium* with thin, two-seeded legumes, the seeds remaining in a dry, bladdery, bag-like endocarp at maturity.

Phillips and Hutchinson (1921) concluded, in a revision of the African species of *Sesbania* (23 in number), that the genus was best treated semi-conservatively, recognizing in *Sesbania* the subgenera Eusesbania (including Agati) and Daubentonia, but agreeing with Small in his treatment of *Glottidium* as a distinct genus. Again, the principal reason for recognition of the latter taxon was given as legume morphology.

In spite of Phillips and Hutchinson's contribution, Rydberg (1924) maintained the four genera, *Sesbania* (as *Sesban*), *Agati*, *Daubentonia*, *Glottidium*, and, in addition, placed the species *Sesbania longifolia* (Cav.) DC. in a newly created, monotypic genus, *Daubentoniopsis*.

It is obvious that taxonomic workers have not exhibited any degree of unanimity in the recognition of genera or subgenera when evidence has been based on external morphology alone. As a result, Senn (1938), on the basis of three reported chromosome numbers in the genus, hinted at the possible validity for at least some of the segregated genera, stating: "*Sesbania* with n numbers 6, 7, and 16 seems to be in need of thorough study as regards the constitution of the genus . . . The occurrence of three unrelated chromosome numbers in *Sesbania* probably means that some of these species belong in different genera."

Senn counted $2n = 12$ for the single species of *Sesbania* investigated in his study. Unfortunately, as pointed out by Jacobs (1941) and more recently by Rao (1946), Haque (1946), and Sampath (1947), the chromosome numbers of $n = 16$ and $n = 7$ reported by Kawakami (1930), and Krishnaswami and Ayyangar (1935) for the other two species, on which Senn's statement was based, were found to be erroneous. When re-investigated, the correct number for both the species was found to be $2n = 24$. Jacobs added two more species counts in his study, reporting the number $2n = 12$ in both instances.

Heretofore, the following counts had been established for the genus:[1]

[1] Darlington and Janaki-Ammal (1945) list a species, *Sesbania australis*, as having $2n = 30$, and give Kreuter (1930) as the authority. This is undoubtedly an error

FIGURES 1–3. Camera lucida drawings of the meiotic chromosomes in *Sesbania* spp. 1. *S. exaltata*, 1a. Univalents indicated by arrows. 1b. Univalents paired but without chiasmata. 2. *S. drummondii*. 3. *S. vesicaria*. (× 2000).

SPECIES	2n	AUTHORITY
Eusesbania		
S. sesban (= *S. aegyptiaca*)	12	Haque; Jacobs; Rao; Sampath
S. speciosa	12	Jacobs; Sampath
S. punctata	12	Frahm-Leliveld (1953)
S. bispinosa (= *S. aculeata*)	12, 24	Haque; Jacobs; Rao; Sampath
S. exaltata (= *S. macrocarpa*)	12	Atchison (1949); Turner (Present paper)
S. marginata	12	Castronova (1945)
S. sericea	24	Frahm-Leliveld
Agati		
S. grandiflora	24	Haque; Jacobs; Rao; Sampath; Tjio (1948)
Daubentonia		
S. punicea	12	Covas and Schnack (1946)
S. tetraptera	12	Senn

---

since reference to the publication cited shows that there is no *Sesbania* mentioned in Kreuter's paper; the report is for *Carmichaelia australis*, which is properly listed by D. & J. on page 163.

From the above tabulation, the basic number, $x = 6$, can be inferred for the genus. The species counted include two of the usually accepted subgenera, Eusesbania and Daubentonia, as well as *S. grandiflora*, which is sometimes separated from Eusesbania and placed in the monotypic subgenus or genus, *Agati*.

In the present paper, chromosome numbers are reported for three species native to the United States, including *S. vesicaria*, the monotypic member of the subgenus Glottidium. The counts were made from P.M.C. smears. Buds were collected in 4 chloroform : 3 absolute alcohol : 1 glacial acetic acid and allowed to remain for several hours. Young anthers were subsequently removed and squashed in acetocarmine. Attempts to obtain satisfactory root-tip squashes were unsuccessful.

Below are listed the sources of materials and corresponding n chromosome numbers of the species examined.[2]

SPECIES	SOURCE	n
Eusesbania		
S. exaltata (Raf.) Cory	Texas. Travis Co.: Austin (Grown from seed collected in Austin, Texas). Aug. 17, 1954. Turner 3655.	$6(5_{II}2_{I})$
Daubentonia		
S. drummondii (Rydb.) Cory	Texas. Galveston Co.: 2 mi. N.W. of Texas City. Aug. 8, 1953. Turner 3149.	6
Glottidium		
S. vesicaria (Jacq.) Ell.	Texas. Travis Co.: Austin. (Grown from seed collected in Giddings, Texas) Aug. 17, 1953. Turner 3656.	6

Smears from a number of plants of *S. exaltata* consistently showed five bivalents and two univalents at first metaphase (Fig. 1). Similar meiotic configurations were reported for *S. sesban* and *S. bispinosa* by Jacobs. All three of these species belong to the subgenus Eusesbania. *S. drummondii* and *S. vesicaria* both showed 6 bivalents at metaphase. Chromosome morphology appeared similar in the three species examined.

Discussion

Rollins (1953) has briefly discussed the value and limitations of chromosome numbers in the circumscription of plant taxa.

[2] Voucher specimens have been deposited in The University of Texas Herbarium, Austin, Texas.

He points out that chromosome numbers are valuable evidence for taxonomic purposes in some cases and of little or no importance in others. The genera in the Leguminosae are notable for their constancy. It was only natural that Senn raised the question of possible generic validity for those taxa thought to have different numbers. Re-examination of these species and counts of additional members of all proposed generic segregates, except the recently proposed *Daubentoniopsis*, shows the base number to be $x = 6$.

The constancy of chromosome numbers in *Sesbania* does not necessarily mean the segregate taxa are not "good" genera; on the other hand it does indicate that there is no cytologic evidence to justify their segregation. The author agrees with Rollins when he states, ". . . chromosomes provide essentially the same kind of evidence to be derived from other parts of the plant." *Sesbania*, then, has another character that links the subgenera together in a single taxon, giving support to such legume workers as Bentham and Taubert who considered external morphological features alone in their world-wide treatments of this genus. It appears that where generic segregation has been proposed for these taxa by recent American workers there has been a tendency to place excessive weight on the characters of the mature pod. From the standpoint of total morphology in the various subgenera, the sum of their resemblances far exceeds their differences.

It is hoped that future genetical work and comparative studies (embryological and anatomical) will be forthcoming so that a more complete synthesis of information will be available from which to draw taxonomic conclusions. Until such additional work is completed it seems best to treat the proposed segregates as subgeneric taxa in *Sesbania*.

Summary

Chromosome counts of $n = 6$ for three species of *Sesbania* are reported: *S. exaltata*, *S. drummondii*, *S. vesicaria*. These species belong to the respective subgenera Eusesbania, Daubentonia, and Glottidium. Previous chromosome reports for the genus have been reviewed. From established counts, a base number of $x = 6$ may be inferred for the genus. Until more evidence is forthcoming, it has been concluded that the genus *Sesbania*

is best treated as containing the subgenera, Daubentonia and Glottidium, as well as the other generic segregates that have been proposed by various authors.—THE PLANT RESEARCH INSTITUTE, THE UNIVERSITY OF TEXAS, AUSTIN, TEXAS, AND THE CLAYTON FOUNDATION FOR RESEARCH.

Literature Cited

Atchison, E. 1949. Chromosome numbers and geographical relationships of miscellaneous Leguminosae. J. Elisha Mitchell Sci. Soc. **65**: 118–130.

Bentham, G. and J. D. Hooker. 1865. *Sesbania*. Gen. Pl. **1**: 502.

Castronova, A. 1945. Estudio cariologico de doce especies de Leguminosas Argentinas. Darwiniana **7**: 38–58.

Covas, G. and B. Schnack. 1946. Numero de chromosomas en autofitas de la region de Cuyo (Republica Argentina). Rev. Argent. Agron. **13**: 153–166.

Darlington, C. D. and E. K. Janaki-Ammal. 1945. Chromosome Atlas of Cultivated Plants. London.

Frahm-Leliveld, J. A. 1953. Some chromosome numbers in tropical leguminous plants. Euphytica **2**: 46–48.

Haque, A. 1946. Chromosome numbers in *Sesbania* spp. Cur. Sci. **15**: 78.

Jacobs, K. T. 1941. Cytological studies in the genus *Sesbania*. Bibliographia Genetica **13**: 225–297.

Kawakami, J. 1930. Chromosome numbers in Leguminosae. Bot. Mag. Tokyo **44**: 319–328.

Kreuter, E. 1930. Beitrag zu karyologisch—systematischen studien an galegeen. Planta **11**: 1–44.

Krishnaswami, N. and G. N. Rangaswami Ayyangar. 1935. Chromosome numbers in *Sesbania grandiflora* Pers. Cur. Sci. **3**: 488.

Phillips, E. P. and J. Hutchinson. 1921. A revision of the African species of *Sesbania*. Bothalia **1**: 40–64.

Pollard, C. L. 1897. Studies in the flora of the central gulf region. I. Bull. Torr. Bot. Club. **24**: 151–154.

Rao, Y. S. 1946. Chromosome numbers in *Sesbania*. Cur. Sci. **15**: 78.

Rollins, R. C. 1953. Cytogenetical approaches to the study of genera. Chronica Botanica **14**: 133–139. (Part of a symposium on PLANT GENERA, their nature and definition.)

Rydberg, P. A. 1923. Genera of North American Fabaceae I. Tribe Galegeae. Am. Jour. Bot. **10**: 485–498.

Rydberg, P.A. 1924. Sesbanianae. N. Amer. Fl. **24**: 202–209.

Sampath, S. 1947. Chromosome numbers in *Sesbania* spp. Cur. Sci. **16**: 30–31.

Senn, H. A. 1938. Chromosome number relationships in the Leguminosae. Bibliographia Genetica **12**: 175–336.

Small, J. K. 1903. Flora of the Southeastern United States. New York.

Tjio, J. H. 1948. The somatic chromosomes of some tropical plants. Hereditas 34: 135–146.

CYTOTAXONOMIC OBSERVATIONS ON NORTH AMERICAN FERNS[1]

WARREN H. WAGNER, JR.

DURING the last five years several contributions to our knowledge of the cytotaxonomy of North American ferns have been made. A list by Britton (1953) of thirty chromosome determinations of ferns collected in southern Ontario was followed by a report on the cytology of the *Dryopteris spinulosa* complex by Manton and Walker (1953), and later by a study of the Appalachian Aspleniums by the writer (1954). The present paper records a number of additional records based largely on plants of Michigan (Table I).

It seems desirable at this time to make a résumé (Table II) of our present knowledge of the chromosomes of North American ferns, and to point out, at least in some cases, where changes or modifications are suggested by the new evidence. The results thus far have yielded a number of taxonomic facts which may be expected to modify some of the concepts of relationship which have traditionally prevailed. A "progress report" pertaining to North American ferns is especially appropriate at this time since two important new revisions of northeastern American ferns have recently appeared, namely those of Gray's Manual of Botany, 8th ed. (Fernald, 1950), and the new Britton and Brown Illustrated Flora (Morton, *in* Gleason, 1952), two revisions which differ from each other quite significantly in a number of taxonomic interpretations and which thus strongly point up the need for new information. While groups of species in certain of our genera, such as *Dryopteris sens. str.* and *Asplenium*, form natural species complexes of considerable appeal to the cytotaxonomist, there are single, isolated species also, such as *Onoclea sensibilis* and *Pteretis pensylvanica*, which warrant attention because of their taxonomic interest at the generic and familial levels of classification. Of our sizeable species-groups, the knowledge of our native *Dryopteris*, *Asplenium*, and *Botrychium* species is being rapidly filled in. Notably absent, however, are data on such important and problematic indigenous assemblages as *Cheilanthes* and *Woodsia*. Of single, isolated

[1] **This study was made possible by a Summer Faculty Research Fellowship awarded by the Horace H. Rackham School of Graduate Studies, University of Michigan.**

species, there are certain ones which particularly invite study, notably such plants as *Lygodium palmatum*, *Pityrogramma triangularis* and its forms, and *Trichomanes boschianum*. That *Schizaea pusilla*, a disjunct species which occurs along the eastern seaboard, may have interesting cytological conditions is suggested by Selling's finding (1944) that its spores exist in two size groups.

Several of the most important types of evidence that have emerged from the study of chromosomes of ferns should be briefly mentioned. First, the data suggest that a given basic number will tend to be constant in large, related assemblages, and that "aneuploidy tends to characterize the relation between genera or groups of genera rather than between species." (Manton, 1950). For example, the *Asplenium* group apparently has a base number which is uniformly 36, while the two genera *Dryopteris* and *Polystichum* have 41, *Athyrium* has 40, and *Cystopteris* 42. Therefore, the determination of chromosome numbers may affect decisions concerning the validity of certain genera, such as *Gymnocarpium* which Morton maintained as distinct from *Dryopteris* but which Fernald did not. The general problem of generic interpretation in the assemblage formerly construed as belonging to one large genus "Dryopteris" has assumed special significance since Holttum's proposal that some of its elements may be so distinct as to represent a separate family, the Thelypteridaceae. This problem will be discussed further below. Another type of evidence possible from cytological studies of ferns bears on whether or not a given taxon is of hybrid origin. Such endemic plants as *Cystopteris fragilis* var. *simulans*, *Botrychium minganense*, and *B. oneidense* have certain seemingly intermediate morphological traits which lead one to suspect that they may have arisen by hybridization between other species. In sterile hybrids the behavior of the chromosomes at the time of spore production may sometimes lead to knowledge of their parents. In fertile hybrids, the chromosome complement may be double that of the parents, i.e., allopolyploids. A third type of evidence associated with chromosomes relates to the evaluation of subspecies or varieties. Thus Britton (op. cit.) has shown that the rare native American variety of the hart's-tongue fern, *Phyllitis scolopendrium* var.

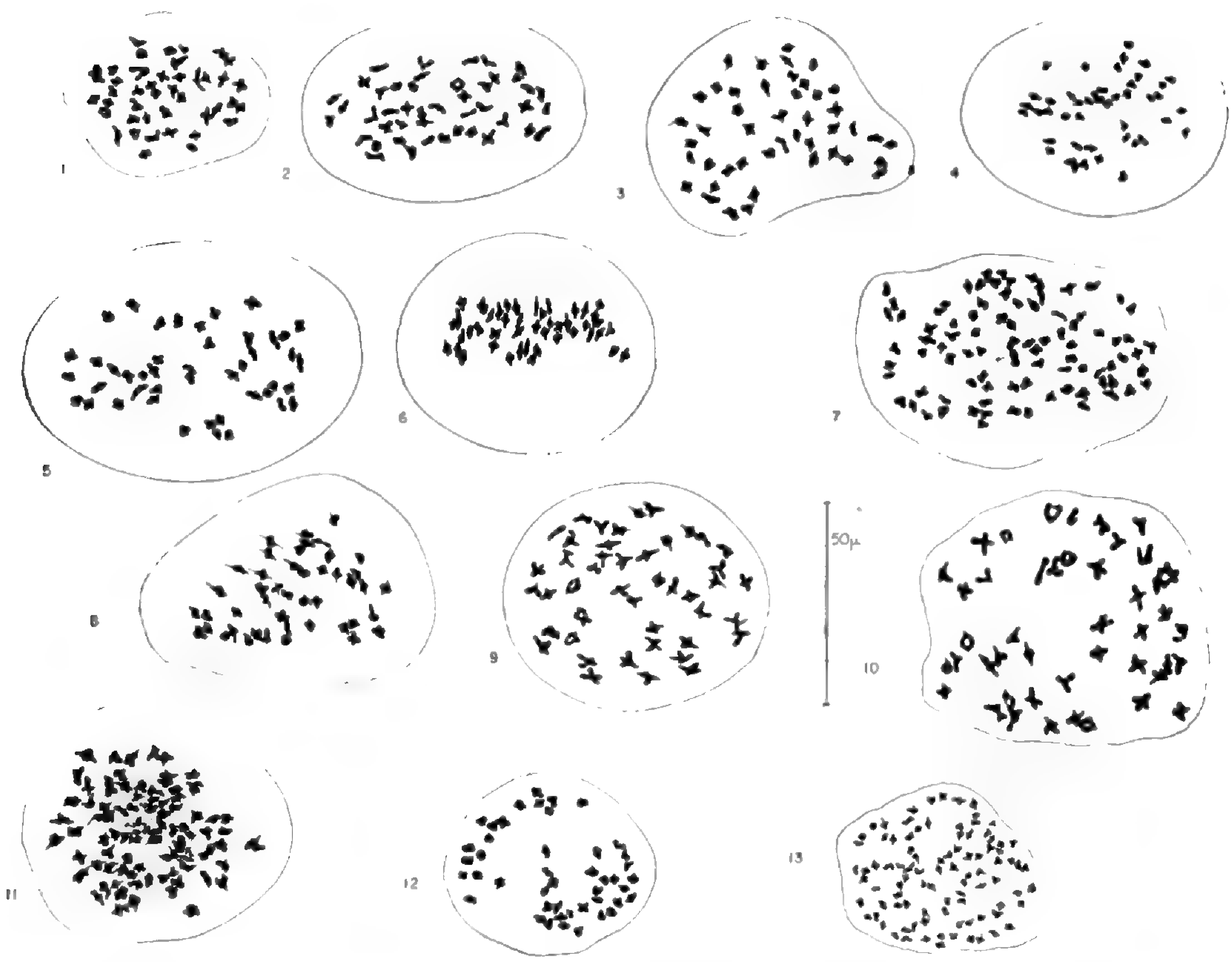


Fig. 1, Botrychium multifidum, Cheboygan Co., Mich. (Wiegand); Fig. 2, B. multifidum, Alpena Co., Mich.; Fig. 3, B. oneidense, Jackson Co., Mich.; Fig. 4, B. oneidense, Saginaw Co., Mich.; Fig. 5, B. dissectum f. dissectum, Saginaw Co., Mich.; Fig. 6, B. dissectum f. obliquum, Saginaw Co., Mich.; Fig. 7, B. lunaria var. onondagense, Emmet Co., Mich. (Voss); Fig. 8, B. simplex var. tenebrosum, Washtenaw Co., Mich.; Fig. 9, B. simplex var. simplex, Washtenaw Co., Mich.; Fig. 10, B. pumicola, Klamath Co., Oregon (R. D. Brown); Fig. 11, B. matricariaefolium, Livingston Co., Mich.; Fig. 12, B. lanceolatum, Emmet Co., Mich. (Voss); Fig. 13, B. virginianum, Washtenaw Co., Mich.

americanum, possesses the tetraploid condition, in contrast to the typical European plant which is a diploid.

I am indebted to a number of people for their interest and assistance in this project. In particular, I wish to acknowledge the expert help of Mr. Dale J. Hagenah, of the Cranbrook Institute of Science, who has contributed numerous living specimens for study, and Mr. Walter F. Kleinschmidt and the Staff of the Botanical Gardens of the University of Michigan, who have cultivated the living plants. Thanks are due also to those who supplied material, either fixed cytological specimens or living plants, unavailable in the immediate vicinity of Ann Arbor, including Mr. Donald F. M. Brown, Mr. Richard M.

Brown, Dr. Edward G. Voss, Miss Florence M. Wiegand, Dr. Edgar T. Wherry, and Dr. Carroll E. Wood.

Methods: Leaflets or other fertile parts were collected in the field or in the greenhouse and put in Newcomer's solution (Newcomer, 1953) prior to squashing in aceto-orcein. Some of the earlier collections were fixed in a modification of Carnoy's solution (4 parts chloroform, 3 parts alcohol, 1 part glacial acetic acid). The results were essentially the same but the material seemed to last in a condition suitable for squashing for a longer period in Newcomer's solution. For members of the genus *Botrychium* it was desirable to crush and macerate masses of sporangia in the aceto-orcein on a microscope slide, and then to remove the large pieces of debris before adding the cover-slip. In addition, it was found effective to dry the outer surfaces of the *Botrychium* sporangia first before placing them in the stain, as this reduced the tendency toward precipitation. In all cases the top of the cover-slip was tapped with the point of a dissecting needle in order to spread out the sporocytes for pressing. The slide was heated nearly to boiling, and then pressed repeatedly with the forefinger on the surface of the cover-slip. In selecting cells to study, those which appeared to be intact, i.e., with unfragmented margins, were chosen. For each collection several perfect cells were carefully drawn with camera lucida at approximately 1450 times magnification using an oil-immersion objective, and a 15X widefield ocular. Using this technique, the size of the flattened cell cannot, of course, be controlled. However, those cells in which the chromosomes were most spread out were usually selected, although sometimes only slightly flattened cells showed chromosomes clearly and were used (cf. figs. 17 and 18). The voucher specimens are deposited in the Department of Botany, University of Michigan. They were made of the same plants or, in some cases, of plants from the same clone or colony, by mounting a leaf or leaves on herbarium sheets and pasting a camera lucida drawing of the chromosomes on the same sheet.

Observations: The genus *Botrychium* was the focus of considerable attention in this study because it was suspected that two of its species (*B. minganense* and *B. oneidense*) might be of hybrid origin. Although a number of species and varieties are reported here for the first time, there still remain several taxa to be investigated. One of the primary difficulties in the study of *Botrychium* is in determining the time of meiosis in a given locality and, because of this, collections from a number of places turned out to be too far advanced in sporogenesis to be of any use in revealing chromosome numbers. Quite clearly in *Botrychium* the monoploid number is usually 45. *Botrychium virginianum* so far appears to be the only exceptional species, having an apparent base number of 46. This species has been found by Britton, in material from southern Ontario, and confirmed by the author from one locality in Michigan, to have a chromosome number of $n = 92$ (fig. 13). The chromosomes themselves appear to be conspicuously smaller than those of the other species of *Botrychium* examined. These cytological differences are interesting in view of the morphological features that characterize this species, such as the thin-textured blade, the partially exposed leaf primordium (the so-called "bud"), and the small sporangia. It will be profitable to determine whether the other members of the subgenus *Osmundopteris*, which, according to Clausen (1938), includes the native *B. virginianum* and four species of other parts of the world, will also reveal the base number 46.

In the subgenus *Sceptridium*, only two varieties of *B. dissectum* have been previously reported upon (Britton, 1953). The question of the related taxon, *B. oneidense* (Gilbert) House, has been an especially vexing one taxonomically since its original description by Gilbert around the turn of the century as a variety of "*Botrychium ternatum*." The latter epithet was used in the past to apply jointly to both *B. dissectum* and to *B. multifidum*, taxa now recognized as wholly distinct species by current authors. However, the plant in question, *B. oneidense*, is at present in the rather paradoxical situation of being interpreted by one author (Fernald, 1950) as a form of *B. dissectum* (*B. dissectum* forma *oneidense* (Gilbert) Clute), and by another (Morton, 1952) as a variety of the other species, *B. multifidum* (*B. multifidum* var. *oneidense* (Gilb.) Farwell). However, Fernald (op. cit., p. 21) describes the plant in question as being "embarrassingly transitional" between *B. dissectum* and *B. multifidum;* and Morton (p. 18) calls it "intermediate

TABLE I. Chromosome Numbers[4]

	n
Ophioglossaceae	
Botrychium multifidum (Gmel.) Rupr.	
Levi Bur's farm, Cheboygan Co., Mich., June 26 (F. M. Wiegand)	45
Williams Lake Rd., Oakland Co., Mich., June 19	45
Sharon Hollow, Washtenaw Co., Mich., June 22	45
Lime sinks near Leer, Alpena Co., Mich., July 3 (D. J. Hagenah)	45
B. oneidense (Gilbert) House	
Waterloo-Munith Rd., Jackson Co., Mich., July 18	45
Jackson Rd., s. of Chelsea, Washtenaw Co., Mich., July 30	45
S of Frankenmuth, Saginaw Co., Mich., July 31	45
B. dissectum Spreng. f. obliquum (Muhl.) Fern.	
U. of Mich. Arboretum, Ann Arbor, Washtenaw Co., Mich., July	45
S of Frankenmuth, Saginaw Co., Mich., July 31	45
B. dissectum Spreng. f. dissectum	
S of Frankenmuth, Saginaw Co., Mich., July 31	45
B. lunaria (L.) Sw. var. onondagense (Underw.) Clute	
Mackinaw City, Emmet Co., Mich., May 15 (E. G. Voss)	ca. 90
B. simplex E. Hitch. var. tenebrosum (A. A. Eat.) Clausen	
Mud Lake, Washtenaw Co., Mich., May 10	45
B. simplex E. Hitch. (typical)	
Silver Hill Rd., near hdqtrs., Pinkney Area, Washt. Co., May 14	45
Oakwood Rd., near Sashabow Rd., Oakland Co., Mich., June 19	ca. 45
B. pumicola Coville	
Llao Rock, Crater Lake, Klamath Co., Oregon, June 19 (R. D. Brown)	45
B. matricariaefolium A. Br.	
2 mi. w. of Howell, Livingston Co., Mich., May 7	ca. 90
Silver Hill Rd., near hdqtrs., Pinkney Area, Washt. C., May 14	ca. 90
Maple River Twp., Emmet Co., Mich., May 15 (E. G. Voss)	ca. 90
B. lanceolatum (Gmel.) Angst. ssp. angustisegmentum (P. & M.) Clausen	
Maple River Twp., Emmett Co., Mich., May 15 (E. G. Voss)	45
B. virginianum (L.) Sw.	
Hankerd Rd., Pinkney Area, Washtenaw Co., Mich., May 15	92
"Polypodiaceae"	
Pteridium aquilinum (L.) Kuhn var. pseudocaudatum (Clute) Heller	
1.5 mi. s. of Lillington on Route 15A, Harnett Co., N. C., gh, July 28 (C. E. Wood)	52
Onoclea sensibilis L.	
Jackson Rd., s. of Chelsea, Washtenaw Co., Mich., July 29	37
Cystopteris bulbifera (L.) Bernh.	
Paint Creek, Ross Co., Ohio, gh, Sept. 5 (D. F. M. Brown)	42
Oxford 40, Oakland Co., Mich., June 17	42
C. fragilis (L.) Bernh.	
Lake Michigamme, Marquette Co., Mich., gh, April (D. J. Hagenah)	84
Grand Ledge, Eaton Co., Mich., gh, May 16 (D. F. M. Brown)	84
C. dickieana Sim	
Mt. Bohemia, Keweenaw Co., Mich., gh, July 19 (D. J. Hagenah)	84
C. fragilis var. tennesseensis (Shaver) McGregor	
Fayette, Delta Co., Mich., gh, July 19, 20 (D. J. Hagenah)	126
Trout Lake, Chippewa Co., Mich., gh, Aug. 13 (D. J. Hagenah)	126
C. fragilis var. simulans (Weatherby) McGregor	
Catoctin Furnace, Frederick Co., Md., gh, June 17 (E. T. Wherry)	ca. 84
Bernville, Berks Co., Penn., gh, July 26 (E. T. Wherry)	84
Thelypteris (Phegopteris) hexagonoptera (Michx.) Weatherby	
Sharon Hollow, Washtenaw Co., Mich., June 22	30
Pine Lake, Hope Twp., Berry Co., Mich., June 25 (D. J. Hagenah)	30
Jackson Rd., s. of Chelsea, Washtenaw Co., Mich., July 4	30

[4] Where chromosome determinations were made from materials grown in the greenhouse, the date of meiosis is probably not significant, so those cases where greenhouse plants were used are indicated by "gh".

TABLE I.—*Continued*

T. noveboracensis (L.) Nieuwl.	
Waterloo-Munith Rd., Jackson Co., Mich., June 25	27
Podunk, Barry Co., Mich., June 29 (D. J. Hagenah)	27
Jackson Rd., s. of Chelsea, Washtenaw Co., Mich., July 4	27
Proud Lake, Oakland Co., Mich., July 11	27
T. palustris Schott. var. pubescens (Lawson) Fern.	
M92, near Green Lake, Waterloo Area, Washt. Co., Mich., July 16	35
Athyrium filix-femina (L.) Roth var. michauxii Mett.	
Sharon Hollow, Washtenaw Co., Mich., July 2	40
A. thelypteroides (Michx.) Desv.	
Sharon Hollow, Washtenaw Co., Mich., July 2	40
Jackson Rd., s. of Chelsea, Washtenaw Co., Mich., July 4	40
A. pycnocarpon (Spreng.) Tidestr.	
Sharon Hollow, Washtenaw Co., Mich., August 3	40
Woodwardia (Anchistea) virginica (L.) Sm.	
Mud Lake, Washtenaw Co., Mich., July 10	35
Near Stockbridge, Ingham Co., Mich., July 13	35
Olson, Midland Co., Mich., July 31	35
W. (Lorinseria) areolata (L.) Moore	
Eastern North Carolina (plant in U. of N. C. greenhouse), Aug. 15 (C. E. Wood)	35
Asplenium ruta-muraria L. var. cryptolepis (Fern.) Wherry	
Sunfish Creek, Pike Co., Ohio, gh, May 23 (D. F. M. Brown)	72

between *B. multifidum* . . . and *B. dissectum* var. *obliquum* and possibly a hybrid between them." Obviously it was especially desirable to determine whether or not there was cytological evidence of hybridity in the presumed intermediate.

To this end, materials of *B. multifidum* were studied from four different counties of Michigan, of *B. oneidense* from three counties, and of *B. dissectum* from two counties. For all three of the basic taxa under discussion the chromosome number proved to be $n = 45$, as determined in meiosis, There was no evidence of hybridity, either in irregular pairing or polyploidy, in the materials of *B. oneidense* which were unquestionably typical of this taxon (cf. figs. 1–6). For this reason, and because of numerous field observations which Mr. Hagenah and the writer have made of the members of this complex in the field, I believe that *B. oneidense* merits interpretation as a distinct species, and that the current concepts of this entity (a) as a variety or form of *B. dissectum*, (b) as a variety or form of *B. multifidum*, or (c) as a hybrid between them, may be erroneous. The hybrid hypothesis especially does not seem to be supported by cytological evidence. Furthermore, all three entities have been found to co-exist in the same locality without evidence of intergradation and the presumed "intermediate" does not seem really to be intermediate. It is hoped that in the near future a detailed analysis of the problem of *B. oneidense* can be presented.

In the subgenus *Eubotrychium*, only the European form of *Botrychium lunaria* has been reported (Manton, op. cit., $n = 45$). In North America, the major taxonomic problem involving this subgenus appears to the writer to be the plant described as *B. minganense* Victorin, which was treated by subsequent authors as merely a variety or form of *B. lunaria*. Although its author described it as a distinct species, Clausen (1938) reduced it to varietal status under *B. lunaria*, stating (p. 68) that "collections from Michigan, Alberta, and various places in the Rocky mountains indicate that, at least in those areas, a complete transition occurs." Morton (1952) also interprets *B. minganense* as a variety of *B. lunaria*, and writes (p. 16) that it is "scarcely distinguishable from the typical variety" of *B. lunaria;* Fernald (1950, p. 22) treats it simply as a form.

Our interest in *B. minganense* has become heightened by a number of field studies which indicate that the Michigan representative is clearly a distinct entity, capable of living sympatrically with typical *B. lunaria* and entirely without transition. In some respects it appears to be intermediate between *B. lunaria* and *B. matricariaefolium*. Although we are still unable to report a chromosome count in *B. minganense*, its spores have been reported to be larger than those of *B. lunaria*, suggesting that it may be a polyploid. However, the latter possibility is complicated now by the fact that the single population of *B. lunaria* which has been studied turned out to be a polyploid itself, with approximately 90 pairs of chromosomes at meiosis. It should be emphasized in this case that the material, from Emmet Co., Mich., represents the endemic variety, *B. lunaria* var. *onondagense*, and material wholly typical of *B. lunaria* from North America has not yet been examined. The problem of chromosome numbers in the *B. lunaria* group is therefore recommended to workers in various places in the area of occurrence of these taxa, roughly from Labrador to Alaska and California, east to northern Wisconsin and Michigan. *B. matricariaefolium* has yielded approximately 90 pairs of chromosomes in the three populations examined, so it is polyploid like *B. lunaria* var. *onondagense*.

The two extreme varieties of *Botrychium simplex* which occur most commonly in Michigan have such different habitats and aspects that it was suspected that they might prove to be different cytologically. *Botrychium simplex* var. *tenebrosum* is normally a plant of deep shady woods in swamps, whereas *B. simplex* of the typical variety occurs usually in open fields on hillsides in relatively dry habitats. Cytologically, however, the two varieties proved to be indistinguishable (figs. 8 and 9). The closely related *B. pumicola*, a rare and local species known only from a couple of localities in Oregon and California, was found also to be like typical diploid Eubotrychiums in its cytology (fig. 10).

Eubotrychium sect. *Lanceolatae* Clausen comprises a single species, *B. lanceolatum*, which is represented in the northeastern United States primarily by its variety *angustisegmentum*. Specimens of the latter from Emmet Co., Michigan, showed chromosome complements which were indistinguishable from those of members of Subgenus *Sceptridium* and Sect. Lunariae (fig. 12).

Onoclea: The genus *Onoclea* is monotypic and its single species, *O. sensibilis*, occurs both in eastern North America and in eastern Asia. In morphology it is a unique genus and the generic relationships are not clear, although, as pointed out by Britton (op. cit), it has been placed in close proximity to *Pteretis*. This interpretation rests largely on the fact that the sporangia are produced on much-modified fertile fronds. Britton has found $n = 37$ in Canadian plants, with a possible error in interpretation of not more than one bivalent. The writer determined 37 pairs in clear preparations of material from Washtenaw Co., Mich., thus adding more certainty to this number. The large-sized chromosomes of *Onoclea* are distinctive, and Fig. 15 shows a cell which is only slightly flattened and in which the chromosomes themselves have apparently not been flattened at all. Britton points out that since the chromosome number of *Pteretis pensylvanica* is 40, the plants are probably not closely related. Research on the comparative morphology and anatomy of these two genera is strongly recommended, to see especially whether they might have acquired their similar-appearing fertile fronds through parallel evolution from unrelated ancestors in which the fronds are monomorphic.

Pteridium: Typical plants of *Pteridium aquilinum* (L.) Kuhn from Europe were determined by Manton to have a chromosome number of $n = 52$. More recently Britton has reported that the eastern American var. *latiusculum* (Desv.) Underw. has this number likewise; and in the present study a plant of *P. aquilinum* var. *pseudocaudatum* (Clute) Heller collected by Dr. Carroll E. Wood, Jr. near Lillington, N. C., was found also to have $n = 52$ (fig. 14).

Cystopteris: Some years ago, Mr. Weatherby (1935) discussed the forms of the *Cystopteris fragilis* complex in eastern North America, and he showed that there are a number of distinct varieties, including a taxon he described as forma *simulans* Weath., with leaf cutting like *C. bulbifera.* Since that time two rather important findings have been made: (1) A peculiar "bulblet-bearing" plant which evidently combines characters of *C. fragilis* and *C. bulbifera* has been reported from a very wide area of Kansas to Pennsylvania and the southern shore of Lake Superior (the last localities discovered by D. J. Hagenah and as yet not reported in detail). Bulblet-bearing plants were named *C. tennesseensis* by Shaver (1950) and plants somewhat like them had been reported earlier by Wherry (1944) and Wagner (1944). Since then, McGregor (1950) has reduced *C. tennesseensis* to varietal status under *C. fragilis,* and he points out that it differs from var. *simulans* (Weath.) McGregor primarily in having minute white glands and narrower pinnae. It is now known that both forms have "bulblets" along the rachis and occasionally along the costae of the pinnae, although var. *simulans* commonly lacks them. All the authors concerned with the relationships of these plants in recent years have suggested hybridity, especially on the basis of the "bulblets" (which, however, are morphologically quite different from those of *C. bulbifera*)[2]. (2) The second recent discovery involves an overlooked American fern, *Cystopteris dickieana* Sim. It has now been recorded from a number of localities where it had previously been undetected because of the microscopic nature

[2] The first mention of bulblets in *Cystopteris fragilis* that I have found is by Pinkerton, M. Elizabeth, 1933, Ferns and Fern Allies of Missouri, Ann. Missouri Bot. Gard. 20: 45–78, who writes (p. 59) under *C. fragilis*, "An exceedingly variable species. Hybridization with *C. bulbifera* might account for some of the aberrations. Forms bearing bulblets have been included under this group as that character does not seem to be a constant feature for *C. bulbifera* alone."

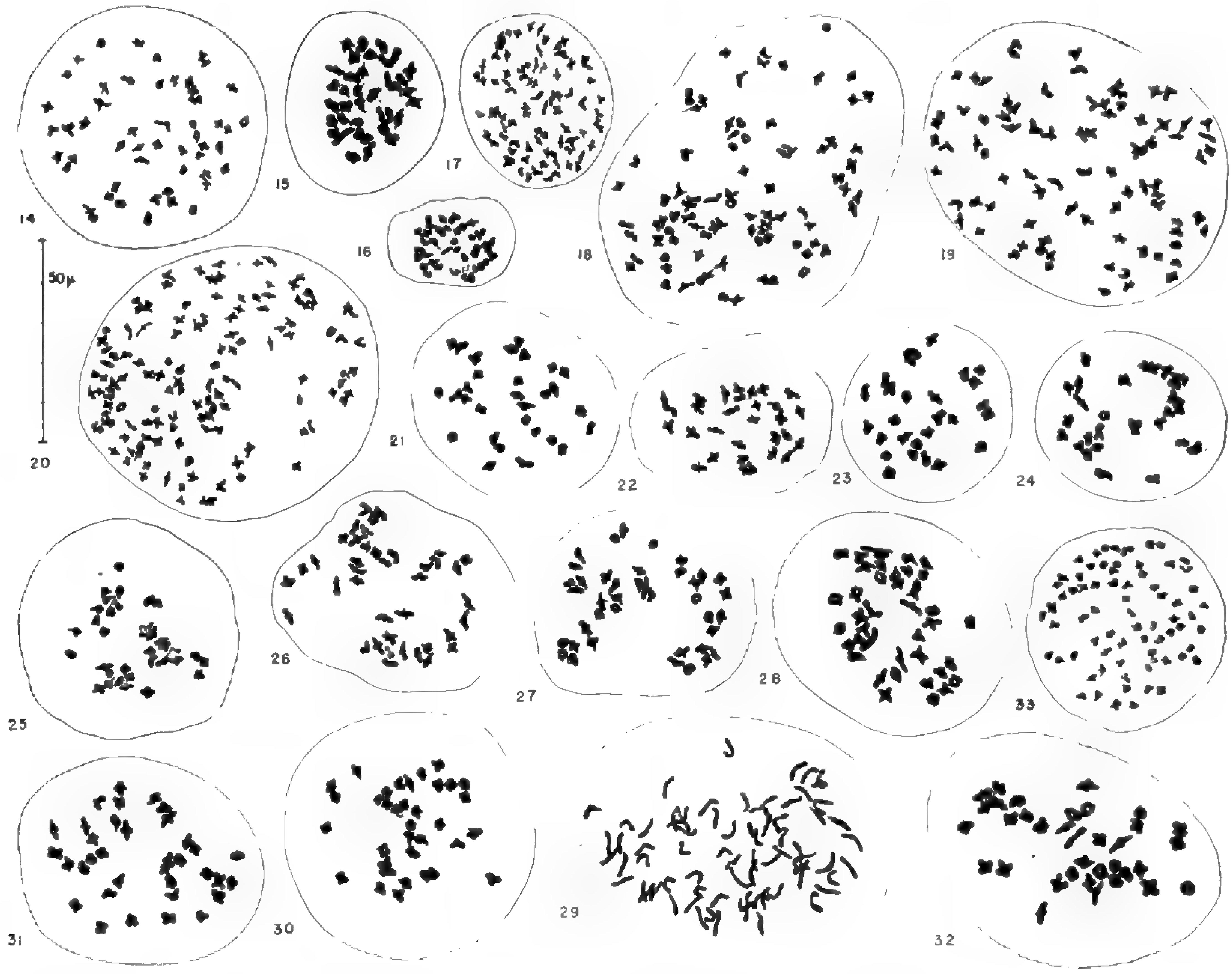


Fig. 14, Pteridium aquilinum var. pseudocaudatum, Harnett Co., N. C. Note: this figure is drawn at approximately two-thirds the magnification of the others, and is not to scale. (C. E. Wood); Fig. 15, Onoclea sensibilis, Washtenaw Co., Mich.; Fig. 16, Cystopteris bulbifera, Ross Co., Ohio (D. F. M. Brown); Fig. 17, C. fragilis, Eaton Co., Mich. (D. F. M. Brown); Fig. 18. C. dickieana, Keweenaw Co., Mich. (D. J. Hagenah); Fig. 19, C. fragilis var. simulans, Berks Co., Penn. (E. T. Wherry); Fig. 20, C. fragilis var. tennesseensis, Delta Co., Mich. (D. J. Hagenah); Fig. 21, Thelypteris hexagonoptera, Washtenaw Co., Mich.; Fig. 22, T. hexagonoptera, Barry Co., Mich. (D. J. Hagenah); Fig. 23, T. noveboracensis, Jackson Co., Mich.; Fig. 24, T. novaboracensis, Oakland Co., Mich.; Fig. 25, T. palustris var. pubescens, Washtenaw Co., Mich.; Fig. 26, Athyrium filix-femina var. michauxii, Washtenaw Co., Mich.; Fig. 27, A. thelypteroides, Washtenaw Co., Mich.; Fig. 28, A. pycnocarpon, Washtenaw Co., Mich.; Fig. 29, Woodwardia virginica, Washtenaw Co., Mich. (somatic division); Fig. 30, the same (meiotic division); Fig. 31, W. virginica, Ingham Co., Mich.; Fig. 32, W. areolata, U. of North Carolina greenhouse (C. E. Wood); Fig. 33, Asplenium ruta-muraria, Pike Co., Ohio (D. F. M. Brown).

of its distinction from typical *C. fragilis*. It differs from the latter species in its spores which are rugose (like those of *Woodsia*, for example) while those of *C. fragilis* are echinate (Alston, 1950). The cytological data to be presented here should be expanded considerably before we may consider our understanding of North American *Cystopteris* to be complete from this standpoint.

However, one point emerges clearly in connection with the presumed hybrids of *Cystopteris* which now favors McGregor's varietal interpretation of the taxa in the "hybrid" group. Cytological studies of *C. fragilis* in Europe and in North America (the latter including the reports of $n = 84$ by Britton and the present writer, fig. 17) show that there is so far no evidence of a low number of 42, such as that found in *C. bulbifera* in material from southern Ontario and from Michigan and Ohio (fig. 16). The European typical *C. fragilis* not only occurs in tetraploid races, but in hexaploid as well. In North America only the tetraploids have been found. A fertile hybrid of *Cystopteris bulbifera* and *C. fragilis,* whether allopolyploid or apogamous, would probably be expected to show at least the hexaploid condition of 126 pairs at meiosis. combining the 84 pairs of *C. fragilis* with the 42 of *C. bulbifera.* But such was not the case in plants that show the "hybrid" characteristics and which conform to McGregor's concept of var. *simulans* collected by Dr. Wherry at Bernville, Berks Co., Pa. (fig. 19) where the number is $n = 84$. In plants like the foregoing from Catoctin Furnace, Frederick Co., Md., the precise number has not been yet determined but it is certainly not more than two bivalents different from 84 pairs. Accordingly, at least two populations do not readily conform to a hybrid hypothesis based on current knowledge of the cytology of the two putative parents as they occur in North America.[3] On the other hand, similar "bulblet-bearing" materials from Fayette, Delta Co., and from Trout Lake, Chippewa Co., Michigan, which fit McGregor's interpretation of var. *tennesseensis* in having many delicate glands on the leaf surfaces have yielded the hexaploid number of chromosomes, showing clearly in a number of preparations 126 pairs at meiosis. The latter are the first reports of hexaploids in the genus as it occurs in North America. The fact that the "hybrids" show two numbers now complicates

[3] The possibility should be recognized, however, that there might exist *now* or might have existed *at some time in the past* more primitive populations of *Cystopteris fragilis* in which the chromosome number was diploid. Thus var. *simulans,* it might be argued, could have arisen from the hybridization of *C. bulbifera* and a diploid *C. fragilis,* and var. *tennesseensis* arose from *C. bulbifera* and a tetraploid *C. fragilis.* (The fact that hexaploids are known in European *C. fragilis* indicates that almost surely there were at one time, at least, diploids in that species.) The wide ranges now known in the "hybrids" make it reasonable that they could have originated in ancient times. The point is that we do not—at present—have direct evidence of diploid *C. fragilis* in any known North American populations.

the picture, but McGregor's interpretation of the "hybrid" plants as comprising two taxa seems to be substantiated.

Of *C. dickieana*, only one population has thus far been studied in North America and this, like the European plants of the same taxon studied by Manton (op. cit., pp. 117–120), yielded $n = 84$ (fig. 18). In the writer's opinion the taxonomic treatment of this plant as a species should be questioned, since up to now I am not aware that it has been shown to differ in more than a single reliable character from *C. fragilis*. It is even conceivable that the difference between rugose and echinate spores in this case depends on merely one or a few genes.

DRYOPTERIS sens. lat.: One of the major taxonomic problems in filicinean classification in general is the proper disposition of the generic groups formerly associated with *Dryopteris* in the broad sense, as illustrated locally by Fernald's treatment (1950, pp. 31–37) which includes widely divergent plants. He states, however, that *Dryopteris* (s.l.) is a "large and very complex world-wide genus, its sections by some considered to form genera." Morton (1952, pp. 48–55) considered the eastern North American species as belonging to three genera, viz. *Thelypteris* (syn. *Lastrea* of Copeland, 1947), *Gymnocarpium*, and *Dryopteris* s.s., and he has given his reasons for this interpretation elsewhere (Morton, 1950, pp. 214–218). The most radical treatment of the generic groups is that of R. E. Holttum (1946, pp. 130–133) mentioned above, in which the *Thelypteris* group is interpreted as a distinct family, *Thelypteridaceae*, demarcated from the *Dryopteris* s. s. group which he deals with as a subfamily (Dryopteridoideae) of his Dennstaedtiaceae. Such a seemingly "violent" interpretation will no doubt surprise many taxonomists versed in traditional fern classification, but the cytological evidence accumulated thus far appears indeed to warrant a sharp division of some sort between these generic groups. Manton has recently concluded (1954, pp. 16–17) that "there is very clear evidence that Copeland's Aspidiaceae is polyphyletic at least to the extent that the *Thelypteris* group of genera with $n = 31$, 34, 35, and 36, are wholly discordant, the rest of the 'family' being all based on 40, 41, or 42. Holttum's new family of Thelypteridacea is therefore strongly supported." With this in mind, the comments in the following discussion will be divided into two parts, the first concerning the *Thelypteris* group and the second the *Dryopteris* group.

The chromosome number of the North American representative of the type species of *Thelypteris* (*T. palustris* var. *pubescens* (Lawson) Fernald) has been reported as $n = 35$ by Britton in Canadian material, and is confirmed by the writer on material from Washtenaw Co., Michigan (fig. 25). The two new numbers to be reported here in the *Thelypteris* group are of special interest, including one which establishes the base number of the segregate *Phegopteris* for the first time, and another which is lower than any previously reported.

The "broad beech fern," *Thelypteris* (*Phegopteris*) *hexagonoptera* (Michx.) Slosson is an endemic North American species ranging from Quebec and Minnesota south to Florida and Texas. It is closely related to *T. phegopteris* (L.) Slosson, the "northern" or "narrow beech fern," a circumboreal species which has been found to be apogamous and to possess 90 pairs of chromosomes at meiosis in British plants studied by Manton and in Canadian plants studied by Britton. Both of the species under discussion have also been placed in a separate genus, *Phegopteris*. With regard to the widespread northern species, Manton wrote (1950, p. 184) that "The possible origin of the species . . . is at present unknown, since the chromosome number (90) is unlike that of any of the genera with which *Phegopteris* has from time to time been classed, and there is therefore no clue to its nearest affinities." It was found that the majority of sporangia of this species show only 8 spore mother cells, instead of the usual 16, and that both generations possess 90 chromosomes, thus indicating the apogamous type of life-cycle.

It is therefore extremely interesting to report that three populations of the endemic American species, *T. hexagonoptera*, were found to possess only 30 pairs of chromosomes at meiosis (figs. 21, 22). This new number suggests (a) that 30 is probably the original, basic number for this pair of species (i. e., for *Phegopteris* as a segregate genus or subgenus), (b) that *T. hexagonoptera* very likely has the more primitive, sexual type of life-cycle, and (c) that there is some justification from the cytological evidence for upholding *Phegopteris* as a distinct genus.

The chromosomes of the "New York fern," *Thelypteris noveboracensis* (L.) Nieuwland were examined because Britton (op. cit., p. 577) indicated that it was a difficult species to study and reported the number of $n = 29 \pm 2$ only for interest and as a tentative determination. Because also of the divergence of this tentative number from the previously reported ones of 31, 34, 35, and 36, it seemed desirable to examine several populations, and the results that emerged in this investigation (figs. 23, 24) turned out to be even more divergent than had been expected. The chromosome number of *T. noveboracensis* appears to be unique—$n = 27$. The chromosome number range now known in the *Thelypteris* group—from 27 to 36—indicates either that within this assemblage the generalization that chromosome numbers are more or less uniform for related groups at the level of genus does not apply here, or that the *Thelypteris* group is polyphyletic, and its members are perhaps less closely related phylogenetically than had been supposed.

In the group of *Dryopteris* sens. str., it is now well known that the basic number of chromosomes of $n = 41$ is quite different from the numbers known in the *Thelypteris* group with the possible exception of *Thelypteris* (*Gymnocarpium*) *dryopteris* and *T.* (*G.*) *robertianum*. The primary cytotaxonomic interest of *Dryopteris* in North America concerns the degree of hybridization which has played a role in the evolution of the species. It should be stressed that to a considerable extent authors have seemingly underestimated the degree to which hybridization has occurred within this genus in eastern North America: practically no large "woodfern" swamp is lacking in numerous intermediate individuals which the critical plant collector will inevitably notice, and which often provide "headaches" in identification. Furthermore, these plants which are certainly of hybrid origin are apomictic, and are capable over a period of years of forming populations by vegetative reproduction. Spread of the plants is accomplished by small buds which develop, several at a time, at the bases of the withering petioles in the autumn, and these are capable of forming successive "families" of plants around old individuals. As it stands, there is no really thorough-going source for determination of these intermediate plants in the herbarium, nor, in fact, has it been until very recently that convincing cytological evidence for their hybridity has appeared. The attention of pteridologists is called to the important work of Manton and Walker (1953), not yet completed, which is of major interest to students of this group.

Athyrium: In tropical areas the genus *Athyrium* often constitutes a bewildering assemblage taxonomically; in North America, however, there are but few species and the major problems are at the subspecific level. Such taxonomic work as has been done on this group has been largely of a subjective nature and little detailed knowledge of the plants concerned is available. Intensive investigations are much needed, especially among the indigenous forms of the *Athyrium filix-femina* complex, which includes at least several distinctive subspecies or varieties, and a large number of forms. Until now, only typical *A. filix-femina* from Britain has been reported ($n = 40$), and *A. filix-femina* var. *michauxii* Mett. (syn. *A. angustum* Small) from southern Ontario and Michigan (with the same number).

Of other North American indigenous species of *Athyrium* there are no previous records. *Athyrium thelypteroides* (Michx.) Desv. from two localities in Washtenaw Co., Michigan, yielded $n = 40$. The most distinctive of the native species, *A. pycnocarpon* (Spreng.) Tidestr., of which Morton (1952, p. 43) wrote "This species is of uncertain generic relationships," also showed $n = 40$. There thus appears to be no special evidence from chromosome number to support placing *A. pycnocarpon* in a separate genus (e.g., as *Diplazium pycnocarpon* Broun, or *Homolosorus* Small). It is interesting to observe that meiosis occurred fully a month later (early August) in *A. pycnocarpon* than it did in the two other species which were found growing with it in the same locality. In *A. pycnocarpon* there were not even crosiers of fertile fronds evident above the ground level at the time fully formed fertile fronds of *A. filix-femina* and *A. thelypteroides* were collected in early July.

Woodwardia: Britton (op cit., p. 577) wrote of the Virginia chainfern, *Woodwardia* (*Anchistea*) *virginica*, that the chromosome number was $n = 36$, and that "this chromosome number may indicate an affinity between this genus and Asplenium."

(Such a relationship was suggested earlier by Bower and other authors on what seemed to be morphological resemblances.) Because of this interesting apparent correlation, and the ready availability of this species in southern Michigan, three populations were studied. Meiotic figures were observed in all three, and in one population mitotic figures of archesporial cells were also studied. The results differ from those of Britton: in all three cases there was no doubt that the gametic number is 35. (In a couple of sporocytes, two unpaired univalents were clearly observed, suggesting an occasional early separation of one of the bivalents at the time of metaphase, but otherwise in the numerous cells examined there was no question concerning the number.) Britton indicated in his count, however, a possible error of $\pm$ 1. The present number of 35 does not so evidently suggest a relationship of *Woodwardia* to *Asplenium*.

Toward the end of this investigation, Dr. Wood kindly sent materials of the very different-appearing species, *Woodwardia* (*Lorinseria*) *areolata*, from living plants in the University of North Carolina greenhouse. It had been expected that this species might perhaps prove to have a different chromosome number, especially in view of the fact that the number $n = 34$ is now known in Old World species of *Blechnum* and *Woodwardia*. However, it turned out that *W. areolata* has the same number as *W. virginica*, $n = 35$ (fig. 32), and there is, therefore, no evidence from this standpoint that our two native species belong to different genera.

ASPLENIUM: One of the groups of leptosporangiate ferns which has been most thoroughly investigated is the Asplenium group characterized by a basic number of 36. Among its species apogamy is shown by *Asplenium monanthes*, intraspecific euploidy by *A. trichomanes*, and allopolyploidy by *A. ebenoides* and others. In the Appalachian spleenworts, three species that show morphological intermediacy between other species have been found to have 72 pairs at meiosis, supporting a hypothesis of allopolyploidy for these taxa (namely, the Alabama population of *A. ebenoides*, *A. pinnatifidum*, and *A. bradleyi*). Aneuploidy in the Asplenium group was suggested for the first time by Britton's report of $n = 35$ for *Camptosorus rhizophyllus* in southern Ontario. However, four populations tested by the author

TABLE II. Summary of Chromosome Numbers Reported for North American Ferns[5]

	n	
Ophioglossaceae		
Botrychium multifidum	45	(Wagner, 1955)
B. oneidense	45	(Wagner, 1955)
B. dissectum f. obliquum	45	(Britton, '53; Wagner, '55)
B. dissectum f. dissectum	45	(Britton, '53; Wagner, '55)
B. lunaria var. onondagense	ca. 90	(Wagner, '55)
B. simplex var. tenebrosum	45	(Wagner, '55)
B. simplex var. simplex	45	(Wagner, '55)
B. pumicola	45	(Wagner, '55)
B. matricariaefolium	ca. 90	(Wagner, '55)
B. lanceolatum var. angustisegmentum	45	(Wagner, '55)
B. virginianum	92	(Britton, '53; Wagner, '55)
Osmundaceae		
Osmunda regalis var. spectabilis	22	(Britton, '53)
O. cinnamomea	22	(Britton, '53)
"Polypodiaceae"		
Dennstaedtia punctilobula	34 ± 1	(Britton, '53)
Pteridium aquilinum var. latiusculum	52	(Britton, '53)
P. aquilinum var. pseudocaudatum	52	(Wagner, '55)
Pellaea atropurpurea	87	(Manton, '50)
P. glabella	116 ± 2	(Britton, '53)
Adiantum pedatum	29	(Britton, '53)
Pteretis pensylvanica	40 ± 1	(Britton, 53)
Onoclea sensibilis	37	(Britton, '53; Wagner, '55)
Woodsia ilvensis	41 ± 1	(Britton, '53)
Cystopteris bulbifera	42	(Britton, '53; Wagner, '55)
C. fragilis	84	(Britton, '53; Wagner, '55)
C. fragilis var. tennesseensis	126	(Wagner, '55)
C. fragilis var. simulans	84	(Wagner, '55)
C. dickieana	84	(Wagner, '55)
Polystichum acrostichoides	41	(Britton, '53)
Dryopteris spinulosa	82	(Manton & Walker, '53)
D. intermedia	82 ± 1	(Britton, '53)
————	41	(Manton & Walker, '53)
D. fructuosa	triploid	(Manton & Walker, '53)
D. boottii	unpaired	(Britton, '53)
————	triploid	(Manton & Walker, '53)
D. marginalis	41	(Britton, '53; Manton & Walker, '53)
D. goldiana	41	(Manton & Walker, '53)
D. cristata	82	(Manton & Walker, '53)
D. clintoniana	123	(Manton & Walker, '53)
Thelypteris phegopteris	90	(Britton, '53)
T. hexagonoptera	30	(Wagner, '55)
T. noveboracensis	29 ± 2	(Britton, '53)
————	27	(Wagner, '55)
T. palustris var. pubescens	35	(Britton, '53; Wagner, '55)
Athyrium filix-foemina var. michauxii	40	(Britton, '53; Wagner, '55)

[5] While this paper was in press, I. Manton and W. A. Sledge's paper entitled "Observations on the Cytology and Taxonomy of the Pteridophyte Flora of Ceylon" (Phil. Trans. Roy. Soc. London, Ser. B., Biol. Sci. 238: 127–185, 1954) has appeared, including the following additional cytological records for North America: *Pityrogramma triangularis* (California), $n = 30$; *Adiantum pedatum* (Vancouver), $n = 29$; and *Woodwardia chamissoi* Brack. (California), $n = 34$.

TABLE II.—*Continued*

A. thelypteroides	40	(Wagner, '55)
A. pycnocarpon	40	(Wagner, '55)
Woodwardia (Anchistea) virginica	36 ± 1	(Britton, '53)
———	35	(Wagner, '55)
W. (Lorinseria) areolata	35	(Wagner, '55)
Asplenium ruta-muraria	72	(Wagner, '55)
A. viride	36	(Britton, '53)
A. trichomanes	36, 72	(Britton, '53)
A. platyneuron	36	(Wagner, '54)
A. bradleyi	72	(Wagner, '54)
A. montanum	36	(Wagner, '54)
A. pinnatifidum	72	(Wagner, '54)
A. trudelli	triploid	(Wagner, '54)
A. ebenoides	(72 univalents)	(Wagner, '54)
——— (Alabama population)	72	(Wagner, '54)
Phyllitis scolopendrium var. american	72 ± 2	(Britton, '53)
Camptosorus rhizophyllus	35	(Britton, '53)
———	36	(Wagner, '54)
Polypodium virginianum	37	(Manton, '50)
———	74	(Britton, '53)

from Ohio, Virginia, and Indiana, showed the usual aspleniaceous number of 36. It should be considered possible that Britton's report was based on an aberrant population; this is a vegetatively reproducing species, and one which might be capable of continued reproduction under abnormal chromosomal conditions. One of the most interesting of the recent findings, mentioned earlier in this paper, was Britton's determination of the chromosome number of the rare limestone-inhabiting American variety of *Phyllitis scolopendrium* as tetraploid, in contrast to the common European representative which is a diploid.

It was worthwhile to find out whether the ill-distinguished American representative of *Asplenium ruta-muraria* (separated by Fernald, without justification in this writer's opinion, as a wholly distinct species, *A. cryptolepis*) might also prove to be distinct cytologically from its European counterpart. The results were negative. Ohio material of this plant showed $n = 72$, as do the European plants (fig. 33).

From the taxonomic viewpoint, it should be emphasized here that the recent reduction by Morton (1952, p. 38) of *A. trudellii* to varietal status under *A. pinnatifidum* has been found to be untenable. This conclusion is based not only on grounds that previously supported its treatment as a hybrid taxon, but on its cytology which also indicated its hybrid nature.

There is a triploid chromosome complement present with approximately 36 pairs and 36 univalents at meiosis (Wagner, 1954, pp. 111–113).

I am more and more inclined to believe that our custom of treating hybrid ferns as binomial taxa (e.g., *Asplenium* × *ebenoides*, *A.* × *gravesii*, *Dryopteris* × *boottii*, etc.) can be justified on the grounds that follow: (1) Evidently hybridization has played a role in the formation of sexual, allopolyploid species, as well as apogamous species, and these species behave in nature as independent populations with their own separate ranges and ecology, (2) Where the hybrids are sterile, vegetative reproduction may enable them to form large clones of importance in the plant community, not unlike those of the dandelion in cultivated places, and there is some evidence from work now being carried out in this laboratory that forms that lack the capacity to reproduce vegetatively may reproduce (in a manner as yet unexplained) by what appears to be ordinary spore-production, in spite of the fact that the spores are normally abortive and meiosis is highly irregular.

CONCLUSIONS

Forty-eight populations of North American ferns, including 27 species and varieties, were examined cytologically in relation to taxonomic interpretation. The following cytotaxonomic observations are discussed:

1. The subgenus *Osmundopteris* of *Botrychium*, as represented by *B. virginianum*, seems to be the most distinctive, cytologically, of the subgenera, having an apparent basic number of 46 chromosomes and chromosomes of small size.

2. The remaining two subgenera of *Botrychium*, namely *Sceptridium* and *Eubotrychium* appear to be similar to one another cytologically and to possess a base number of 45 chromosomes. Polyploidy has now been observed in *Eubotrychium*.

3. There is no evidence of hybrid origin of *B. oneidense* (n = 45). On the contrary, this taxon appears on the basis of chromosomal and other information to behave like a normal species, distinct from both *B. dissectum* (n = 45) and *B. multifidum* (n = 45), and not like a variety of either of them.

4. In the group of *B. lunaria*, *B. minganense* appears from field studies to be a taxon specifically distinct from *B. lunaria*, although in some respects it appears to be intermediate between the latter species and *B. matricariaefolium*. However, cytological data on *B. minganense* are still not available. *B. lunaria* var. *onondagense* has proved to be a polyploid with n = ca. 90, in contrast to typical *B. lunaria* of Europe, n = 45. The related *B. matricariaefolium* is also polyploid (n = ca. 90).

5. Two well-marked varieties of *Botrychium simplex*, the typical variety and var. *tenebrosum*, show no distinctions in chromosome number from each other, and the closely related *B. pumicola* is also indistinguishable (all three with $n = 45$).

6. *Eubotrychium* Sect. *Lanceolatae* as represented by *B. lanceolatum* ssp. *angustisegmentum* ($n = 45$) resembles the species of Sect. *Lunariae.*

7. Further research on the relationship of *Onoclea sensibilis* ($n = 37$) and *Pteretis pensylvanica* ($n = 40$) is suggested by the differences in their chromosome numbers.

8. *Pteridium aquilinum* var. *pseudocaudatum* ($n = 52$) is no different from the other varieties of the bracken thus far studied.

9. A hypothesis of hybridity to explain the "bulblet-bearing" populations of *Cystopteris fragilis* is not directly supported by presently known cytological facts, since *C. fragilis* in Europe and in the United States has not been found to have less than 84 pairs of chromosomes, while *C. bulbifera* has 42. "Bulblet-bearing" plants of *C. fragilis* var. *simulans* show 84 pairs, thus offering no support to an allopolyploid hypothesis. On the other hand, the "bulblet-bearing" *C. fragilis* var. *tennesseensis* yielded $n = 126$, justifying the recent taxonomic separation of these two varieties.

10. The American *Cystopteris dickieana* was found to have $n = 84$ chromosomes like its European counterpart. The only difference (exine sculpture) thus far demonstrated for this taxon does not seem by itself to justify its treatment as a species.

11. The chromosome number of *Thelypteris* (*Phegopteris*) *hexagonoptera* indicates that the base number of the segregate genus *Phegopteris* (formerly in question because the related *T. phegopteris* has $n = 90$ chromosomes and is apogamous) is $n = 30$.

12. *Thelypteris noveboracensis* with $n = 27$ is the lowest-numbered form yet reported for the *Thelypteris* group. The latter group now is known to have a range in chromosome number from 27 to 36, suggesting that either the chromosome numbers in this group tend to fluctuate more readily than in other fern groups, or the group is actually polyphyletic.

13. The species of *Eudryopteris* are well distinguished by their basic chromosome number ($n = 41$) from the thelypteroid ferns, and the evidence that has been accumulated in the past several years shows clearly that hybridization has played a strong role in the evolution of many of the North American populations.

14. There is no reason especially from chromosome number to warrant the placing of *Athyrium pycnocarpon* in a separate genus from *A. thelypteroides* or *A. filix-femina* since all have $n = 40$.

15. Both species of *Woodwardia* of the northeastern United States possess $n = 35$ chromosomes, in contrast to Old World species of *Blechnum* and *Woodwardia.*

16. The ill-defined eastern North American variety of *Asplenium ruta-muraria* with $n = 72$, is indistinguishable in chromosome number from the typical European form.

17. *Asplenium* × *trudellii* should be considered a hybrid taxon, rather than as a variety of *A. pinnatifidum*, because of its triploid chromosome complement and its meiotic behavior.

18. Our taxonomic custom of treating hybrid ferns as binomials seems justified to this writer in view of their capacity to form populations and behave as typical sexual or asexual plant species.

Literature Cited

Alston, A. H. G. 1951. An overlooked North American fern. Am. Fern Jour. **41**: 76–78.

Britton, D. M. 1953. Chromosome studies on ferns. Am. Jour. Bot. **40**: 575–583.

Clausen, R. T. 1938. A monograph of the Ophioglossaceae. Torr. Bot. Club Mem. **19** (2): 1–177.

Copeland, E. B. 1947. Genera Filicum. Waltham, Mass.

Fernald, M. L. 1950. Gray's Manual of Botany, 8th Edition. American Book Co.

Holttum, R. E. 1946. A revised classification of leptosporangiate ferns. Jour. Linn. Soc. Bot. **53**: 123–186.

Manton, I. 1950. Problems of Cytology and Evolution in the Pteridophyta. Cambridge Univ. Press.

Manton, I., and S. Walker. 1953. Cytology of the *Dryopteris spinulosa* complex in Eastern North America. Nature **171**: 1116–1118.

Morton, C. V. 1950. Notes on the ferns of the Eastern United States. Am. Fern Jour. **40**: 213–225, 241–253.

————. 1952. Pteridophyta, *in* Gleason, H. A., The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada, pp. 1–56. Lancaster Press.

Newcomer, E. H. 1953. A new cytological and histological fixing fluid. Science **118**: 161.

Selling, O. H. 1944. Studies in the recent and fossil species of *Schizaea* with particular reference to their spore characteristics. Meddel. Göteborgs Bot. Trädgård **16**: 1–112.

Shaver, J. M. 1950. A new fern, *Cystopteris tennesseensis* sp. nov., from Tennessee. Tennessee Acad. Sci. Jour. **25** (2): 106–113.

Wagner, W. H. 1944. Another occurrence of the apparent hybrid *Cystopteris*. Am. Fern Jour. **34**: 125–127.

————. 1954. Reticulate evolution in Appalachian Aspleniums. Evolution **8**: 103–118.

Weatherby, C. A. 1935. A new variety of *Cystopteris fragilis* and some old ones. Rhodora **37**: 374–378.

Wherry, E. T. 1944. Cystopteris Bluff. Am. Fern Jour. **34**: 92–94.

Volume 57, no. 679, including pages 189–212, was issued 2 August, 1955.

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Vol. 57 September, 1955 No. 681

CONTENTS:

The New England Botanical Club, Inc.

8 and 10 West King St., Lancaster, Pa.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of the Gray's Manual Range and regions floristically related. Price, $4.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) of not more than 24 pages and with 1 plate, 40 cents, numbers of more than 24 pages or with more than 1 plate mostly at higher prices (see 3rd cover-page). Back volumes can be supplied at $4.00. Some single numbers from these volumes can be supplied only at advanced prices (see 3rd cover-page). Somewhat reduced rates for complete sets can be obtained on application to Dr. Hill. Notes and short scientific papers, relating directly or indirectly to the plants of North America, will be considered for publication to the extent that the limited space of the journal permits. Illustrations can be used only if the cost of engraver's blocks is met through the author or his institution. Forms may be closed five weeks in advance of publication. Extracted reprints, if ordered in advance, will be furnished at cost.

Address manuscripts and proofs to Reed C. Rollins,
Gray Herbarium, 22 Divinity Ave., Cambridge 38, Mass.

Subscriptions (making *all remittances* payable to RHODORA) to

Dr. A. F. Hill, 8 W. King St., Lancaster, Pa., or, preferably, Botanical Museum, Oxford St., Cambridge 38, Mass.

Entered as second-class matter March 9, 1929, at the post office at Lancaster, Pa., under the Act of March 3, 1879.

Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 57 September, 1955 No. 681

THE AURICULATE-LEAVED SPECIES OF LESQUERELLA (CRUCIFERAE)

Reed C. Rollins

An intensive study of the most easterly species of the genus *Lesquerella* has raised a number of problems regarding the taxonomy of those with auriculate cauline leaves. With the possible exception of *L. lasiocarpa,* these are all more closely related to each other than to other species of the genus and should be formed into a separate section or subgenus. There is now definite proof that the flat-podded *L. Lescurii* is genetically very closely related to the very unlike globose-podded *L. densipila.* They cross freely in the field (Rollins, 1954) and can be readily crossed in the laboratory, producing highly viable seeds. Second generation offspring retain the high fertility of the F_1, so that there appears to be little or no bar to free gene exchange between them. The total evidence (to be presented elsewhere) shows without question that *L. Lescurii,* though singular in many of its characteristics, should not form a monotypic section as maintained by Payson (1922) in his monograph of the genus. The earlier treatment of Watson (1888) in which *L. Lescurii* is associated with *L. auriculata* and *L. grandiflora* is preferable.

The differentiation of *Lesquerella* in the Central Basin of Tennessee resulting in such morphologically divergent species as *L. Lescurii, L. densipila* and *L. perforata* has posed questions as to their origin and nearest relatives within the genus. Where did these Tennessee Lesquerellas come from and by what migratory route did they get there? The genus in large part is southwestern and Mexican in distribution with a heavy concentration of species in Texas. However, there are a goodly number in the Rocky Mountain area and several species in South America. But for the relatives of the Tennessee species, we need to look no farther west than Texas and Oklahoma. There, among the three possible species, *L. auriculata* appears to be the most likely progenitor of the more easterly species. Not only does it agree in many characteristics with the Tennessee and Alabama species under consideration but the chromosome number of n = 8 is the same. *L. grandiflora*, the other possible Texas relative, has n = 9.

The discovery of a new species, *L. lyrata*, in northwestern Alabama is significant in connection with the problems posed above. This species, lying geographically and morphologically between *L. densipila* of Tennessee and *L. auriculata* of Oklahoma and Texas, fills a gap as nearly as one could ask for it. *L. lyrata* provides the proper evolutional step from *L. auriculata* to *L. densipila* as well as a possible remnant of a more or less continuous distribution pattern that must have connected the Tennessee and southwest species in a past era. It is interesting that *L. lyrata* should only now be found and furthermore that *L. gracilis*[1] should be discovered in Mississippi for the first time.

Lesquerella as a whole is under study, and it is hoped that a monograph of this interesting genus may eventually be presented. The present paper deals with only the auriculate-leaved species. The herbarium citations follow the symbols of Index Herbariorum (1954). I am indebted to Dr. L. O. Gaiser and Mrs. Winslow Briggs for making the chromosome counts given at the end of each description in those instances where it is known. Dr. Elsie Quarterman of Vanderbilt University has kindly assisted by providing information about the Central Basin of Tennessee and by participating in the field work, for which I am grateful.

[1] Last April, in company with Mr. George R. Cooley and Dr. James D. Ray, Jr., I examined a large population of *L. gracilis* (Hook.) Wats. growing on heavy black prairie land just north of Okolona in Chickasaw County, Mississippi. Here the plants were as thoroughly at home as on the black-land prairies of Texas. Thanks to the efforts of Dr. Ray, Mr. Cooley, and Mr. L. J. Brass, there are now three known stations for *L. gracilis* in Mississippi, the southernmost in Lowndes County and the northernmost in Pontotoc County, all on the "prairie strip." To my knowledge, the genus *Lesquerella* has not been previously reported from either Mississippi or Alabama.

KEY TO THE SPECIES

A. Pedicels recurved; siliques slightly compressed to flattened contrary to septum; filaments not dilated at base; cauline leaves nonauriculate to obscurely auriculate, not clasping the stem . . . . 1. *L. lasiocarpa.*

A. Pedicels ascending; siliques globose, subglobose, pyriform, or flattened parallel to septum; filaments dilated at base; cauline leaves markedly auriculate and clasping the stem.

  B. Siliques strongly flattened parallel to septum; valves pubescent with a mixture of large bulbous-based trichomes and an understory of small branched trichomes; flowers yellow . . . . 2. *L. Lescurii.*

  B. Siliques globose, subglobose or pyriform, not flattened; valves glabrous or uniformly pubescent with simple or forked trichomes; flowers yellow or white.

    C. Flowers yellow; siliques globose or subglobose; septum complete.

      D. Siliques densely pubescent with minute simple or forked trichomes; styles pubescent; plants of Tennessee . . . . 3. *L. densipila.*

      D. Siliques glabrous; styles glabrous; plants of Alabama, Oklahoma, and Texas.

        E. Ovules 4–8 in each silique, septum dense, opaque; stigma scarcely expanded; siliques less than 3 mm. high, depressed globose . . . . 4. *L. lyrata.*

        E. Ovules 12–20 in each silique; septum less dense, translucent; stigma markedly expanded; siliques 4–8 mm. high, globose to elliptical.

          F. Lower stems hirsute with spreading simple trichomes; lower cauline leaves markedly auriculate; petals 4–5 mm. wide; infructescences dense . . . . 7. *L. auriculata.*

          F. Lower stems pubescent with appressed branched trichomes; lower cauline leaves not auriculate; petals 6–9 mm. wide; infructescences lax, greatly elongated . . . . . . 8. *L. grandiflora.*

    C. Flowers white; siliques pyriform or depressed globose to somewhat didymous; septum perforate.

      G. Siliques densely hirsute, slightly didymous to depressed globose; valves glabrous on interior; styles hirsute . . . . 5. *L. stonensis.*

      G. Siliques glabrous to very sparsely hirsute, pyriform; valves densely pubescent on interior; styles glabrous . . . . 6. *L. perforata.*

1. **Lesquerella lasiocarpa** (Hook. ex Gray) Watson, Proc. Amer. Acad. **23:** 251, 1888.

Annuals, biennials or perennials; stems several to numerous, slender, decumbent to procumbent, pubescent with branched trichomes or a combination of branched and simple spreading trichomes, 1–5 dm. long; basal leaves petiolate, oblanceolate in outline, variable, sinuate dentate to somewhat lobed or incised, 3–10 cm. long, 1–3 cm. wide, densely pubescent with small branched trichomes or a mixture of these and large trichomes; cauline leaves sessile, narrowed toward base, varying from nonauriculate to barely auriculate or with definite auricles present, sinuate dentate to incised, obovate elliptical or oblong in outline, densely pubescent, 1–4 cm. long, 0.5–2 cm. wide; infructescence lax; pedicels slender, recurved in fruit, not expanded toward summit, densely pubescent, 1.5–

2.5 cm. long; sepals green, pubescent with small branched trichomes to hirsute, linear-oblong, nearly acuminate, 4–5 mm. long, 1.5–2 mm. wide; petals broadly obovate, 6–8 mm. long, 4.5–5.5 mm. wide, light yellow, often drying purplish, blade nearly orbicular, limb very short; anthers sagittate, 2–3 mm. long; filaments not dilated at base, barely exceeding anthers in length; glands formed into horn-like projections at the bases of the filaments; siliques sessile, definitely flattened contrary to the partition to only slightly flattened, orbicular in outline to elliptical or cordate; densely pubescent with a mixture of small branched and large simple trichomes or with the simple trichomes absent, 5–9 mm. long, 4–9 mm. wide; style 1–1.5 mm. long; stigma expanded; replum oblong to nearly elliptical; septum transparent; ovules 8–14 in each locule; funiculi attached to septum at base; seeds nearly orbicular, slightly longer than broad, margined, ca. 1.5 mm. long; cotyledons accumbent.

KEY TO THE VARIETIES

Siliques hirsute with large simple trichomes as well as being pubescent with an understory of small branched trichomes.
  Plants annual; caudex not noticeably thickened; cauline leaves scarcely cuneate at base, barely auriculate to definitely so; low elevations in Texas and coastal eastern and northeastern Mexico.
    Siliques orbicular to elliptical in outline; leaf-lobes acute to acuminate .... 1a. var. *lasiocarpa.*
    Siliques cordate in outline; leaf lobes rounded to obtuse, plants of Mexico .... 1c. var. *ampla.*
  Plants biennial or perennial; caudex thick; cauline leaves cuneate at base, nonauriculate; mountains and foothills of northeastern Mexico......... .... 1d. var. *heterochroma.*
Siliques pubescent with small branched trichomes only . . 1b. var. *Berlandieri.*

1a. **L. lasiocarpa** var. **lasiocarpa.**

Vesicaria lasiocarpa Hook. ex. Gray, Smithson. Contrib. **5:** 13. 1853. *Synthlipsis Berlandieri* var. *hispida* Watson, Proc. Am. Acad. **17:** 321. 1882.

Alyssum lasiocarpa Kuntze, Rev. Gen. Pl. **2:** 931. 1891. Type seen at Kew, but there is no indication of place of collection on the type sheet. Gray, l.c., says, "between Bexar and Trinity River, May, 1828, Berlandier (in herb Hook.)."

Texas: Rio Frio north of Dilley, Frio Co., *Painter, Lucas & Barkley 14206* (MO, TEX); 3 mi. south of Dilley, La Salle Co., *Painter & Barkley 14305* (TEX); Rockport, Arkansas Co., *Tharp s.n.* (GH); Corpus Christi, Nueces Co., *Tracy 9348* in part (NY); same locality, *E. J. Palmer 11215* (MO, TEX); same locality, *Heller 1405* (GH, MO); Bishop, Nueces Co., *Young s.n.* (TEX); Alice, Jim Wells Co., *E. J. Palmer 11259* (MO, TEX); San Diego, Duval Co., *Croft s.n.* (GH, NY); Apache Ranch, ca. 40 mi. s.w. Catarina, Webb Co., *Blair et al. 48-500* (TEX); 6 mi. n. Laredo, Webb Co., *K. M. & M. C. Wiegand 750* (GH); 6 mi. w. of Aguilares, Webb Co., *Tharp et al. 51-1693* (TEX); King Ranch, Kleberg Co., *M. C. Johnston 5410* (TEX); Kingsville, Kleberg Co., *High 57* (MO); 4½ mi. e. of Hebbronville, Jim Hogg Co., *M. C. Johnston 54124* (OKLA, TEX); Donna, Hidalgo Co., *Clover 624* (NY); 3 mi. n. of Edinburg, Hidalgo Co., *Painter & Barkley 14448* (TEX); s. of Raymondville, Willacy Co., *Gentry 52–653* (TEX); w. of Holly Beach, Cameron Co., *M. C. Johnston 54201* (TEX); w. of Brownsville, Cameron Co., *Hansen 321* (GH, MO, NY, TEX).

Mexico: Hacienda el Carrizo, Nuevo León, *Pringle 10236* (GH, NY); 23 mi. n. of Sabinas Hidalgo, Nuevo León, *Webster & Barkley 14591* (TEX); Sierra de San Carlos, Tamaulipas, *Berlandier 3101* (GH): Laredo, Tamaulipas, *Berlandier 157* (GH); 16 mi. s. of Nuevo Laredo, Tamaulipas, *Heard 2* (TEX); San Lorenzo de Leguna, 70 mi. s.w. from Parras, Coahuila, *E. Palmer 26* (GH, type of *Synthlipsis Berlandieri* var. *hispida*).

1b. **L. lasiocarpa** var. **Berlandieri** (Gray) Payson, Ann. Mo. Bot. Gard. **8:** 139. 1922.

Synthlipsis Berlandieri Gray, Bot. Mex. Bound. Surv. 34. 1859.

Texas: Corpus Christi, Nueces Co., *Tracy 9348* (GH, MO, NY in part); Sanz Ranch, Willacy Co., *M. C. Johnston 54547* (TEX); San Juan, Hidalgo Co., *Parks 18003* (GH). **Mexico:** Matamoros, Tamaulipas, April, 1836, *Berlandier 3017* (GH, type; MO); same location, *Berlandier 710, 778, 1517, 2127, 2198, 3102* (GH);

1c. **L. lasiocarpa** var. **ampla** Rollins, var. nov.

Herba annua; foliis obtusis amplis; siliquis cordatis.

Mexico: vicinity of Victoria, Tamaulipas, Feb. 1 to Aptil 9, 1907, *E. Palmer 41* (GH, type; NY, isotype); vicinity of Pueblo Vieja, Vera Cruz, 2 kilo. s. of Tampico, *E. Palmer 366* (GH).

1d. **L. lasiocarpa** var. **heterochroma** (Watson) Rollins, comb. nov.

Synthlipsis heterochroma Watson, Proc. Amer. Acad. **17:** 321. 1882.

Mexico. Nuevo León: Guajuco, 27 mi. s.e. from Monterrey, March, 1880, *E. Palmer 33* (GH, type); Villa de Santiago, *Leavenworth 120* (GH); Linares, *I. C. & E. M. Frye 2522a* (GH); 12 mi. e. of Monterrey, *Barkley 14354* (TEX).

Lesquerella lasiocarpa is tremendously variable. Not only can one find a great range in the size of individual plants but every part of the plant seems to run through a rather wide range of variation. For example, this species has been commonly thought of as having siliques that are rather markedly flattened contrary to the partition, the resulting shape of the replum being narrowly oblong. However, the actual amount of flattening varies all the way from the rather strongly flattened type to siliques that are just short of being round. In the latter type, the replum is broadly elliptical to nearly round. Other characters are not noticeably correlated with the degree of flattening. Many of the plants collected are obviously annuals, but some, as in the type of Watson's *Synthlipsis heterochroma* and other specimens from Nuevo León, seem to be perennials. Unfortunately, I have had no field experience with this particular species and can only attempt to interpret the specimens.

Although quite definitely a *Lesquerella,* this species has certain features in common with the monotypic genus *Synthlipsis* and suggests a possible ancient connection between the two genera. If this view gains further support as evidence concerning the phylogeny of the Cruciferae is accumulated, it would point to a southern, perhaps Mexican, origin for the genus *Lesquerella.* This idea is in immediate conflict with a widely held view that *Lesquerella* is related to and probably originated from either *Vesicaria* or *Alyssum* of the Old World.

The varieties of *L. lasiocarpa* are not especially marked except with relatively minor characters. Variety *Berlandieri* lacks large simple trichomes on the fruits and has a reduced number elsewhere on the plants. I am not sure that this is a natural taxon for it seems to occur within the range of var. *lasiocarpa* and has even been collected at the same location. Variety *ampla* is more southerly in its range than the other varieties and marks a trend toward cordate-shaped fruits and large blunt leaves. The simple trichomes on the fruits are not so pronounced as in var. *lasiocarpa* where they are frequently large, stiff and with a bulbous base. Payson did not recognize var. *ampla* as separable from var. *lasiocarpa* although he had available to him the same collections that I have studied. However, the Gray Herbarium specimen, which he did not see, is the one with mature fruits where the cordate shape is strongly evident.

In var. *heterochroma* appears a trend of development not seen in other varieties, that of a perennial caespitose habit. The specimens so far collected all have a comparatively thick caudex. A note by one collector (Barkley) indicates that the plants were taken near a brook, suggesting a moist habitat. All collections appear to have come from above one thousand feet in elevation. The other varieties are low elevation plants occurring mainly on the Gulf coastal plain.

Although four varieties are recognized in *L. lasiocarpa,* the present taxonomic treatment leaves considerable to be desired.

Not only is some explanation for the tremendous variation needed but there are trends of differentiation observable, for example that toward globose siliques, that require a more adequate explanation than can be surmised from specimens alone. A genetical and cytological study of this species is definitely needed and would contribute profitably to an understanding of the role of *L. lasiocarpa* in the phylogeny of the genus as a whole.

The cauline leaves of some plants of *L. lasiocarpa* are non-auriculate; in others they are slightly auriculate; and in some, definite auricles are present. The questions follow naturally as to whether *L. lasiocarpa* should be included with the definitely auriculate species as in the present treatment and whether it is more closely related to them than to other species of the genus. There is little to go on at present to provide answers to these questions except to say that *L. lasiocarpa* is as nearly in place with the auriculate species as with any group of species in the genus.

2. **Lesquerella Lescurii** (Gray) Watson, Proc. Amer. Acad. **23:** 250. 1888.

Vesicaria ? Lescurii Gray, Manual Bot. ed. 2, 38. 1856.
Alyssum Lescurii Gray, Manual Bot. ed. 5, 72. 1867.

Annual; stems several to numerous, erect or decumbent, simple or usually branched, hirsute below, densely pubescent with branched trichomes above and below, 1–3 dm. long; basal leaves petiolate, lyrate, deeply lobed, 3–7 cm. long, 5–20 mm. wide, hirsute below with mostly simple trichomes, coarsely pubescent above with a mixture of large simple and smaller branched trichomes, lateral lobes remote; cauline leaves sessile, auriculate, dentate, broadly oblong to ovate, coarsely pubescent with large simple and smaller branched trichomes, upper leaves often lacking the simple trichomes 0.5–2 cm. long, 3–10 mm. wide; pedicels divaricate, nearly straight, densely pubescent with coarse branched trichomes, 8–15 mm. long, not expanded at summit; sepals coarsely pubescent, yellowish at anthesis, broadly oblong, 3–4 mm. long, 1.5–2 mm. wide, outer pair slightly saccate, inner pair flat at base; petals yellow, obovate, rounded to slightly emarginate at apex, gradually narrowed to base with no sharp differentiation into blade and claw, 5–7 mm. long, 3.5–4.5 mm. wide; glandular tissue in a continuous mold subtending the filaments, surrounding the attachment point of single stamens; filaments dilated at base, 2.5–3.5 mm. long; anthers oblong, ca. 1 mm. long; siliques sessile, strongly flattened parallel to septum, orbicular to slightly longer than broad, 4–6 mm. long, 3–4 mm. wide, valves coarsely and densely pubescent on the exterior with large simple bulbous-based trichomes and an understory of small branched trichomes, sparsely pubescent with minute branched trichomes on the interior; septum complete, dense; replum thick, glabrous; style glabrous, 1.5–2 mm. long; stigma greater in diameter than the style in dried material, the same diameter as the style on the growing plant; ovules 2–4 in each locule; funiculi attached to septum at base only; seeds flattened, prominently margined, nearly orbicular in outline to slightly longer than broad, 2–2.8 mm. long, 1.5–2 mm. broad; cotyledons accumbent. N = 8. Plate 1207.

L. Lescurii is limited in distribution to central Tennessee. The following specimens, supplementing those cited earlier (Rollins, 1952), show a considerably wider range than was formerly known.

Tennessee. Summer County: 4.5 mi. e. of Gallatin, *Deam 61336* (DEAM). Wilson County: 2 mi. n. of Green Hill, *Rollins 5309* (GH). Rutherford County: Stewart's Creek, ½ mi. e. of Smyrna, *Rollins 55174* (GH). Williamson County: near Arrington Creek, ½ mi. s.e. of Arrington, *Rollins 55116* (GH); near Arrington Creek, ca. 7 mi. n. of College Grove, *Rollins 55117* (GH); roadside, 1 mi. n. of Kirkland, *Rollins 5517* (GH); near Mill Creek, 3 mi. n. of Nolensville, *Rollins 55110* (GH); 2.5 mi. n. of Triune, *Rollins 55111* (GH). Cheatham County: 3 mi w. of Ashland City, *Rollins 55151* (GH); flood plain of Cumberland River, 10 mi. n.w. of Ashland City, *Rollins 55156* (GH); near Pleasant View, *Quarterman & Stauffer 4948* (GH). Davidson County: flood plain of South Harpeth River near Linton, *Rollins 53134* (GH).

Of the fifty-four mounted specimens of *L. Lescurii* assembled from various herbaria for study, and excepting my own specimens, all but two were collected within the city of Nashville. Actually, the species is abundant in many localities in the six counties of the northern portion of the Central [Nashville] Basin of Tennessee. It seems strange that documentation for the wider range now known is not available in herbaria.

L. Lescurii appears early in the season, sometimes beginning to flower in early March, but most often it is at its flowering peak in April. Whole hillsides or open fields may be covered by a dense stand of the plants. This species seems to thrive equally on the flood plains of the river valleys and on the thin soil of open cedar glade-like areas of the hill slopes.

The branched trichomes present on the interior of the valves have not been seen by previous students. This feature is rare in the Cruciferae, but is now known in several species of *Lesquerella* including *L. perforata* where it was first noticed in the genus (Rollins, 1952). The long bulbous trichomes of the exterior valve surfaces are distinctive as may be seen in plate 1207. These trichomes are attached to a pedicel of tissue that projects above the valve wall. An understory of small branched

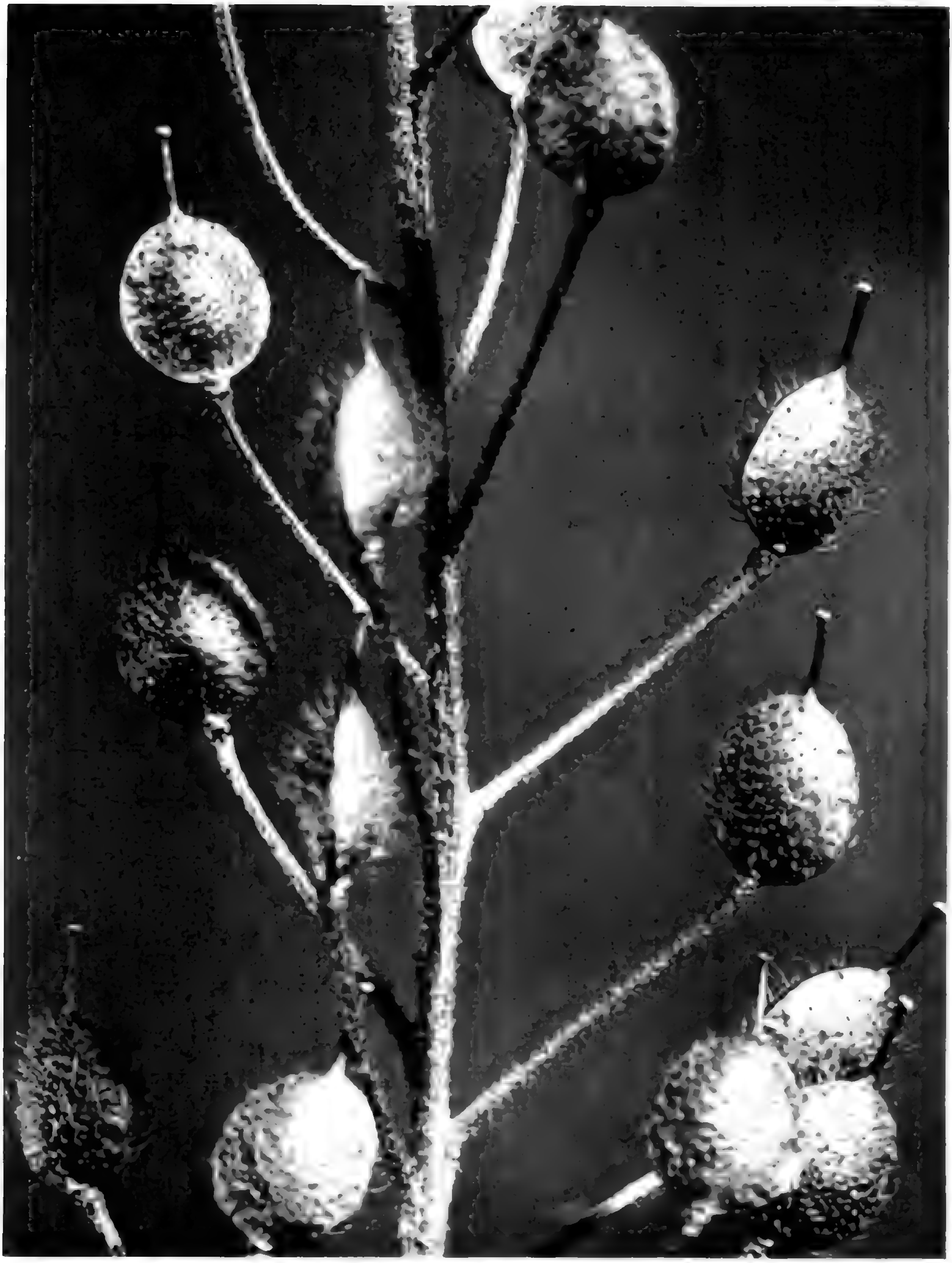


PLATE 1207. *Lesquerella Lescurii.* Part of an infructescence, ×6 (*Rollins 55174*). Photo by Frank White.

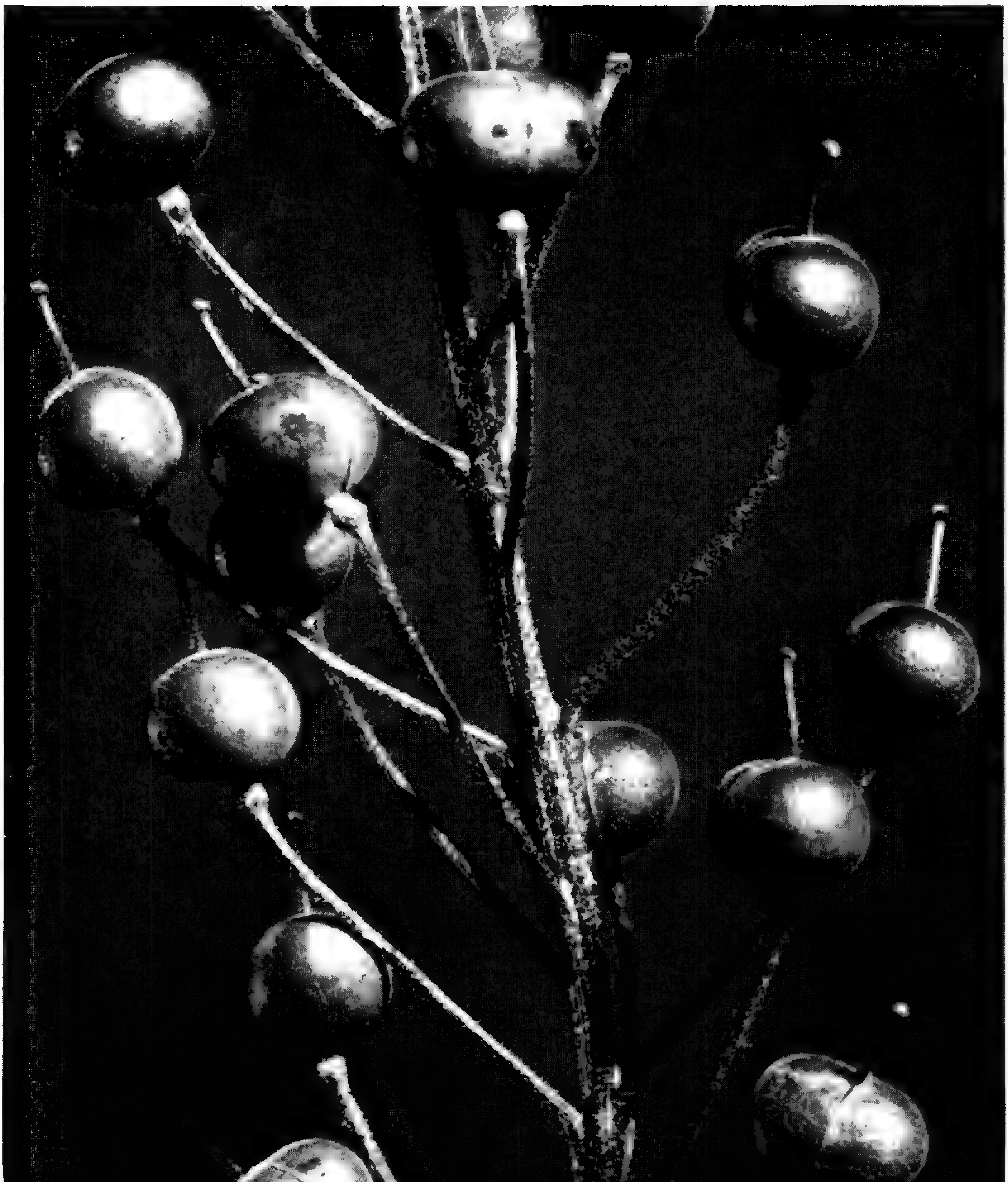


PLATE 1208. *Lesquerella densipila.* Part of an infructescence. ×6 (*Rollins & Quarterman 55146*). Photo by Frank White.

trichomes is present on young fruits, but these are often shed as the siliques mature.

There is considerable variation from plant to plant in any given population of *L. Lescurii* and trends of variation in different populations are sometimes recognizable. The intrapopulation variation is most frequently quantitative and may often be associated with local environmental factors, such as depth of soil, exposure and moisture availability. If conditions for prolonged growth are not present, a given plant may be small in stature and cease flowering after the setting of a few fruits. However, if factors are favorable, growth continues and the fruiting racemes become considerably elongated. The largest plants are found on the deep soils of the flood plains.

The taxonomic history of *L. Lescurii* reflects the doubts of Gray as to its rightful generic position. He was undoubtedly led to refer this species to *Vesicaria* in the beginning because other species of *Lesquerella* were being referred there by Hooker and other European botanists. The flattened siliques must have finally influenced him to move it into *Alyssum*, but it was equally out of place there as Watson finally showed. *L. Lescurii* has now been crossed artificially with *L. densipila* and *L. perforata* and it hybridizes naturally with *L. densipila.*

3. **Lesquerella densipila** Rollins, Rhodora **54:** 186. 1952.

Annual; stems several to numerous, erect or the outer decumbent at base, simple or branched, purplish below, 1–4 dm. high, hirsute below with spreading simple trichomes, rachis of inflorescence and upper portion of stems hirsute with smaller less spreading and frequently branched trichomes; basal leaves petiolate, lyrately pinnatifid to pinnately lobed, obtuse, 4–8 cm. long, 1–1.8 cm. wide, terminal lobe comparatively large, lateral lobes decurrent on rachis, hirsute on upper surface with mostly simple trichomes, lower surface with a mixture of large simple and smaller branched trichomes; cauline leaves sessile, auriculate, broadly ovate to oblong, 1–3 cm. long, 0.5–1.5 cm. broad, lower broadly obtuse, upper smaller and tending toward acuteness, dentate to nearly lobed, hirsute on both surfaces with mostly simple spreading trichomes; inflorescence racemose, 1–2 dm. long; fruiting pedicels divaricately ascending, straight, expanded at summit, 1–2 cm. long, pubescent with a mixture of simple and branched trichomes; sepals yellowish, nonsaccate, sparsely to generally covered with appressed branched trichomes, often with spreading single trichomes in addition, oblong, alternating members flat and boat-shaped, narrowed toward apex but remaining rounded, 2.5–4 mm. long, 1.5–2 mm. wide; petals yellow, broadly obovate, not markedly differentiated into blade and claw, 6–8 mm. long, 4–5 mm. wide; filaments strongly dilated at base, attached to anthers just below middle, anthers nearly versatile, not sagittate, ca. 1.5 mm. long; glandular tissue in a thin continuous mold beneath stamens, forming projections between single and paired stamens and an abbreviated ring around the base of the filament of the single stamens; siliques subglobose to slightly broader than long, uncompressed, 3–4 mm. in diameter, densely pubescent with minute simple or forked spreading trichomes; styles 2–3 mm. long, pubescent sometimes, glabrous above, slightly expanded into a capitate stigma; 2–4 ovules in each loculus, funiculi free except at their very base; septum entire; replum nearly orbicular, pubescent; seeds margined, flattened, orbicular to slightly longer than broad, brown, 2–2.5 mm. in diameter; cotyledons accumbent; radicle short. N = 8. Plate 1208.

Tennessee. Rutherford County: 4 mi s.e. of Murfreesboro, *Rollins & De Selm 55122* (GH); near West Fork of Stone's River, 1.3 mi. s.w. of Bethel, *Rollins & De Selm 55124* (GH); near West Fork of Stone's River where state route 102 crosses, *Rollins & Bold 55134* (GH); floodplain of the Harpeth River, 1 mi. n. of Eagleville, *Rollins 5526* (GH). Bedford County: roadside near Alexander Creek, 2 mi. n. of the North Fork of Duck River, *Rollins 5537* (GH). Williamson County: 1 mi. n. of College Grove, *R. C. & D. Rollins 5215* (GH); ½ mi. n. of Kirkland, between Triune and College Grove, *Rollins 5315* (GH); same locality, *Rollins 5518* and *55112* (GH); Kirkland, *Rollins 53138* (GH); 3 mi. s.e. of Kirkland, *Rollins 5519* (GH); 6 mi. n. w. of College Grove near the Harpeth River, *Rollins 5514* and *55114* (GH). Marshall County: Duck River bottom, north of Verona, *Sharp, Felix and Adams 11187* (GH, type; UT, isotype); 1 mi. n. of Chapel Hill, *Rollins 5319* (GH); near Duck River, 3 mi. s. of Chapel Hill, *R. C. & D. Rollins 5217* (GH); ½ mi. s. of Duck River, ca. 5 mi. s. of Chapel Hill, *Rollins 5321* (GH). Maury County: flood plain of the Duck River, 10 mi. n.w. of Lewisburg, *Rollins 5539* (GH); open field and cedar glade, 4 mi. w. of Columbia, *Rollins 55108* (GH); same location, *Rollins and Quarterman 55146* (GH).

Though originally thought to be extremely local in its occurrence, *L. densipila* now proves to have a range in area approaching that of *L. Lescurii*. Recent collections from Rutherford, Bedford and Maury Counties provide the evidence for a considerably enlarged geographic area as compared to that known at the time the species was described in 1952. The species is confined to the Central Basin of Tennessee with its predominance of limestone soils.

The populations of *L. densipila* usually consist of a large number of individuals often numbered in the tens of thousands. These may be in open glade-like areas or along the river and stream bottoms which are subjected to spring flooding each year. As in *L. Lescurii*, there is considerable variation between individuals and between populations. These are principally single character variations which can be seen from plant to plant, but there are few correlated differences between individuals of the same populations. Thus, independent assortment of genetic characters seems to be the rule. *L. densipila* is largely self incompatible, thereby insuring a continuing intermixing of the genes of any given population. Where different populations are involved, there are some minor correlated characteristics. However, *L. densipila* is an easily recognized species, and the characters that make it distinguishable from other species are present in every population. The exception to this comes in the hybrid populations that result from the natural crossing of *L. densipila* and *L. Lescurii* and of *L. densipila* and *L. stonensis.*

Lesquerella densipila and *L. Lescurii* come together at the junction of Arrington Creek, where the latter is found in abundance, and the Harpeth River, where *L. densipila* is abundantly found. From the entrance of Arrington Creek on down the Harpeth River, there are numerous populations of hybrids that have resulted from the crossing of these species. In these, the variation is very wide and the characters, for the most part, segregate independently. The fruit shape on most of the plants is somewhere between that of being extremely flattened which is characteristic of *L. Lescurii* and the globose type that is found in *L. densipila.* Occasional hybrid plants have flattened siliques, and in occasional ones the siliques are globose. The latter may be hirsute with very long trichomes, and the flattened type may lack simple trichomes altogether thus combining in different ways these characters of both species. In like manner, many other characteristics are combined in a complex series. Data supporting these conclusions have been given previously (Rollins, 1954).

Natural hybridization between *L. densipila* and *L. stonensis* has not been previously demonstrated, and the facts are at present being worked out. *Lesquerella densipila* var. *maxima* was based on hybrid plants from a population on Stones River whose variation was recognized, but was inexplicable at the time of publication. Now sufficient field work has been done to show that *L. densipila* is present on the West Fork of Stones River and some of the smaller tributaries to it. *L. stonensis* is so far known only from the East Fork of Stones River. These two species meet at the junction of the east and west forks of the river, and from that point down river hybrid populations are produced which apparently quickly incorporate the genetic makeup of stray plants of either species that come within range of cross pollination. The hybrids of *L. densipila* × *L. stonensis* have previously been referred to under the name *L. densipila* var. *maxima*.

4. **Lesquerella lyrata** Rollins, sp. nov.

Annual, stems one to several, usually simple, erect, outer decumbent at base, 1–3 dm. long, densely hirsute below with simple spreading trichomes, upwards becoming a mixture of large simple and smaller branched trichomes with the small branched trichomes predominating above; basal leaves petioled, lyrate, 2–7 cm. long, 6–15 mm. wide, hirsute with simple trichomes or with a mixture of small branched and large simple trichomes, terminal lobe large and orbicular to elliptical; cauline leaves sessile, auriculate, clasping, ovate to broadly oblong, obtuse, nearly entire to coarsely dentate, 5–20 mm. long, 4–10 mm. wide, densely to sparsely hirsute with simple or simple and branched trichomes; inflorescences dense; pedicels slender, straight, divaricately ascending, densely pubescent, 1–1.5 cm. long; sepals pubescent, spreading and yellowish at anthesis, oblong, 3–4 mm. long, 1.2–1.5 mm. wide, outer pair very slightly saccate at base; petals yellow, broadly obovate, 5–7 mm. long, 3.5–4 mm. wide, slightly rounded, truncate or shallowly retuse at apex, limb short; glandular tissue subtending paired stamens, surrounding single stamens; paired stamens ca. 4 mm. long, single stamens ca. 3 mm. long; filaments dilated at base, those of paired stamens 3–3.5 mm. long, those of single stamens 2–2.5 mm. long; siliques depressed globose to subglobose, often slightly depressed at base of style and slightly didymous, glabrous, sessile, 2.5–3 mm. high, 3–4 mm. broad; styles slender, glabrous 1–1.5 mm. long; stigma unexpanded, nearly same diameter as style; replum orbicular to slightly broader than high; ovules 2–4 in each locule, funiculi free; seeds flattened, oval to nearly orbicular in outline, margined, brown, variable in size, 1.5–2.5 mm. on longest dimension, larger seeds in capsules with 2 per locule; cotyledons accumbent. N = 8. Plate 1209.

Herba annua; caulibus erectis vel decumbentibus simplicibus vel rare ramosis hirsutis 1–3 dm. longis; foliis radicalibus lyratis petiolatis hirsutis 2–7 cm. longis, 6–15 mm. latis; foliis caulinis sessilibus auriculatis oblongis vel ovatis obtusis pubescentibus dentatis vel integris 5–20 mm. longis, 4–10 mm. latis; pedicellis ascendentibus divaricatis pubescentibus, 1–1.5 cm. longis; sepalis flavis oblongis pubescentibus 3–4 mm. longis; petalis luteis late obovatis 5–7 mm. longis, 3.5–4 mm. latis; siliquis subglobosis depressis glabris 2.5–3 mm. altis, 3–4 mm. latis; stylis tenuibus glabris 1–1.5 mm. longis; loculis 2–4-ovulatis; seminibus marginatis brunneis compressis; cotyledonibus accumbentibus.

Alabama. Franklin County: cedar glade, roadside and field, near Richardson's Crossing, 7 miles east of Russellville, April 16, 1955, *Reed C. Rollins*, *George R. Cooley and L. J. Brass 5599* (GH, type); same location, April 5, 1955, *Rollins 5548* (GH); same location, April 27, 1955, *Rollins 55188* (GH); bottom land of creek, 4 miles north of Richardson's Crossing, about 9 miles east of Russellville, April 27, 1955, *Rollins 55187* (GH). Franklin-Moulton County line: roadside near cedar covered hill, 1.5 miles east of Newburg, April 5, 1955, *Rollins 5547* (GH).

Lesquerella has not heretofore been known from Alabama. However, I was led deliberately to look for it there because of the close parallel in the over all distribution pattern of the most easterly auriculate species of *Lesquerella* and of the genus *Leavenworthia*. The latter has been known from several stations in northwestern Alabama for some time. It seemed probable that if *Lesquerella* did occur between Tennessee and Texas, it would be on limestone or soils of limestone origin. The *Leavenworthia* stations in Moulton and Franklin Counties were picked as target areas for the search. *Lesquerella* was first found on April 5th near the Moulton-Franklin County line, as I proceeded westward on Alabama State Route 24. Here there was a small population of a few dozen plants extending along the roadside for about fifty yards. The glabrous fruits immediately indicated this *Lesquerella* was not the same species as any of those known from Tennessee, although the auriculate cauline leaves left no doubt about its being related to them. However, there remained the possibility that it was an outlying station of *L. auriculata* a species found chiefly in Oklahoma, but extending into Texas. My enthusiasm was aroused and I began to search in all directions to find additional populations. As the area of my search grew larger, I moved gradually west beyond the small village of Newburg, but no new populations were encountered until Richardson's Crossing was reached. At this location, marked by a lone roadside building housing the Richardson family and a general store, *Lesquerella* was found in abundance. This population, occurring with *Leavenworthia*, *Sedum* and similar cedar glade inhabiting plants, extended over a sizeable area of the glade itself, spilling up onto the roadside and over much of an adjacent old cotton field. Here was adequate material for field study, a mass collection and cytological fixations. On April 16th I had the pleasure of showing this station to Mr. George R. Cooley and Mr. L. J. Brass, at which time the type series was collected.

Lesquerella lyrata is most nearly related to *L. densipila* on the one hand and to *L. auriculata* on the other. The siliques are on the average smaller than in either of these species, being much smaller than in *L. auriculata*. Both the latter and *L. lyrata* have glabrous siliques, but they are fundamentally separated by ovule number. In *L. auriculata* there are from 12 to 20 ovules in each silique, while in *L. lyrata* there are only 4 to 8. The basal leaves are quite different in the two. Those of *L. auriculata* are often spatulate and nearly entire but there is variation to a sinuate dentate leaf similar to that of *L. grandiflora*. However in all of the material I have seen, the basal leaves of *L. lyrata* are definitely lyrate with a large terminal obtuse lobe and much reduced more or less acute lobes or teeth along the margins.

Aside from ovule number, perhaps the most noticeable differences between *L. auriculata* and *L. lyrata* are in silique size and shape. In the former, the siliques are longer than broad, elliptical in outline, with a rounded apex, while in the latter they are broader than long and often with a slight depression at the base of the style. As to size, the fruit of *L. lyrata* measures 2.5–3 mm. high, whereas in *L. auriculata*, it ranges from 4–6(–8) mm. high. The stigma is rather strongly expanded in *L. auriculata* being at least twice the diameter of the style. In *L. lyrata*, the stigma is very slightly expanded beyond the style diameter itself.

The siliques of *L. lyrata* are only slightly smaller than in *L. densipila* and they are of the same general shape although perhaps more markedly depressed globose to nearly didymous than in the most extreme populations of the latter. Also, the ovule number runs about the same in the two species, so far as extremes are concerned. No data have been assembled on the point but I have the impression that 7 or 8 ovules per silique occur most frequently in *L. densipila* while the most frequent number in *L. lyrata* is 4. The one very marked difference between these species is the indument on the exterior of the siliques and on the styles. In *L. lyrata*, both are perfectly glabrous. In *L. densipila*, the exteriors of the siliques are densely pilose with minute trichomes and the styles are hirsute.

All of the known facts of morphology point to a closer relationship between *L. densipila* and *L. lyrata* than between the latter

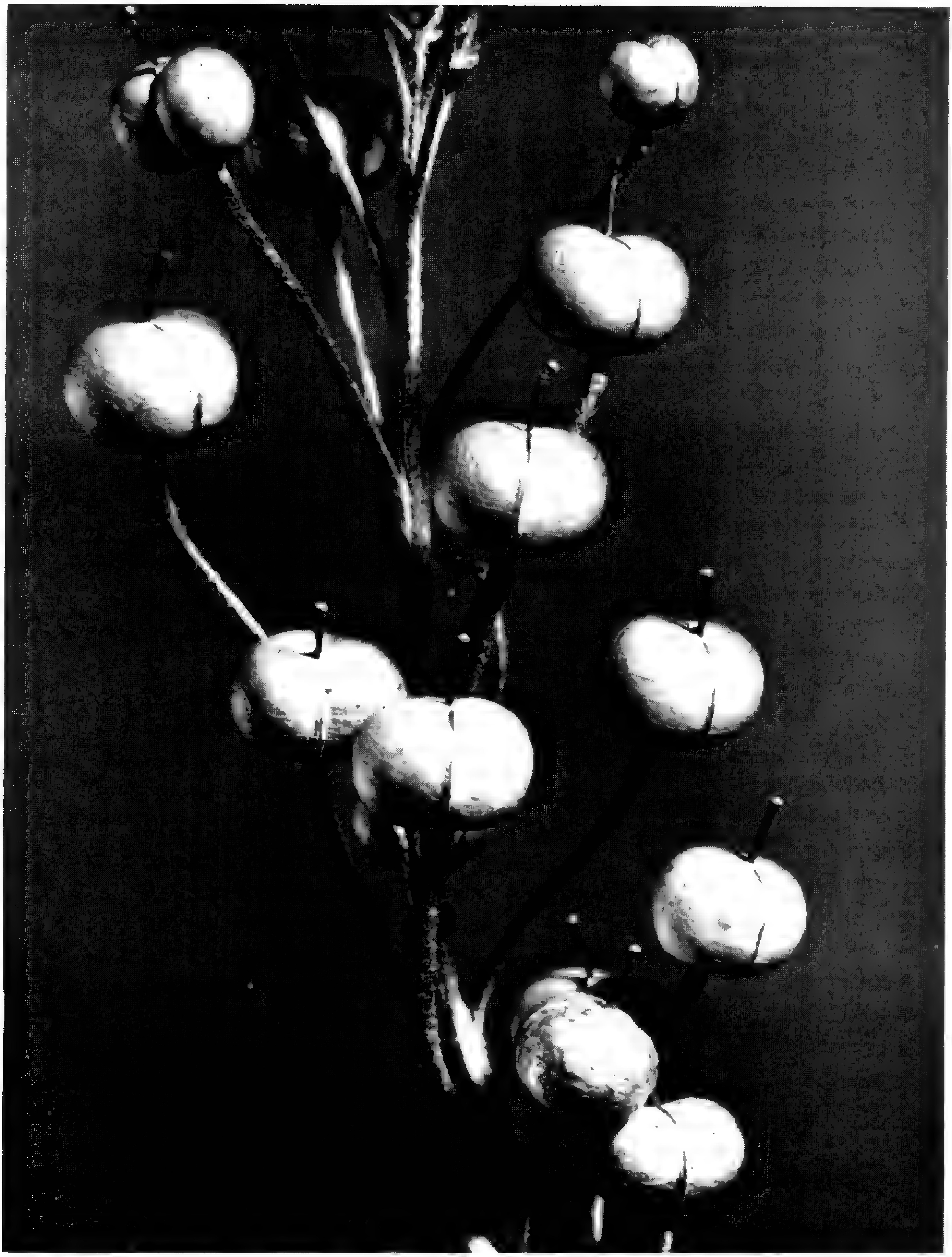


PLATE 1209. *Lesquerella lyrata.* Part of an infructescence, ×6 (*Rollins, Cooley & Brass 5599*). Photo by Frank White.

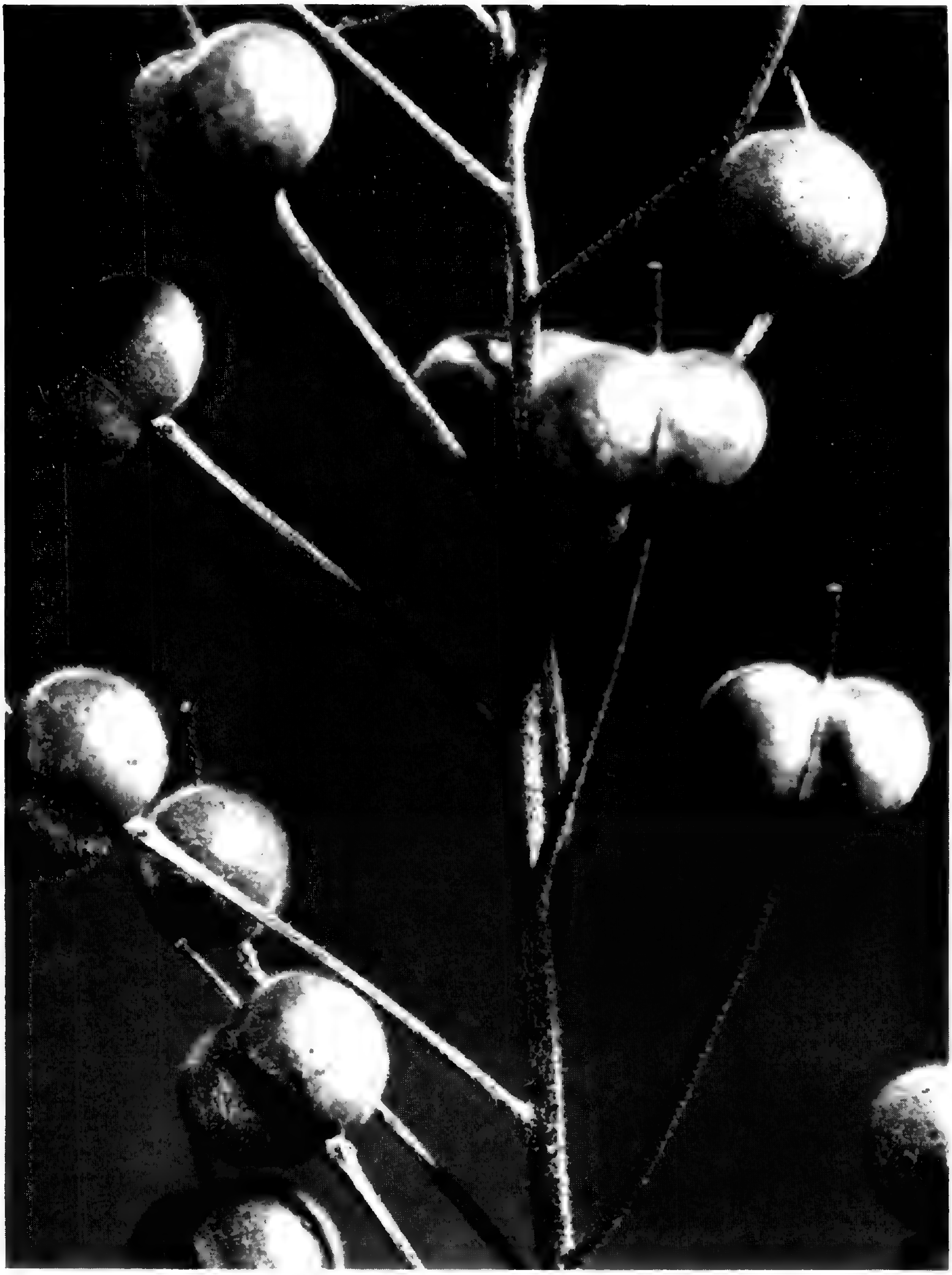


PLATE 1210. *Lesquerella stonensis*. Part of an infructescence, ×6 (*Rollins, 55176*). Photo by Frank White.

and *L. auriculata.* This presumed affinity has not been tested experimentally. The chromosome numbers of all three are the same, n = 8.

5. **Lesquerella stonensis** Rollins, sp. nov.

Annual, stems several from the base, simple or usually branched, 2–4 dm. long, erect, the outer usually decumbent at base, densely hirsute with simple trichomes below, densely pubescent above with simple or a combination of simple, forked and more lightly branched trichomes; basal leaves petioled, lyrately lobed to pinnatifid, obtuse, 3–6 cm. long, 8–15 mm. wide, densely hirsute, simple trichomes present on upper surface, a mixture of long simple and shorter forked or branched trichomes present on lower surface, lobes variable, terminal lobe large and ovate to nearly orbicular, entire to sinuate dentate, lateral lobes triangular to broadly oblong, obtuse, decurrent on the leaf rachis; cauline leaves sessile, auriculate, clasping, broadly oblong to ovate dentate, 1–5 cm. long, 5–15 mm. wide, lower cauline leaves densely hirsute with predominantly simple trichomes on upper surface, a mixture of simple, forked and branched trichomes on lower surface, upper cauline leaves densely pubescent with predominantly forked or branched trichomes; infructescence 8–15 cm. long, rachis densely pubescent with mostly branched or forked trichomes; pedicels straight or nearly so, divaricately ascending, densely pubescent, 1–2.5 cm. long; sepals oblong to nearly ovate, narrowed toward apex, pubescent, 4.5–5.5 mm. long, 1.5–2 mm. wide, outer pair slightly saccate, inner pair narrower and nonsaccate; petals white with a yellowish short claw, obovate, rounded to emarginate at apex, 7–9 mm. long, 5–6 mm. wide; filaments dilated at base, those of the paired stamens 4–4.5 mm. long, those of single stamens 3–3.5 mm. long; glandular tissue continuous, surrounding insertion point of single stamens, subtending insertion point of paired stamens; siliques depressed globose to slightly didymous, densely hirsute with simple trichomes, 4–5 mm. broad, 3–4 mm. high; edge of replum hirsute, not raised above valve margins; valves glabrous on interior; styles hirsute at least below, slender, ca. 2 mm. long; stigma expanded; replum orbicular to slightly wider than long, rounded at apex; septum usually perforate, sometimes entire, perforation variable in size; funiculi not attached to septum; ovules 4–6 in each locule; seeds dark brown, flattened, oval in outline, margined, 1.8–2 mm. long, ca. 1.5 mm. wide; cotyledons accumbent. Plate 1210.

Herba annua, caulibus ramosis vel rare simplicibus erectis vel decumbentibus hirsutis 2–4 dm. altis; foliis radicalibus petiolatis lyratis hirsutis 3–6 cm. longis, 8–15 mm. latis; foliis caulinis sessilibus auriculatis dentatis oblongis vel ovatis 1–5 cm. longis, 5–15 mm. latis; pedicellis divaricatis pubescentibus 1–2.5 cm. longis; sepalis oblongis vel ovatis pubescentibus 4.5–5.5 mm. longis, 1.5–2 mm. latis; petalis albis obovatis 7–9 mm. longis, 5–6 mm. latis; siliquis subglobosis depressis dense hirsutis 4–5 mm. latis, 3–4 mm. altis; stylis hirsutis ca. 2 mm. longis; loculis 4–6-ovulatis; seminibus marginatis, brunneis compressis 1.8–2 mm. longis, ca. 1.5 mm. latis; cotyledonibus accumbentibus.

Tennessee. Rutherford County: field and flood plain, East Fork of Stones River, Walterhill, April 26, 1955, *Reed C. Rollins 55176* (GH, type); same location, April 1, 1955, *Rollins 5507* (GH); pasture and hilltop, near East Fork of Stones River, 4½ mi. n.w. of Walterhill, April 1, 1955, *Rollins 5508* (GH); east of Old Jefferson near point where state route 102 crosses East Fork of Stones River, April 22, 1955, *Reed C. Rollins and Harold Bold 55138* (GH); pasture near East Fork of Stones River, 1 mi. s.w. of Lascassas, April 26, 1955, *Rollins 55177* (GH).

The variability of populations of *Lesquerella densipila* var. *maxima* noticeable in the field first suggested that these were of hybrid origin. In publishing this variety (Rollins, 1952) I called attention to the divergence in trichome length on different plants of the same population. Later, in working up data compiled in seeking to discover species that might have figured in the origin of var. *maxima*, it became clear that while *L. densipila* was probably involved as one parental species, there was no known species in the Central Basin of Tennessee that could have played the role of the other parent. There were characters such as fruit shape, trichome size and trichome distribution that could not have arisen from *L. densipila* or any other known species. In the spring of 1955, working on the hypothesis that the plants of var. *maxima* were of hybrid origin and that an unknown *Lesquerella* was involved in producing these hybrid plants, I sought to find the unknown. *L. stonensis* is that heretofore unknown species.

The situation with regard to the hybrid origin of var. *maxima* is now fairly clear, though a complete study has not been made, up to the present. *Lesquerella stonensis* exists as a pure species at various localities along the East Fork of Stones River. *L. densipila* exists as a pure species on the West Fork of Stones River and to the south and west of this area in the Central Basin. Both species occupy flood plain habitats and presumably their most important direction of movement is downstream, the seeds being carried during the annual spring floods. The two species come together where the two forks of Stones River meet and hybridization takes place there. From the junction of the East and West Forks downstream, all of the populations examined showed evidences of their hybrid origin.

Lesquerella stonensis is a white flowered species, most closely related, as shown by most of its characteristics, to the yellow flowered *L. densipila*. It differs not only in flower color from

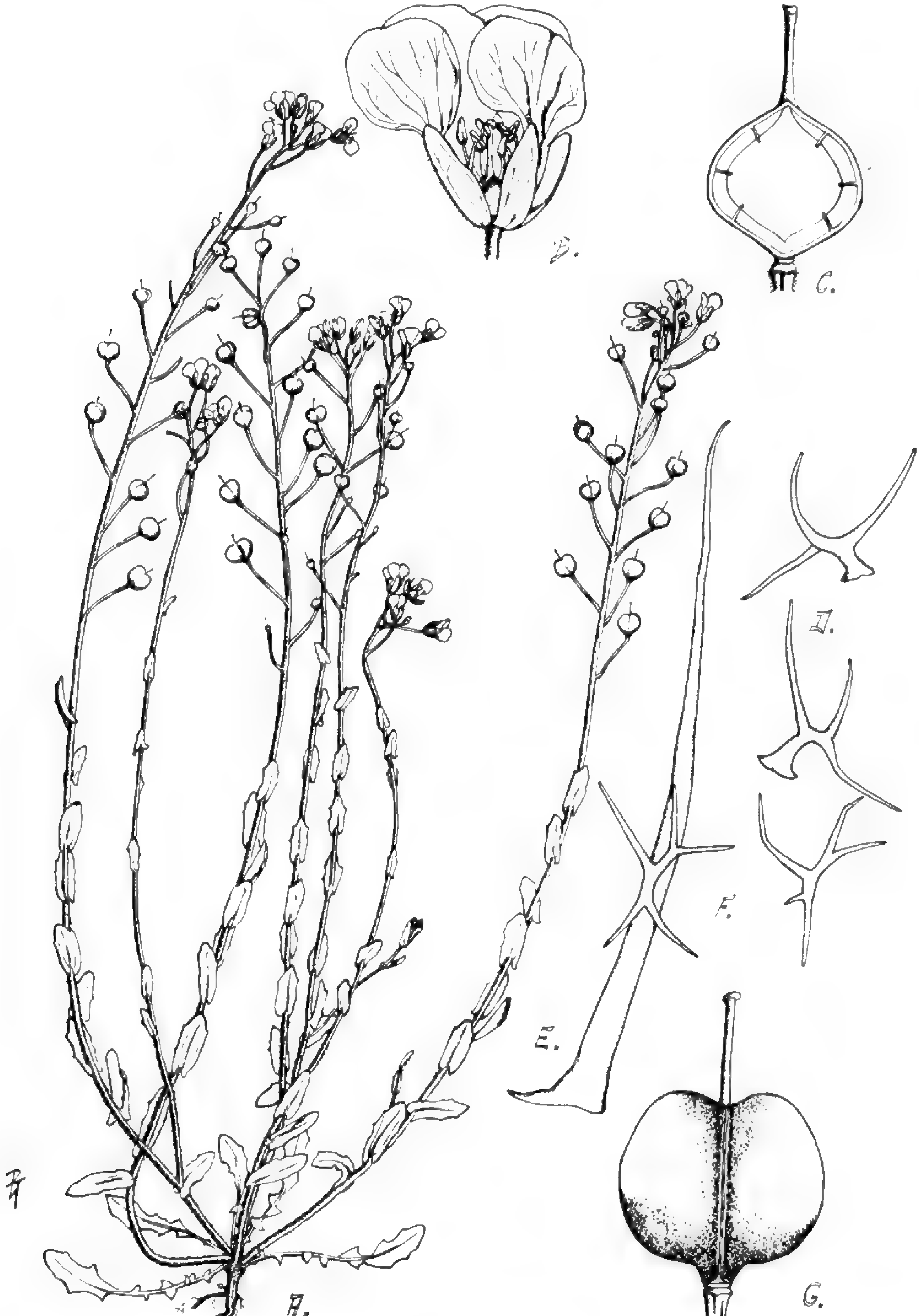


Fig. A–G. *Lesquerella perforata.* A—habit sketch ×½. B—flower ×3. C—replum and perforate septum ×4. D–F—trichomes of the stems and leaves ×125. G—silique ×4. Drawings by B. Tugendhat.

L. densipila but also in the size and shape of the siliques and in the length of the trichomes on the valves of the siliques. In *L. stonensis*, the larger fruits are depressed globose to slightly didymous while the smaller fruits of *L. densipila* are globose to subglobose. On the valve surfaces, a dense covering of minute simple or forked trichomes is present in *L. densipila*, but in *L. stonensis* the simple trichomes are much longer and form a less dense indument. By comparing plate 1210, *L. stonensis*, and plate 1208, *L. densipila*, which are reproduced at the same scale of magnification, the differences of indument between these species can readily be seen. Most of the siliques of *L. stonensis* examined possessed a perforate septum. Sometimes the perforation was small. However, in many instances it was larger, ranging upward in size to about one-fourth of the total area of the septum.

6. **Lesquerella perforata** Rollins, Rhodora **54:** 190. 1952.

Annual; stems several to many, outer usually decumbent at base, inner erect, simple or branched, 1 dm. high, densely hirsute below with large spreading mostly simple trichomes, pubescent above with less-spreading mostly branched trichomes; basal leaves lyrately lobed, petiolate, 2–5 cm. long, 5–15 mm. wide, lobes variable, terminal lobe orbicular to ovate, entire or dentate, obtuse to more pointed, lateral lobes broadly oblong, entire or shallowly toothed, becoming remote toward petiole; hirsute on both surfaces, with mostly simple trichomes, marginal trichomes smaller and branched; cauline leaves sessile, auriculate, broadly oblong to nearly ovate, sagittate, dentate, 8–20 mm. long, 4–8 mm. wide, hirsute above with simple trichomes, below with a mixture of simple and branched trichomes; pedicels straight, divaricately ascending, scarcely swollen at apex, 6–12 mm. long, uniformly pubescent with branched trichomes or with a mixture of simple and branched trichomes; sepals oblong, pubescent with a mixture of large and small branched trichomes, 3.5–5 mm. long, 1.5–2 mm. wide; petals white to pale lavender with a yellowish claw, sometimes tinged with light purple when dry, unguiculate, obovate to very broadly spatulate, emarginate to nearly entire, 7–9 mm. long, 5–6 mm. wide; filaments dilated at base, those of paired stamens 4–4.5 mm. long, anthers ca. 1.3–1.5 mm. long; glandular tissue subtending all filaments and nearly surrounding those of the single stamens, with projections between single and paired stamens; siliques inflated, variable in shape, broadly obovoid to subpyriform, very slightly stipitate, sparsely hirsute with large simple or forked trichomes to nearly glabrous on the exterior, densely pubescent with small dendritically branched trichomes on the interior, 4–6 mm. long, widest above the middle, 4 mm. wide; septum nearly obsolete, represented by only a narrow band of tissue around the inner margin of the replum; styles 1.5–.5 mm. long, unexpanded or only very slightly expanded at apex; ovules 2–6 in each loculus, funiculi nearly free, seeds slightly longer than broad to nearly orbicular, flattened, margined, 1.5–2.5 mm. long, 1.2–2 mm. broad; cotyledons accumbent. N = 8. Plate 1211.

Tennessee, Wilson County: open field near Spring Creek, 5 mi. n. of Lebanon, 1952, *R. C. & D. Rollins 5207* (GH); same general locality, 1953, *Rollins 5304* (GH); same locality, 1955, *Rollins & Bold 55139* (GH); near Lebanon, *Sharp 83* (TENN); western edge of Lebanon, *R. C. & D. Rollins 5208* (GH); near Barton Creek, ½ mi. w. of Lebanon, *Rollins 5306, 53145* (GH); 3 mi. w. of Lebanon, *Rollins & Bold 55141* (GH).

Aside from the perforate septum and the very dense covering of dendritic trichomes on the interior of the valves which I have emphasized before, l.c., one of the striking features of this species is the papery quality of the siliques. As may be seen in plate 1211, the valves are somewhat wrinkled and unusually strongly veined. These are not raised veins, but they do have greater density than the papery valve itself. The replum margin stands above the level of the adjacent valves which flare slightly outward on each side of it. Thus, the edge of the replum together with the valve margins forms a definite ridge that nearly encircles the silique.

Mass collections of fruiting racemes have been available for study, and one of the very noticeable things about the plants of a population of *L. perforata* is the variation in the shape of the silique. In some plants, the siliques are definitely pyriform, in others nearly the shape of an inverted triangle, and in still others the siliques are much depressed and almost didymous. Also, there appears to be a difference in ovule number between two populations. In ten plants from the population near Spring Creek represented by No. 55139, there was an average of 3.1 ovules per locule. Ten plants of the population three miles west of Lebanon, No. 55141, had an average of 5.0 ovules per locule. The significance of these and other differences between populations is not understood at present, but I shall not be surprised if further study eventually shows that this and other species of *Lesquerella* of the Central Basin are in the process of fractionating, evolutionally speaking, to produce a new array of forms that may eventually become quite distinct.

Lesquerella perforata is apparently local in its occurrence, but I suggest this with considerable caution. In three different years, I have searched the general area around Lebanon for populations of *Lesquerella* hoping to discover a broader range for *L. perforata.* On each occasion, the species was found in great abundance at the known stations, but these are all within six miles of Lebanon. Attempts to find it farther afield were not successful. However, my experience with *Lesquerella* elsewhere in the Central Basin of Tennessee leads me to be cautious about stating a definite range for a given species. At first, *L. densipila* was thought to be from a very limited area, but now, as a result of recent field work, it is known to be quite widespread in the Central Basin.

7. **Lesquerella auriculata** (Engelm. & Gray) Watson, Proc. Am. Acad. **23:** 250. 1888.

Vesicaria auriculata Engelm. & Gray, Bost. Journ. Nat. Hist. **5:** 240. 1845.

Alyssum auriculatum (Engelm. & Gray) Kuntze, Rev. Gen. Pl. **2:** 931. 1891.

Annual; stems several to many, erect or decumbent at base, simple, 0.5–2 dm. high, rather stout, hirsute with long simple trichomes and with an understory of smaller branched trichomes; basal leaves with a short petiole, lyrate to sinuate dentate, sometimes nearly entire, usually obtuse, rarely somewhat acute, 2–5 cm. long, 8–15 mm. wide, hirsute on margins, midrib, and much of upper surface with simple trichomes, upper and lower surfaces often pubescent with smaller branched trichomes; cauline leaves auriculate, sessile, entire to dentate, usually overlapping on the stem, oblong to sagittate, 1–4 cm. long, 3–10 mm. wide; pedicels divaricately ascending to divergent at about 45°, nearly straight, hirsute with spreading simple and branched trichomes, 7–15 mm. long, not expanded at summit; sepals narrowly oblong, hirsute with spreading simple and branched trichomes, 4–6 mm. long, 1.5–2 mm. wide, outer pair slightly saccate, inner pair flat at base; petals yellow, obovate, entire to slightly emarginate at apex, 7–10 mm. long, 4–5 mm. wide; filaments abruptly dilated at base; siliques globose to longer than broad, glabrous, 4–6 (–8) mm. long, 4–6 mm. wide, nearly sessile, valves glabrous within; septum entire or rarely with a small perforation; styles glabrous, 1.5–2 mm. long; stigma expanded; ovules (4–) 6–8 (–10) in each locule; seeds nearly orbicular, flattened, margined, ca. 2 mm. in diameter; cotyledons accumbent. N = 8.

Oklahoma: 2 mi. so. Choteau, Mayes Co., *D. M. Moore 55–11* (GH); 6 mi. so. Ponco City, Kay Co., *Waterfall & McCoy 11402* (OKLA, TEX); 1 mi. w. Perry, Noble Co., *Harding 296 & 334* (OKLA); 4 mi. e. Stillwater, Payne Co., *Waterfall 9907* (OKLA, TEX); edge of Enid, Garfield Co., *Gephardt 16 & 160* (US); near Kingfisher, Kingfisher Co., *Stevens 188* (GH, MO, NY, OKLA, US);

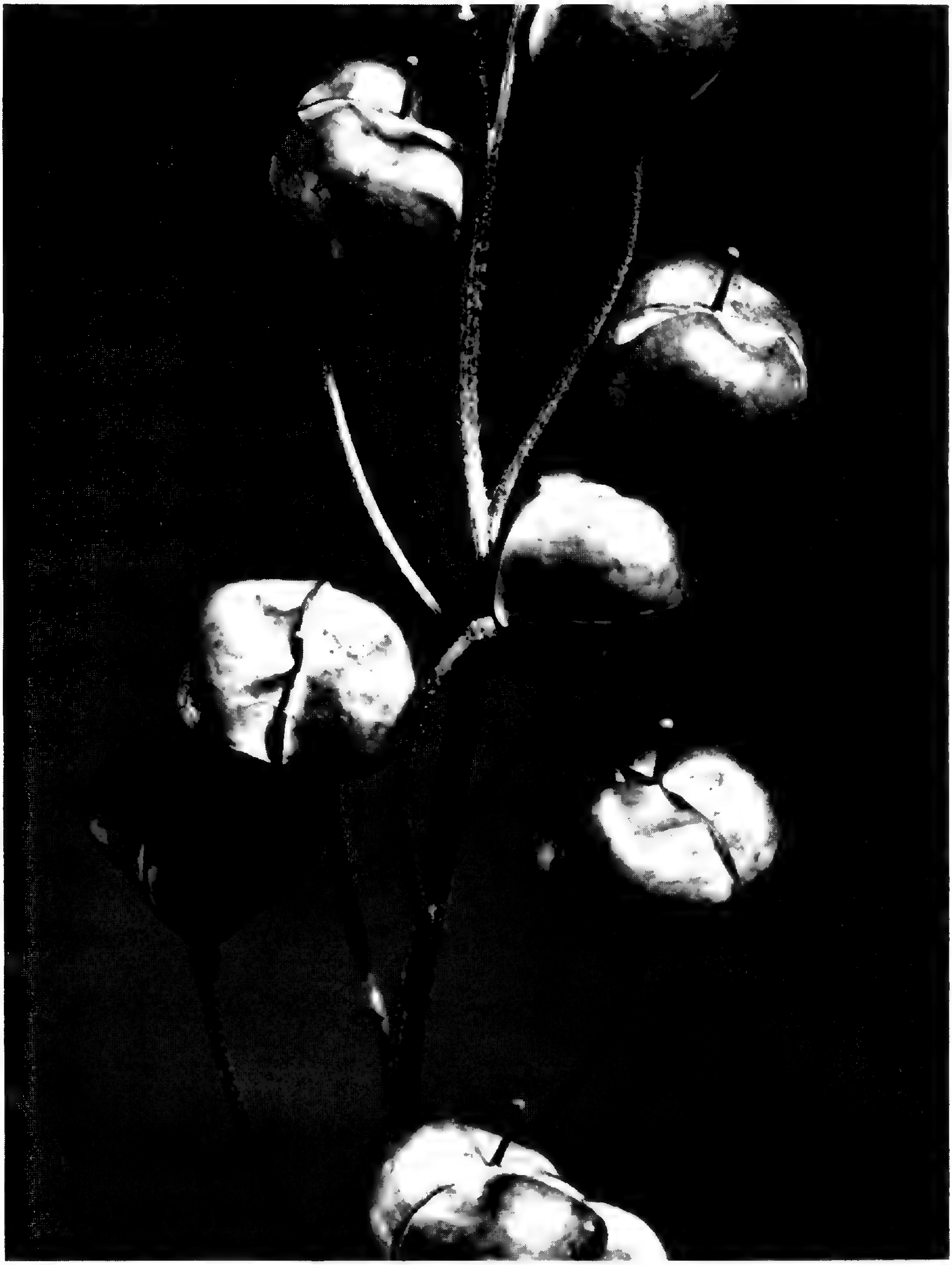


PLATE 1211. *Lesquerella perforata.* Part of an infructescence, ×5 (*Rollins & Bold 55139*). Photo by Frank White.

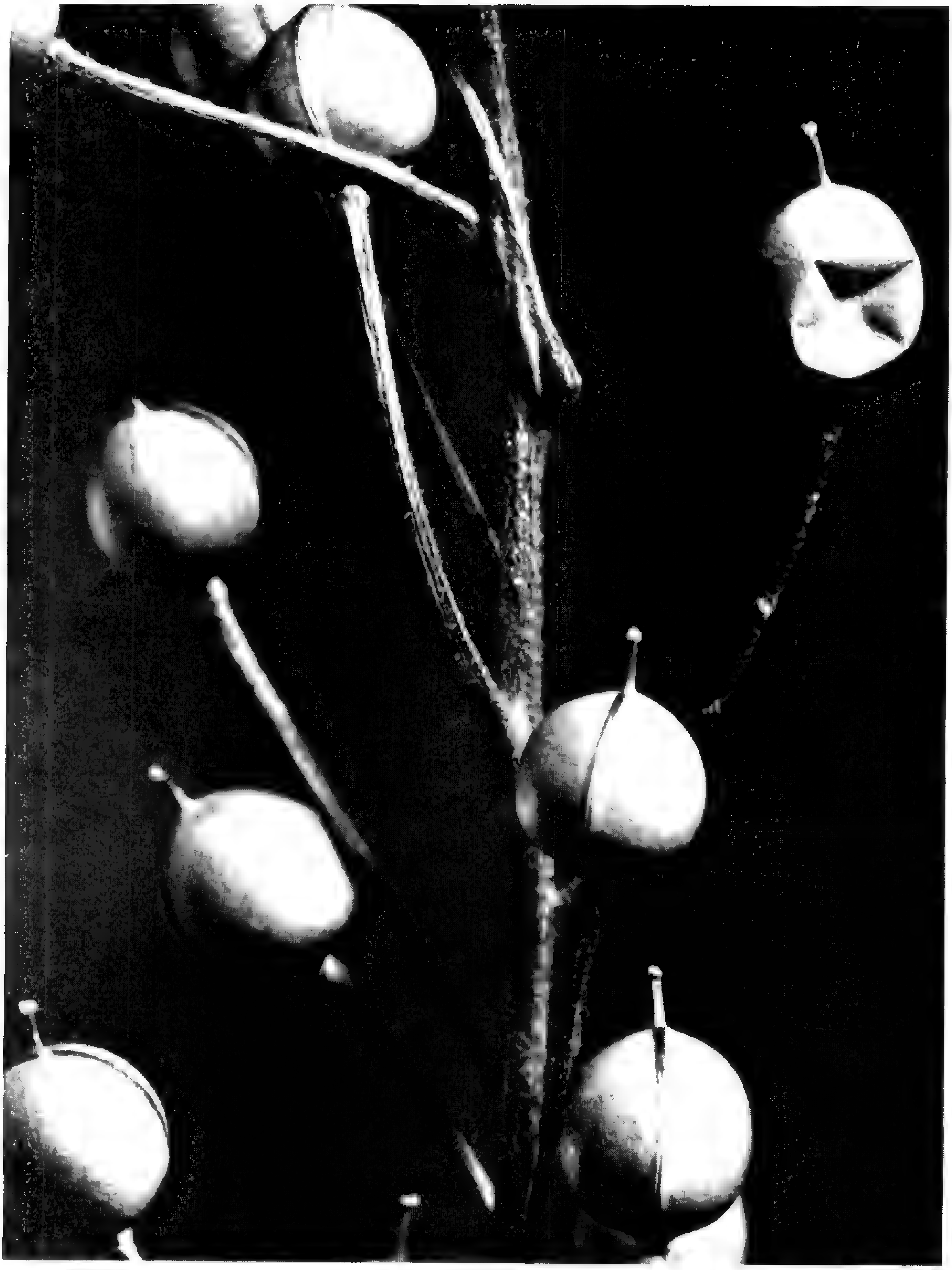


Plate 1212. *Lesquerella grandiflora.* Part of an infructescence, ×5 (*Rollins 5561*). Photo by Frank White.

U. S. Highway 66 e. of S. Canadian R. bridge, Canadian Co., *Waterfall 3609* (MO, OKLA); open plains, Grady Co., *Goodman 2090* (GH, MO, NY); 3 mi. so. Union, Grady Co., *Rollins 53126* (GH); 8 mi. so. Watonga, Blaine Co., *Goodman 2382* (GH, MO, NY); near Hinton, Caddo Co., *Demaree 11919* (GH); 3 mi. n. Lawton, Comanche Co., *Rollins 53123* (GH); 5 mi. n. Granite, Green Co., *Bull 72* (MO).

Texas: Big Sandy, Upshur Co., *Reverchon 2967* (MO); Terrell, Kaufman Co., *Reverchon 3717* (GH, MO, NY, US); s.w. Dawson, Navarro Co., *Reverchon s.n.* (MO); near San Felipe on the Brazos, Austin Co., March, 1844, *E. Lindheimer 217* (GH, type; GH, MO, isotypes); Brazos Prairie, Feb., 1846, *Lindheimer s.n.* (NY).

The rarity and the curiously disrupted distribution of *Lesquerella auriculata* in Texas contrast with the abundance and the more or less integrated distributional area of this species in Oklahoma. Adding to the puzzling known distribution is the fact that there are no recent collections from Texas. Those of Reverchon go back to 1902 and 1903, and there are no more recently collected specimens in the herbaria from which I have received material. In 1953, I made a special search in Texas for *L. auriculata* especially in Kaufman and Navarro Counties and in the area around San Felipe, the type station. Near San Felipe, the related *L. grandiflora* was present in abundance, but I could not find *L. auriculata.* In fact, by the time the San Felipe area had been searched as thoroughly as time would permit, I was almost ready to conclude that *L. auriculata* had been based on an unusual specimen of *L. grandiflora.* However, I have studied the type and a series of isotypes (four sheets of specimens of the type series in all), and there is no doubt but that they belong to the same species as the material from farther north in Texas and that of Oklahoma.

It is difficult to point up the differences between *L. auriculata* and *L. grandiflora* in such a way as to be convincing as to the specific nature of each. The smaller stature of *L. auriculata* is perhaps significant, but there are populations of *L. grandiflora* with equally small plants. The basal leaves are often lyrate to nearly entire and broadly oblanceolate in *L. auriculata;* and if all populations possessed basal leaves of this type, it would be considered a distinctive feature. However, there are a number of collections that show evenly dentate and more or less acute basal leaves similar to those of *L. grandiflora.* Characters such as the nature of the pubescence, flower size, and the density of the infructescence appear to be the most constant for purposes of identification. In spite of the relatively few rather unsatisfactory morphological differences, there seems to be no doubt that two species, not a single one, are present. This view is reinforced by the evidence from chromosome numbers. In two of the Oklahoma populations of *L. auriculata* (*Rollins 53123* & *53126*) where counts were made, n = 8 was found. On the other hand, n = 9 has been found in three populations of *L. grandiflora*. This aneuploid relationship between *L. auriculata* and *L. grandiflora* is almost certain to provide a genetic basis for breeding incompatibility between the two species.

The different populations of *L. auriculata* are by no means identical with each other, and there is considerable variation within populations as well. In most plants of *L. auriculata*, the siliques are globose or nearly so, but there are occasional plants in which they are longer than broad, approaching the elliptical in outline. Such plants were found in a population three miles north of Lawton, Oklahoma (*Rollins 53123*), and I have seen specimens of this type collected by others. The ovule number is higher than usual in these more elongate fruits; for example, in the plants of my collection there were as many as ten ovules in each locule. The most frequent number is between six and eight. There is also a trend toward a reduced ovule number indicated by plants from the most northeasterly known station, Mayes County, Oklahoma (*Moore 55-11*). In this collection, I have examined fruits with only four and five ovules per locule. This particular collection is rather unusual in other respects, such as the deep cutting of the basal leaves and the rather markedly dentate cauline leaves.

8. **Lesquerella grandiflora** (Hook.) Watson, Proc. Am. Acad. **23:** 250. 1888.

Vesicaria grandiflora Hook., Bot. Mag. **63:** pl. 3464. 1836.
V. grandiflora var. *pinnatifida* Gray, Bost. Jour. Nat. Hist. **6:** 146. 1850.
V. brevistyla Torr. & Gray, Fl. N. Am. **1:** 102. 1838.
Alyssum grandiflorum (Hook.) Kuntze, Rev. Gen. Pl. **2:** 931. 1891.

Annual; stems several to numerous, erect to decumbent at base, simple or branched, 2–7 dm. long, densely pubescent with branched usually five-parted trichomes; basal leaves petiolate, oblanceolate, irregularly dentate to bipinnatifid, acute to obtuse, varying greatly in size from 5–15 cm. long, densely pubescent with branched, mostly five-parted trichomes, rays of trichomes often erect; cauline leaves oblong to lanceolate, acute to obtuse, usually overlapping, dentate to conspicuously toothed, mid-rib conspicuous, densely pubescent with branched trichomes, 1–4 cm. long, sessile, upper definitely auriculate, lower often narrowed toward base and usually lacking auricles; pedicels ascending to divaricate, straight to slightly curved upward, densely pubescent, 1–2 cm. long; sepals oblong, densely pubescent, nonsaccate, 5–7 mm. long, 2–3 mm. wide; petals yellow, broadly obovate to nearly orbicular in outline, rounded to slightly emarginate at apex, usually narrowed abruptly to a short claw, 8–11 mm. long, 6–9 mm. wide; anthers sagittate, 2.5–3 mm. long; filaments dilated at base, 3–4 mm. long; glandular tissue projecting, subtending paired stamens, nearly surrounding base of single stamens; siliques globose to slightly longer than broad, glabrous, 4–6 mm. high, 4–5 mm. wide, with a very short gynophore to nearly sessile; valves glabrous within; styles 1–1.5 mm. long; stigmas expanded; funiculi slender, 1–1.5 mm. long, attached to septum by lower half; seeds margined, orbicular, flattened, 2.5–3 mm. in diameter; cotyledons accumbent. N = 9. Plate 1212.

Texas: Houston, Harris Co., Biltmore Herb. 14807 (MO); San Felipe, Austin Co., 1835 *Drummond 20 bis* (K, type; NY, type of Vesicaria brevistyla; GH, isotypes); 3 mi. s.e. of San Felipe, Austin Co., *Rollins 5352* (GH); Herrington, Brazos Co., *E. J. Palmer 13440* (MO, US); 12 mi. s.w. Caldwell, Burleson Co., *Cory 51660* (US); Columbus, Colorado Co., *Howell 356* (US); Bastrop, Bastrop Co., *Duval s.n.* (US); Victoria, Victoria Co., *Tracy 9193* (GH, MO, NY, US); prairies east of Victoria, Feb., 1845, *Lindheimer 300* (GH, type of Vesicaria grandiflora var. pinnatifida; MO, isotypes); Austin, Travis Co., *Hall 23* (GH, MO, NY, US); Caldwell Co., *McBryde s.n.* (NY); 11 mi. n.w. of Westhoff, Gonzales Co., *Rollins 5363* (GH); 6 mi. s. of Lulling, Gonzales Co., *Rollins 5555* (GH); Ottine, Gonzales Co., *Cory 5691* (GH); 4 mi. n. Cuero, Dewitt Co., *Rollins 5561* (GH); Goliad, Goliad Co., *E. J. Palmer 9136* (MO); 3 mi. s. Seguin, Guadalupe Co., *Cory 54056* (OKLA); ½ mi. w. Stockdale, Wilson Co., *Rollins 5364* (GH); 3 mi. w. of La Vernia, Wilson Co., *Rollins 5365* (GH); 4 mi. s.e. Floresville, Wilson Co., *Rollins 5567* (GH); Riviera, Kleberg Co., *Harrison s.n.* (US); Kingsville, Kleberg Co., *Sinclair s.n.* (GH, MO); Llano, Llano Co., *Reverchon 1488* (GH, MO, NY, US); 16 mi. s. of Llano, *Rollins 5575* (GH); Edge Falls, Rendall Co., *H. B. Parks s.n.* (GH); 6 mi. w. Thelma, Bexar Co., *Johnson & Webster 578* (GH, OKLA, US); near Moore, Frio Co., *E. J. Palmer 33861* (GH, MO, NY); Carrizo Springs, Dimmit Co., *E. J. Palmer 33750* (NY).

In stature and vegetative characters, *Lesquerella grandiflora* is quite variable. Individual plants appear to respond sharply to shading, moisture, and similar factors of the environment. At several locations, I have observed populations that extended from sunny to shady habitats. In the sun, the plants were short with comparatively small leaves and shortened internodes.

Plants in the shade or growing in a dense growth of other herbs were tall with large thin leaves and elongated internodes. Herbarium specimens need to be interpreted with these points in mind. *Vesicaria grandiflora* var. *pinnatifida* of Gray appears to be a shade form, and the deeply cut leaves found on the type specimen are usual in shade grown plants.

The populations of *L. grandiflora* that I have seen were all on sandy, loose, well-drained soils. These habitats are relatively dry and depend on current rains for a moisture supply. The most frequent occurrence of the species appears to be in the south central part of Texas just east of the Edwards Plateau. However, it is extremely abundant in the valley of the Llano River in Llano County which is well within the Plateau area. In general, *L. grandiflora* occurs south and west of *L. auriculata*, but the two species evidently come together at San Felipe in Austin County. There are no recent records of *L. auriculata* at the latter locality, but the species was founded on material from that location.

The problem of distinguishing *L. auriculata* and *L. grandiflora* has been dealt with above. There is a sharp break between petiolate basal leaves and markedly auriculate cauline leaves in *L. auriculata*. However, in *L. grandiflora*, the transition is a gradual one with the lower cauline leaves being narrowed to the base and devoid of auricles in most instances. Proceeding up the stem, the leaves become less narrowed at base, and the auricles become more prominent. Another point of difference that should perhaps be stressed again is in the infructescence. In *L. auriculata*, the infructescence is dense and rather short while in *L. grandiflora*, the infructescence tends to elongate greatly and becomes rather loose as a result.—GRAY HERBARIUM OF HARVARD UNIVERSITY.

Literature Cited

Lanjouw, J. and F. A. Stafleu. 1954. Index Herbariorum, part I. The Herbaria of the World, Ed. 2. Regn. Veg. **2**: 1–179.

Payson, E. B. 1922. A Monograph of the Genus Lesquerella. Ann. Mo. Bot. Gard. **8**: 103–235.

Rollins, Reed C. 1952. Some Cruciferae of the Nashville Basin, Tennessee. Rhodora **54**: 182–192.

————. 1954. Interspecific Hybridization and Its Role in Plant Evolution. VIII Cong. Int. Bot. Rapp. & Comm. Sect. **10**: 172–180.

Watson, Sereno. 1888. Contributions to American Botany. Proc. Am. Acad. **23**: 249–287.

PLANTS NEW TO ILLINOIS AND TO THE CHICAGO REGION

JULIAN A. STEYERMARK AND FLOYD A. SWINK

THE last report by the authors appeared in RHODORA **54:** 208–213. 1952. As on previous occasions, the authors have either collected or have found these new records in the herbarium of the Chicago Natural History Museum. All specimens collected have been deposited in the herbarium of that institution.

1. ADDITIONS TO THE FLORA OF ILLINOIS

TRILLIUM ERECTUM L. This species is not given by Jones in the second edition of his Flora of Illinois. During the spring of 1954 while botanizing a tract of rich woodland on the property of Mr. Richard Babcock in northeastern Illinois, the senior author saw numerous plants belonging to this species growing with hundreds of *Trillium grandiflorum.* Mr. Babcock was certain that neither of the two species had been introduced, since he and his mother before him have maintained the property in its natural condition. Associated with the rich mesophytic woodland flora were *Hepatica acutiloba, H. americana, Mitella diphylla, Asclepias exaltata,* and many other native species. My field notes for the *Trillium erectum* collection read: "ovary deep purple, petals spreading from base, maroon-purple, peduncle ascending to spreading, above the leaves." The data for this collection are as follows: rich wooded slopes along headwaters of tributary of Boone Creek, T 44 N, R 7 E, sect. 11, on property of Mr. Richard Babcock, 4 mi. east of Woodstock, Mc Henry Co., May 9, 1954, *Steyermark 76094.*

This locality is close to the Ringwood station, cited by Jones (p. 100) in the second edition of his Flora of Illinois for *Trillium cernuum,* in which he includes var. *macranthum* Wieg. The senior author has examined the Ringwood specimen collected by Dr. Geo. Vasey, identified by him as *T. cernuum* and later verified by Stanley J. Smith, but it is not possible to judge in the dried condition of preservation two of the critical characters used in delimiting *T. cernuum,* i. e., color of the ovary and position of the petals in anthesis, whether spreading from the base (as in *T. erectum*) or from the middle (as in *T. cernuum*). The senior author has determined this Vasey specimen as *T. erectum,* rather than as *T. cernuum,* on the basis of the field observations on plants from the Woodstock locality, which is near the Ringwood station of Vasey's collection. The E. J. Hill collection from Wolf Lake, Chicago, cited under *T. cernuum,* has not been examined. It is probable, however, that both *T. cernuum* and *T. erectum* will have to be admitted to the Illinois flora.

RUMEX ACETOSELLA L., forma INTEGRIFOLIUS (Wallr.) G. Beck. The data for this collection are: in shaded ground of Col. Fabyan Forest Preserve south of Geneva, Kane Co., June 8, 1952, *Swink 1198.*

Fragaria vesca L., forma alba (Ehrh.) Rydb. A colony of about fifty plants was found by Mrs. Charles W. Miller growing wild on her property in the Biltmore Estates subdivision of Lake County. In this colony the fruit was whitish with white superficial achenes; the calyx lobes were spreading on all specimens noted. In general the plants are of a paler green color than in the common redfruited variety with which they were associated. The data for this collection are as follows: upland oak-hickory open woodland on property of Chas. W. Miller, Kimberley Road, Biltmore Estates subdivision, 5 mi. north of Barrington, Lake Co., June 26, 1952, *Steyermark 73627*.

Baptisia minor Lehm. Mr. Karl Bartel, a keen local ornithologist and amateur botanist, discovered this species growing in a natural dry prairie associated with typical dry prairie species, such as *Eryngium yuccifolium*, *Silphium laciniatum*, and *Silphium terebinthinaceum*. As only one plant was noted and the station is well out of the known range (Mo. and Kans. to Tex.) of the species, it is suspected that the plant has been introduced at this locality. There is no indication at this time, however, to suggest how it could have been introduced from the southwest, as the nearest railroad is some distance away. The data for this collection are: in a dry prairie near 105th St. and Central Ave. near Chicago Ridge, Cook Co., August 2, 1953, *Swink & Bartel 2521*.

Vigna sinensis (L.) Endl. The authors found this Cowpea as an adventive in a state forest area. The data for the collection are as follows: sandy soil in *Quercus stellata-Q. marilandica-Q. velutina* forest, Mason State Forest, 5 mi. north of Forest City, Mason Co., August 13, 1949, *Steyermark & Swink 68854*.

Vitis riparia Michx., var. syrticola (Fern. & Wieg.) Fern. Several collections which may be referred to this variety are the following: Jo Daviess Co.: ¼ mi. south of Council Hill, *Lansing 4145;* Kankakee Co.: Altorf Island, 9 mi. northwest of Kankakee, *Steyermark 68633;* Kankakee, *E. J. Hill;* Du Page Co.: Naperville, *Umbach;* Cook Co.: Graceland, Chicago, *F. C. Gates 252;* Camp Harrison, between 154th and 159th streets, T 36 N, R 14 E, NE ¼ sect. 13, 1¼ mi. west of Calumet City, *Steyermark 68303;* Winnetka, *Sherff 1917;* La Salle Co.: Starved Rock, *Greenman, Lansing & Dixon 5*.

2. Additions to the Flora of the Chicago Region

Bromus squarrosus L. This was collected in sandy soil along a path near the Baltimore & Ohio Railroad west of Lake Street in the Miller section of Gary, Lake Co., Indiana, June 21, 1952, *Swink 1362*.

Triodia flava (L.) Smyth, forma cuprea (Jacq.) Fosberg. An abundant grass known from several stations: along U. S. 12 near Lakeside, Berrien Co., Michigan, *Swink 1904;* sandy soil of a forest preserve parking lot on the south side of Ridge Road east of Thornton, Cook Co., Illinois, September 25, 1954, *Swink 2762*.

Elymus interruptus Buckl. This was collected in woods near South Lake of the Grand Marais lake chain near Stevensville, Berrien Co., Michigan, June 15, 1952, *Swink 1299*.

Sporobolus vaginiflorus (Torr.) Wood, var. inaequalis Fern. This collection was found in gravelly soil along Whitcomb St. near 17th St. in Gary, Lake Co., Indiana, September 21, 1952, *Swink 1911.*

Muhlenbergia asperifolia (Nees & Meyen) Parodi. Although Deam found this once in Lake Co., Indiana, it has not been reported previously for the Illinois portion of the Chicago region. The data for this record follow: along Douglas Park r.r. tracks property, just east of 52nd Avenue, Cicero, Cook Co., Illinois, July 29, 1953, *Swink 2356.*

Panicum miliaceum L. This was collected along a roadside in the Lakewood Estates subdivision north of Dundee, Kane Co., Illinois, July 24, 1954, *Swink 2751.*

Luzula luzuloides (Lam.) Dandy & Wilmott. This is collected in woods of Covenent Harbor near Lake Geneva, Walworth Co., Wisconsin, July 4, 1953, *Swink 2272.*

Allium stellatum Fraser. Found in a dry prairie near the ski slide in Fox River Grove, Mc Henry Co., Illinois, August 3, 1952, *Swink 1636.* This record applies only to the Illinois area, as it was found once in the dune area of Indiana (see Deam's Flora of Indiana, p. 1034, for details).

Nymphaea odorata Ait. Collected in shallow water of the boggy area of South Lake of the Grand Marais lake chain near Stevensville, Berrien Co., Michigan, June 21, 1953, *Swink 2207.*

Jeffersonia diphylla (L.) Pers. Collected in rich woods near Butternut Springs, 3 miles east of Wheeler, Porter Co., Indiana, April 19, 1953, *Swink 1949.* This new record applies only to the Indiana area, as the plant has been collected in Cook Co., Illinois.

Podophyllum peltatum L., forma aphyllum Plitt. This form was found in rich woods of Pilcher Arboretum east of Joliet, Will Co., Illinois, May 16, 1953, *Swink 2016.*

Sisymbrium loeselii L. This was collected in a barnyard north of Helm Road and east of Route 25, about 3 miles northeast of Carpentersville, Kane Co., Illinois, June 27, 1953, *Swink 2221.*

Filipendula rubra (Hill) Robins. This rare and local species, previously known in the Chicago region only from Du Page County, Illinois, has recently been discovered by Mr. Karl Bartel in Will and Cook counties, Illinois. The data for these collections are: marshy ground along a roadside south of an old scout camp three miles southeast of Custer Park, Will Co., Illinois, August 2, 1953, *Swink & Bartel 2425;* marshy ground along 107th Street east of Kean Avenue north of Palos Park, Cook Co., Illinois, August 2, 1953, *Swink & Bartel 2505.*

Rubus laciniatus Willd. Collected along the east side of the Des Plaines River in Schuth's Grove just north of Cermak Road near North Riverside, Cook Co., Illinois, December 6, 1953, *Swink 2664.*

Cassia nictitans L. Collected in sandy soil south of Ridge Road, 1½ miles east of Thornton, Cook Co., Illinois, August 14, 1954, *Swink 2755.* This record applies only to the Illinois area, as the plant has been found in the Indiana dunes.

Crotalaria sagittalis L. Collected in sandy soil south of Ridge

Road, 1½ miles east of Thornton, Cook Co., Illinois, August 14, 1954, *Swink 2763.*

Desmodium glutinosum (Muhl.) Wood, forma chandonnetii (Lunell) Schub. Collected in woods near Long Lake near Black Hawk Beach, Porter Co., Indiana, July 14, 1952, *Swink 1467.*

Lespedeza leptostachya Engelm. Collected in a dry gravelly prairie along the south side of Shoe Factory Road west of Sutton Road north of Bartlett, Cook Co., Illinois, *Swink 2757.* Jones (2nd edition, p. 179, Flora of Illinois) records this species from McHenry and Winnebago counties in northern Illinois.

Euphorbia vermiculata Raf. Collected in sandy soil near Lake Michigan in Bridgman, Berrien Co., Michigan, September 20, 1952, *Swink 1898.*

Viburnum opulus L. Collected in woods of Petrifying Springs Park east of Somers, Kenosha Co., Wisconsin, July 26, 1953, *Swink 2289.*

Aster furcatus Burgess. Jones (2nd edition, p. 273, Flora of Illinois) records this species only from Starved Rock, La Salle Co. Two collections from the Chicago region are known, in addition, as follows: upland slopes near creek, just east of Kimberley Road, Biltmore Estates subdivision, 6 miles northeast of Barrington, Lake Co., Illinois, August 14, 1948, *Steyermark 65964;* wooded north-facing slopes along creek, same locality, September 16, 1947, *Steyermark 65017.* Other collections of this species in the Chicago Natural History Museum Herbarium from Illinois are: Winnebago Co. (*E. W. Fell 531109*); Peoria Co. (*Brendel, Stewart*); Tazewell Co. (*Stewart*); Ogle Co. (*Patterson*); Henderson Co. (*Patterson*); Woodford Co. (*McDonald*).

Centaurea vochinensis Bernh. The authors found this species abundant locally in open grassy places along both sides of Butterfield Road (Route 55), near Lambert Road south of Wheaton, Du Page Co., Illinois, July 25, 1954, *Steyermark & Swink 76353; Swink & Steyermark 2753.*

Hieracium vulgatum Fries. Collected in woods of Covenant Harbor near Lake Geneva, Walworth Co., Wisconsin, July 4, 1953, *Swink 2287.*—
Chicago Natural History Museum and College of Pharmacy, University of Illinois.

Volume 57, no. 680, including pages 213–240, was issued 12 August, 1955.

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Vol. 57 October, 1955 No. 682

CONTENTS:

The New England Botanical Club, Inc.

8 and 10 West King St., Lancaster, Pa.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of the Gray's Manual Range and regions floristically related. Price, $4.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) of not more than 24 pages and with 1 plate, 40 cents, numbers of more than 24 pages or with more than 1 plate mostly at higher prices (see 3rd cover-page). Back volumes can be supplied at $4.00. Some single numbers from these volumes can be supplied only at advanced prices (see 3rd cover-page). Somewhat reduced rates for complete sets can be obtained on application to Dr. Hill. Notes and short scientific papers, relating directly or indirectly to the plants of North America, will be considered for publication to the extent that the limited space of the journal permits. Illustrations can be used only if the cost of engraver's blocks is met through the author or his institution. Forms may be closed five weeks in advance of publication. Extracted reprints, if ordered in advance, will be furnished at cost.

Address manuscripts and proofs to Reed C. Rollins,
Gray Herbarium, 22 Divinity Ave., Cambridge 38, Mass.

Subscriptions (making ***all remittances*** payable to RHODORA) to

Dr. A. F. Hill, 8 W. King St., Lancaster, Pa., or, preferably, Botanical Museum, Oxford St., Cambridge 38, Mass.

Entered as second-class matter March 9, 1929, at the post office at Lancaster, Pa., under the Act of March 3, 1879.

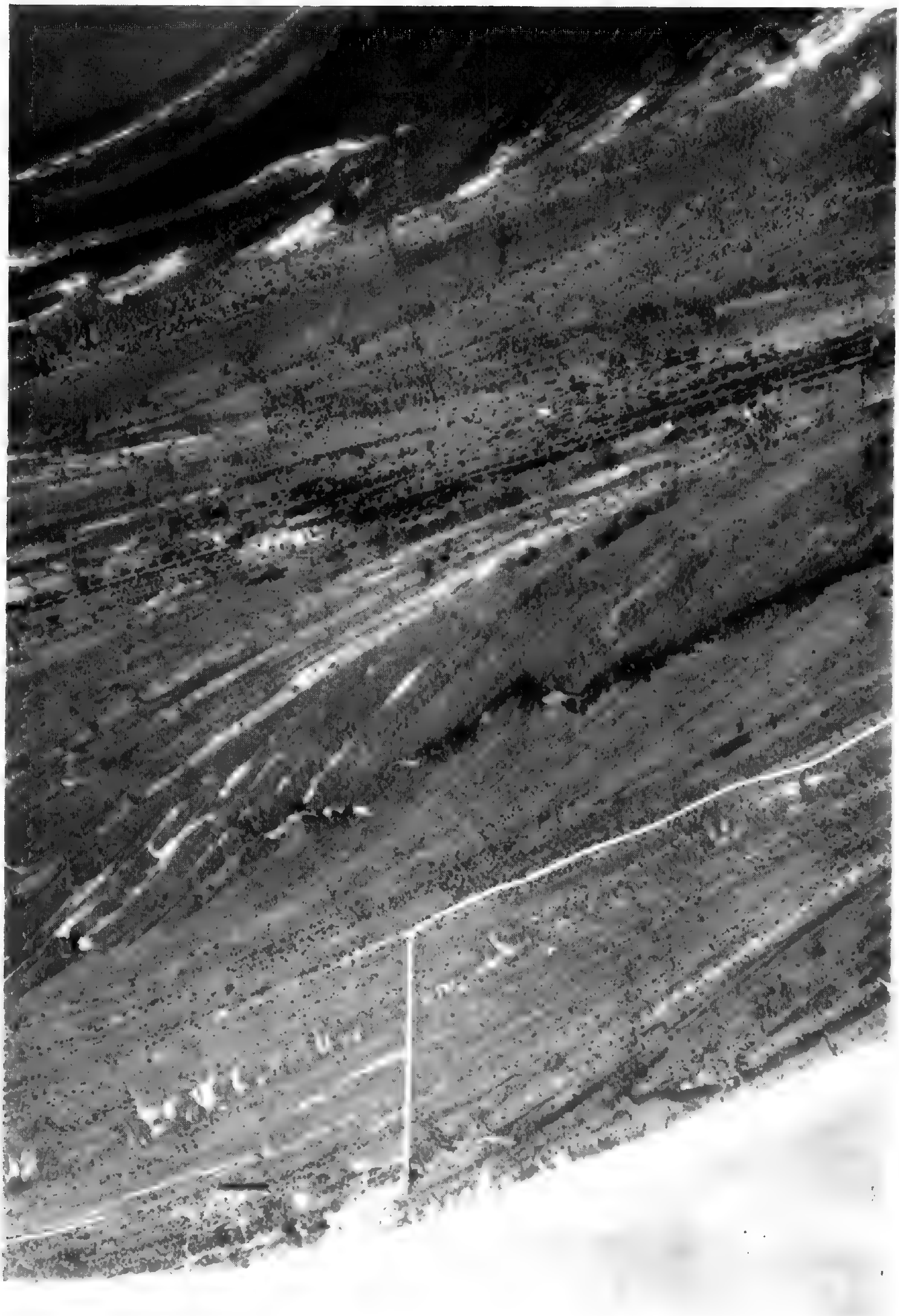


PLATE 1213. Aerial photograph of east-central portion of Sanibel Island, showing vegetational features.

Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 57 **October, 1955** **No. 682**

THE VEGETATION OF SANIBEL ISLAND LEE COUNTY, FLORIDA

George R. Cooley

Introduction

Sanibel Island lies in the Gulf of Mexico, a few miles off the southwestern coast of peninsular Florida near the mouth of the Caloosahatchee River about fifteen miles from the city of Fort Myers. Lying as it does, less than three degrees north of the Tropic of Cancer, Sanibel Island has many characteristics of tropical and sub-tropical insular areas. Furthermore, being only a few miles from the mainland, the island has the appearance of many sections of South Florida. Yet it is not exactly the same as any region of the tropics or of Florida, historically, geographically, geologically, or botanically. Occupied by white people for little more than seventy years, influenced by rivers, ocean currents, and mighty storms; made up almost entirely of shells and shell material; and the home of plants of the tropical, sub-tropical, and temperate zones, it is unlike, in many respects, any area to be found in the southern United States.

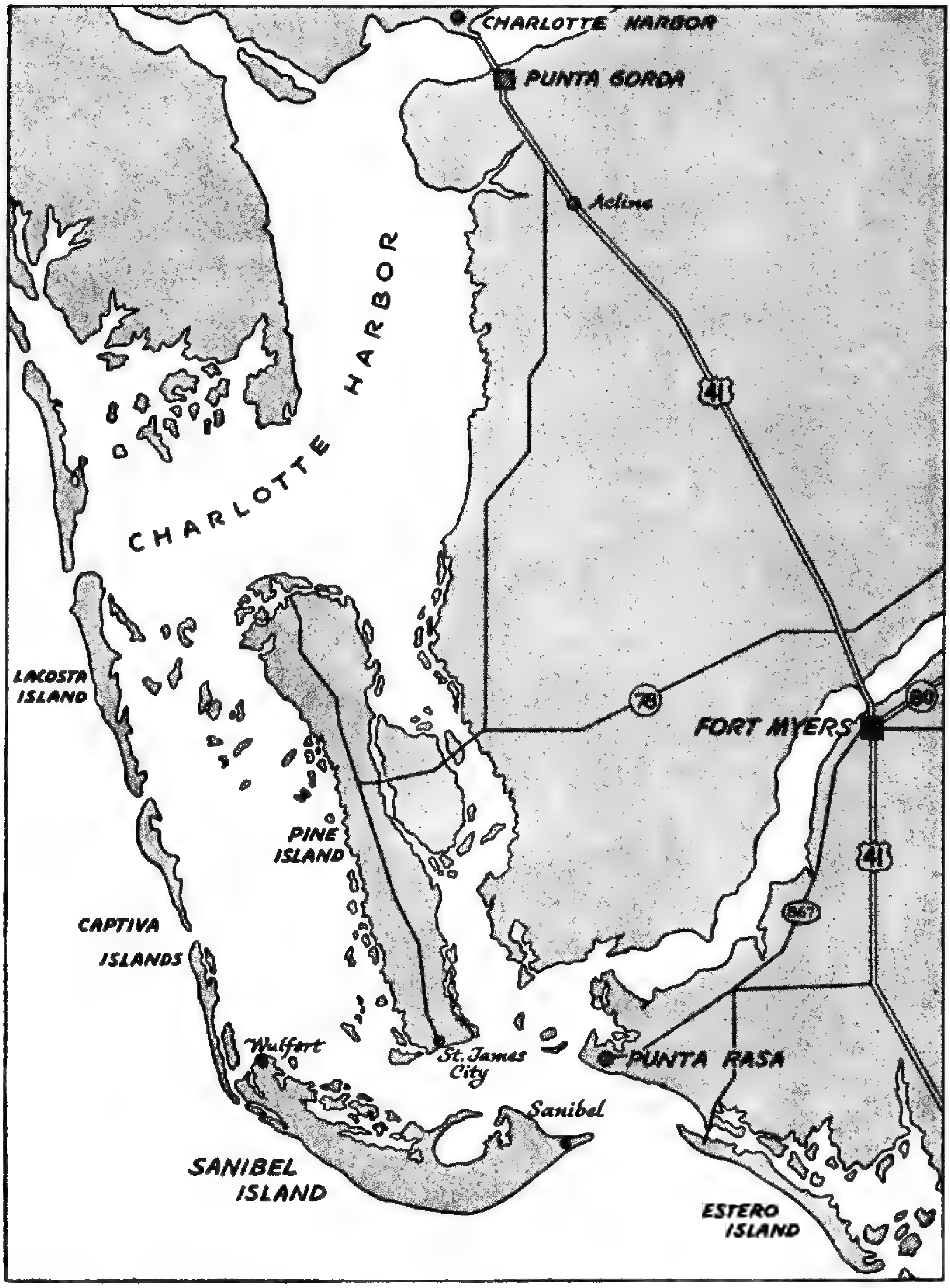
History of Sanibel

It is said that on his trip to the Gulf of Mexico and Mississippi River in 1539, De Soto stopped at Sanibel Island. Captain Bernard Romans, "Draugh$^{m.}$ Mathem$^{n.}$ Navigat$^{r.}$" and "Naturalist & Botanist" in 1774, when describing the region around Charlotte Harbour north of Sanibel, said, "This nook in the land forms what the Spaniards call *Ensenada de Carlos*, i.e. Charle's Bay: the piece of coast that trends E. and W. is the beach of an island called Sanybel, This place is further remarkable for a great number of pine-trees without tops, standing at the bottom of the Bay, like which there is no spot in the whole extent of this coast. The northernmost entrance is likewise remarkable for a singular hummock, or grove of pine-trees, standing very near the beach, and the only one of its form and kind in all these parts." No other records seem to be extant which would help us in an understanding of the flora of this island before its discovery by the white man four hundred years ago, or for that matter at any time up to the present.

At the time of De Soto's exploration and for three hundred years thereafter a tribe of Muspah Indians apparently made their homes on Sanibel Island and nearby Captiva Island. Great kitchen middens, mostly shells, give evidence of long tenure by these Indians. Mr. Julien C. Yonge of the Library of Florida History found in early records that in 1831 a New York company set up a colonial development at the eastern end of the island; there were also comments of a traveler to the effect that two years thereafter no evidence of this development remained except the framework of the largest house. About 1883 an agricultural and horticultural development started which was to change the face of the island for a period of over forty years. All the arable land on the island was cleared and cultivated (Map C). Citrus fruits and garden vegetables, principally tomatoes, eggplants, and squashes, were raised in considerable quantities. Boats came from the terminus of the railroad on the mainland a score of miles to the north to collect the produce. It is reported that one gardener in 1901 received $1,100 for the tomatoes grown on one acre of ground. In time, competition from the mainland lessened the prosperity of Sanibel farmers so that when a disastrous hurricane struck the island in 1926, half the population left. Those who remained have served winter visitors, fishermen, and shell collectors, for Sanibel has become known as one of the three great shell collecting beaches of the world. The replacement vegetation of the previously cultivated land is now again steadily progressing toward a climax.

Geography

All of the islands off the west coast of Florida lie north and south like reefs along the shoreline of the peninsula except

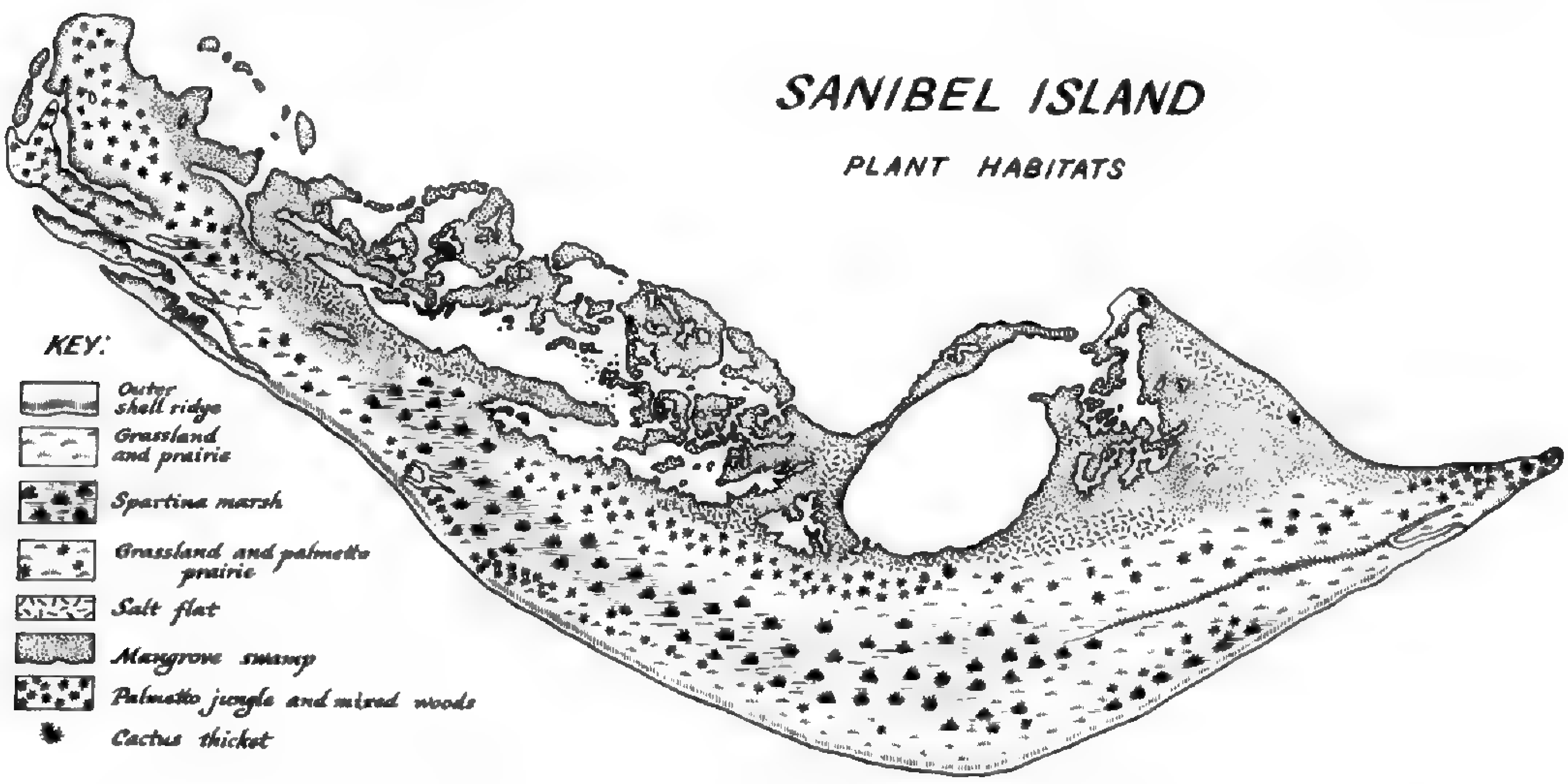


Map A. The Charlotte Harbor area of southwestern Florida, showing the location of Sanibel Island

Sanibel which lies east and west, at right angles to the others, taking the full brunt of storms from the south and being subjected to the constant flow of a northward moving gulf stream. The island is about 10.75 statute miles long and 2.6 statute miles across at its widest point; it lies at 26° 30′ N. latitude and 82° 10° W. longitude (Map A.)

Nowhere is the land more than fourteen feet above the level of the Gulf of Mexico. The elevation of most marsh areas is six feet or less; the grasslands, six to eight feet, and the hammocks and former cultivated areas from six to fourteen feet above sea level.

From the aerial photograph (Plate 1214, fig. 2) one can obtain a general idea of the geographical features and vegetation of the island. At the rounded point to the east is a 70-foot lighthouse; west of it can be seen a road bordered by casuarina trees. At this point there is the ferry landing, a restaurant, the post office and the home of the postmistress. On both sides of this road, which crosses the narrow end of the island, can be seen cleared areas representing an incipient real estate development. The dark space toward the lighthouse is a rather dense button mangrove thicket; the black spots represent red mangroves. The rest of the dense growth consists of button mangrove (*Conocarpus erecta*) and its associates, with a cactus thicket at the side toward the lighthouse. In the photograph the dark mass in the upper left indicates the presence of red mangrove swamps, which form matted growths along most of the inner shore on Pine Island Sound. The lighter-colored sweeps of gray are button mangrove swamps where airplants grow in abundance. A road extends east and west through the middle of the island. This is now a well-maintained macadam highway connecting by a concrete bridge at the west end of the island with neighboring Captiva. Along this road can again be seen rows of casuarinas planted about 1912 to 1914. South of the main road the grasslands are extensive, changing into *Spartina* marshes where the land is lower between the ancient shell ridges. Over the part of the island not shown the *Spartina* marshes are very much larger, being fully one-half mile in breadth and far-reaching in extent. A natural drainage area is shown by the irregular dark line through the center of the grasslands. The straight white line indicates the road leading to the island's only general store and a community of winter dwellings. From this road toward the west, on the north side of the main highway, one can see formerly cultivated fields. A large part of the land on both sides of the main road from this section across the entire island is where the farming of the 1883–1928 period was done. The design at the lower left shows a winter resort. There are



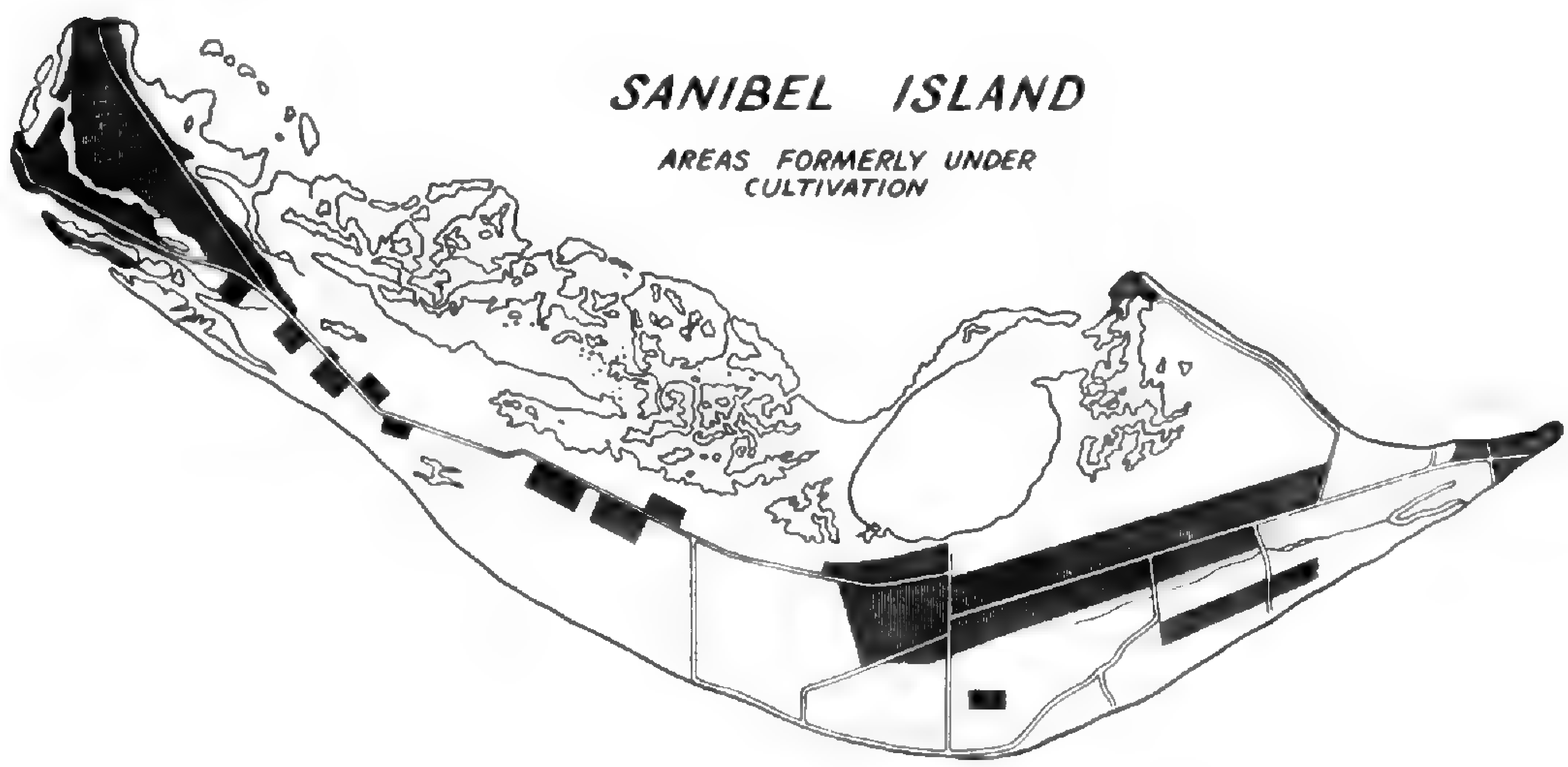
Map B. The principal habitats and vegetational groupings on Sanibel Island.

four such regions on the Gulf side of the island. Plate 1213 is an aerial photograph of the east central portion of the island. It shows vegetational features similar to those described above.

Ecological Features

The beach on the Gulf side ends abruptly at a ridge of shells washed up by a previous great storm. The island, other than the mangrove swamps and inner salt marshes, is made up of ridges more or less parallel to the Gulf shore. In ages past these ridges were formed in the same way as the present outer ridge which was created by the storm of October, 1953. Great quantities of shells were washed up onto the beach and over the beach-strand vegetation, burying all but the tallest of the shrubs and trees (Plate 1214, Fig. 1). Four and five feet of shells covered the strand for varying widths of fifty to one hundred-fifty feet forming a new ridge. Back of the new ridge is a marsh of *Spartina* and its associates growing up through broken shells. Successive ridges and low places produce prairie growths and marsh vegetation, then transition vegetation and hammocks as the distance lengthens from the beach (Map B).

The inner north shore facing the quiet waters of Pine Island Sound is free from the effects of waves and storms and the vegetation consists of a great mangrove swamp. Back of the mangroves are tidal marshes, back of these on slightly higher ground are button mangroves bordering on hammocks and mixed woods as the elevation increases.



Map C. Former cultivated areas of Sanibel Island.

Among the red mangroves organic muck has formed to the depth of several feet; in the *Spartina* marshes a foot or more of humus has accumulated; but all other soils are made up of decomposing shell material and varying amounts of decaying vegetable matter.

Evidence of human occupation and disturbance in the form of ditches old and new, abandoned homesites, fence-rows, and former groves, give character to much of the higher ground. (See Map C showing formerly cultivated land, as defined by an old resident.)

Research discloses meager records of the flora of Sanibel and few specimens indeed are in herbaria of America. Botanists have neglected this interesting place. At the suggestion of Dr. Richard A. Howard the writer was prompted to undertake a floristic study of Sanibel and to that end made a winter's stay on the island and two subsequent visits to it.

A. S. Hitchcock visited Sanibel in 1900, and three specimens collected by him at that time have now been located at the Gray Herbarium. He was probably the instigator of S. M. Tracy's trip to Sanibel in 1901, when the new species *Eragrostis tracyi* Hitchcock was collected, but no notes and only few specimens of this trip can now be found. George A. Orric collected on neighboring Captiva Island in 1915, but it is not known that he made any study of Sanibel. On January 24, 1924 Roland M. Harper spent a few hours on the island and, as stated in a letter to the author, "took what notes I could on the vegetation, and a few pictures, but do not think I collected any plants." James B. McFarlin did some collecting on Sanibel November 4, 1934, incidental to his study of the flora of Polk County, central Florida. In 1936, J. R. Swallen collected five grasses; and in 1951, R. Bruce Ledin spent two days on Sanibel collecting 52 numbers for the Buswell Herbarium at the University of Miami. Ledin collected plants of Sanibel that were typical of the Florida Keys of Monroe County. He was amazed at the number of identical species found in both places. About 35 of 52 species collected were considered to be essentially West Indian plants. Specimens in the herbarium of the University of Florida (from Sanibel) are probably less than a dozen, according to Miss Lillian E. Arnold, Curator. John H. Davis and the writer spent a day on Sanibel in 1951, but did little collecting.

Of all these visits few comments remain for our understanding of the flora of Sanibel. In 1927 in "Natural Resources of South Florida" Harper said of the West Coast islands, "the vegetation comprises that of beaches and dunes, cactus thickets, salt flats, palm savannas, mangrove swamps, and a little tropical hammock. There is a little truck-farming on some of the islands, such as Sanibel."

This study purports to provide a general understanding of the ecology of the Island and its present vegetation to the end that comparisons in the future may be accurately made.

Vegetational Features

Even the casual visitor to Sanibel is impressed by the number and ubiquity of the cabbage palm (*Sabal palmetto*). Throughout the island it is found in almost all habitats, giving its name to some, as cabbage palm prairie (Plate 1215, Fig. 3) to the grasslands, and cabbage palm jungle to the hammocks. A quarter of a mile from the ferry landing adjoining the oldest settlement area on the island is a stand of *Sabal palmetto* reminding one of a mature reforestation plantation so tall, so straight, and so dominant are the trees of this species.

Clinging to the cabbage palms and often growing rampant over them are *Rhus radicans* and less frequently *Parthenocissus quinquefolia.* Living on them epiphytically are *Ficus aurea, Vittaria lineata*, and *Phlebodium aureum* and that strange cryptogam of the sub-tropics, *Psilotum nudum*, with slender, branching, delicate stems is sometimes found at the base of the cabbage palms.

Another tree which is characteristic of the modern Sanibel landscape is the Australian pine (*Casuarina equisetifolia*) which lines many of the roads and beaches. Brought to the island about forty-five years ago, *Casuarina* has become well established. By the distribution of vast numbers of seeds it has extended its territory far beyond the roadsides and beach strands where it was originally planted. At one place in the center of the island it has multiplied to the point of forming a wood where it tends to become dominant. On Wulfert Road is a row of *Casuarina cunninghamiana* about 30 to 40 years old. This species is apparently not becoming naturalized.

From the main black-top road which extends through the center of the island for its entire length, mangroves are noticeable at only one point. However, a boat ride along the inner shore for almost the entire length of the island reveals a mangrove swamp of eight square miles. Dominant at the water's edge is the red mangrove (*Rhizophora mangle*), its interlacing and arching trunks, branches, and roots forming a maze through which progress can be made only with persistence and a sharp machete. Wherever the soil has been built up above the mean tide level, black mangroves (*Avicennia nitida*) appear with trunk diameters up to 4″ at breast height. Deeper in the swamp (hence rarely seen from a passing boat) and only where the soil is generally above the tide are the white mangroves (*Laguncularia racemosa*), attaining a size no greater than large shrubs.

Between the red mangrove swamps and the hammocks and cabbage palm savannas toward the middle of the island are interesting belts of button mangroves (*Conocarpus erecta*, Plate 1215, Fig. 4). Here flourish air plants in some profusion; not much Spanish moss (*Tillandsia usneoides*) but an abundance of *Epidendrum tampense*, *Tillandsia fasciculata*, *T. balbisiana*, *T. utriculata*, and *T. tenuifolia*. At four places cactus thickets have been formed among the button mangroves; wicked places for the botanist, but happy homes for gopher snakes which grow to lengths of seven and eight feet.

As the button mangroves become numerous, extending toward the center of the island (Plate 1216, Fig. 6), they are joined by an interesting transition group of a score or more of hammock trees and shrubs, including the following:

Ardisia escallonioides
Baccharis glomeruliflora
Chiococca alba
Dodonaea jamaicensis
Eugenia anthera
Eugenia myrtoides
Eugenia axillaris
Forestiera porulosa
Jacquinia keyensis
Pithecellobium unguis-cati
Randia aculeata
Phytolacca rigida
Rivina humilis
Zanthoxylum fagara
Capparis cynophallophora
Rapanea guianensis
Sideroxylon foetidissimum
Bumelia angustifolia
Psychotria nervosa

On the larger of these trees, Spanish moss grows more abundantly than other air plants. Cabbage palms are present, acting as hosts to the shoestring fern (*Vittaria lineata*), the golden polypody (*Phlebodium aureum*), and young growths of the strangling fig (*Ficus aurea*) (Plate 1216, Fig. 5). They also support a vigorous growth of poison ivy (*Rhus radicans*) and Virginia creeper (*Parthenocissus quinquefolia*).

The writer should mention here Sanibel's second worst pest (mosquitoes are first), poison ivy. Apparently it will not tolerate salt water and is therefore not found in the mangrove swamps or the salt marshes. The beaches and the black-top road do not provide happy homes for *Rhus radicans* either, but every other habitat is congenial to it. On a cabbage palm was found a poison ivy plant with a stem 9 cm. in diameter at breast height. One branch 13 dm. long bore 6,130 blossoms. Often leaves are found 10 cm. wide and 20 cm. long. On the cabbage palms some poison ivy plants grow 10 meters high. In a cabbage palm thicket six hundred seventy-two poison ivy plants or sprouts were counted in a quadrat twenty by twenty feet.

In the buttonwood swamps and the hammocks and near Indian shell mounds has grown the tree cotton (*Gossypium hirsutum*). For a long time, despite the fact that commercial cotton is not raised within two or three hundred miles of Sanibel, the Department of Agriculture has sent four men to the island several times a year to rid it of wild cotton and thus deprive the boll weevil of food and a breeding place. The species has persisted but is now almost extinct on Sanibel as only three young plants were found in a two-day search in February (1954).

Hammocks on Sanibel vary greatly. As indicated above, one hammock is a stand of pure *Sabal palmetto;* many are *Sabal palmetto* jungles where trees, shrubs, vines and herbs compete; some in the center of the island are distinguished by *Quercus virginiana;* and some are mixed forests. The gumbo limbo tree (*Bursera simaruba*), although frequent and widespread through the higher elevations of the island, is nowhere abundant. Because of its red bark it is often mistakenly called mahogany by natives and visitors alike. In a mixed wood on Wulfert Road stands a slash pine (*Pinus elliottii* var. *densa*) with several younger trees near by. Millions of slash pines grow on the mainland and yet Sanibel can boast of but one small colony.

Several square miles of *Spartina* marshes lie between the principal hammocks and the coastal shell ridge. Here the dominant is *Spartina bakeri*, accompanied by *Cladium jamaicense, Andropogon glomeratus, Bacopa monnieri*, and *Sesuvium portulacastrum* (Plate 1217, Fig. 7). In the marshes the presence of ancient shell ridges is evidenced by plants which prefer slightly drier ground. Luxuriant growths appear of *Baccharis halimifolia, Sporobolus domingensis, Aristida patula, Fimbristylis castanea, Flaveria linearis, Kosteletzkya virginica, Mikania batatifolia, Rhus radicans, Melothria pendula, Melanthera deltoides*, and on still higher ground *Sabal palmetto* and its prairie associates (Plate 1217, Fig. 8).

The grass lands between the coastal shell ridge and the *Spartina* marshes are largely dry open areas in which the following species grow:

Bouteloua hirsuta	*Piriqueta caroliniana*
Sporobolus virginicus	*Pluchea purpurascens*
Aristida patula	*Rhynchosia michauxii*
Chloris petraea	*Samolus ebracteatus*

Bidens pilosa	*Sida carpinifolia*
Cirsium horridulum	*Waltheria americana*
Coreopsis leavenworthii	*Conyza canadensis*
Flaveria floridana	*Vigna repens*
Flaveria linearis	*Lochnera rosea*
Gaura angustifolia	*Crotalaria striata*
Opuntia austrina	*Cassytha filiformis*
Physalis elliottii	*Cenchrus pauciflorus*

The shrubby areas also present are composed of:

Forestiera porulosa	*Lantana involucrata*
Baccharis halimifolia	*Lantana ovatifolia*
Myrica cerifera	*Sophora tomentosa*
Ernodea littoralis	*Trichostema suffrutescens*
Eugenia axillaris	*Capraria biflora*
Jacquinia keyensis	

Charles Torrey Simpson said "To the naturalist . . . the seashore is the most fascinating place in the world."[1] On Sanibel's seashore the coastal shell ridge—a pile of countless shells—influences the botanist by some powerful and irresistible charm. To be sure, the hand of man has contributed to the flora of the coastal ridge by his plantings of *Casuarina equisetifolia* to bind the soil and break the wind, but the hand of nature has brought to the beach strand other plants entrancing in their characteristics and different in their forms and habits.

Coccoloba uvifera, the sea grape, changes in appearance many times a year. Its shiny, bright new leaves in March replace the dull "platter" leaves which fall to cover the earth beneath; then 15 cm. spikes of greenish yellow flowers extending from the axils of pairs of near-opposite leaves attract the bees and insects; clusters of large fruit of deepening color tempt the local housewives to make sea-grape jelly; then the aging leaves grow dull again and await the rebirth of another spring.

A pan-tropical half-shrub, *Scaevola plumieri* (Fig. 9) tolerates the salt spray and saline soil of the upper beach. Its succulent leaves retain a full green color throughout the year; its springtime white flowers have five white involute petals arranged palmately in a plane.

The active waters of the beach give *Rhizophora mangle* no chance for a footing, and the dry character of the ridge excludes *Avicennia nitida* and *Laguncularia racemosa*. *Conocarpus erecta*,

[1] "In lower Florida wilds," page 276. New York. 1920.

the button mangrove, has more success along the coastal shell ridge, generally near the marshes or in man-made ditches (Plate 1218, Fig. 10). The cinereous form of *Conocarpus erecta* grows at four stations, none of them near the coast. On the neighboring island of Captiva *Ambrosia hispida* forms runners exceeding fifty feet, but on Sanibel the plant is rare and small. Another soil-binder, however, is by no means so rare; *Ipomoea pes-caprae*, the railroad vine, climbs over both the ground and the vegetation.

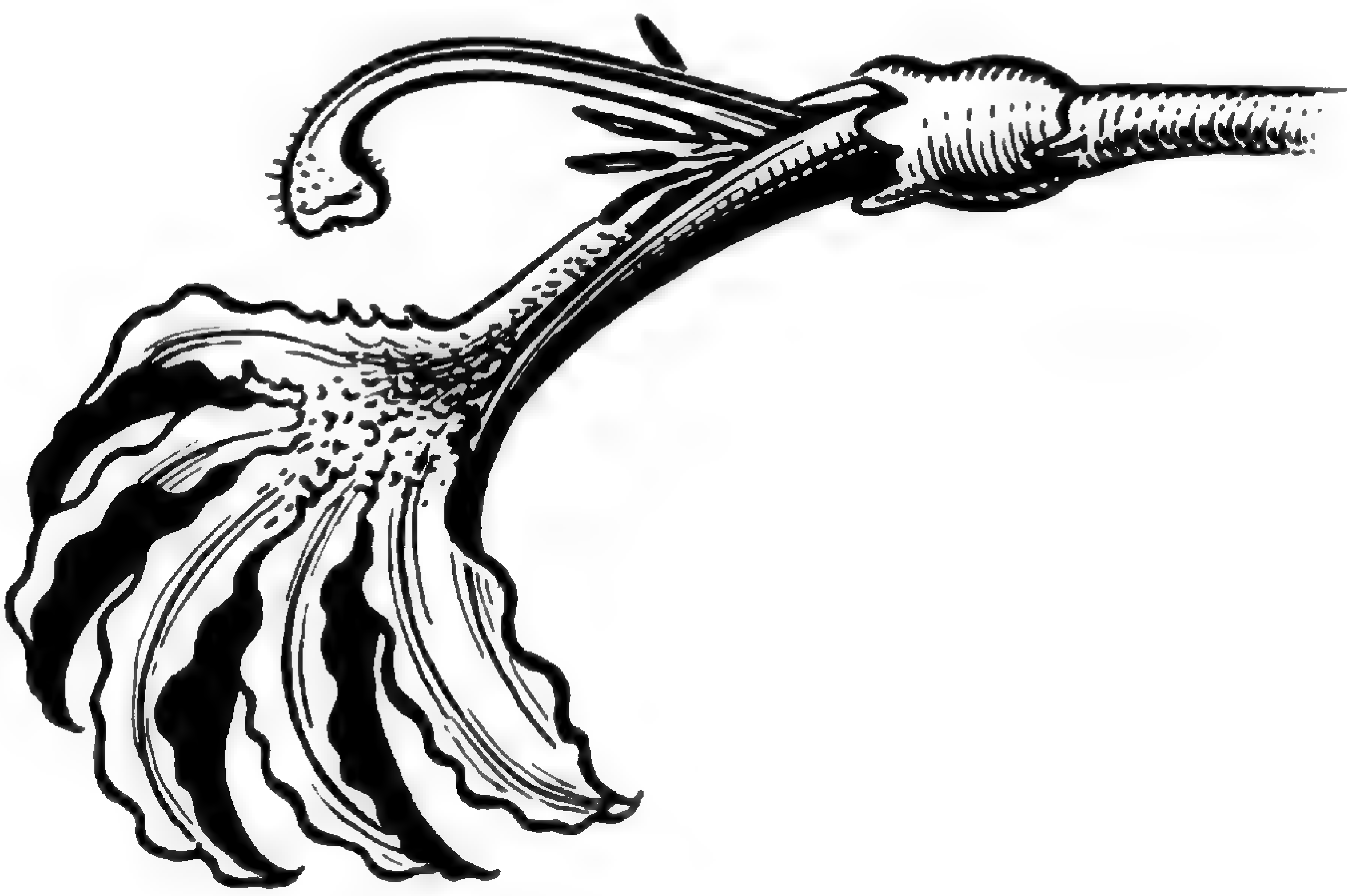


Fig. 9. Flower of *Scaevola plumieri*, × 4.

Most abundant of the shrubby growths of the coastal shell ridge is *Suriana maritima*, the bay cedar, in the West Indies often called tassel plant, with small yellow flowers and alternate entire leaves. With it are scattered plants of *Uniola paniculata* with culms two meters in height. These sea oats serve to bind the coastal soil but are never dominant on Sanibel.

I collected what appeared to be two species of *Oenothera* occur on the beach, one with yellow flowers and one with reddish flowers. Both are *Oenothera humifusa*, whose flowers are yellow when new blown and reddish when older, the change taking place even from morning to afternoon.

The creeping plants of the marshes, *Sesuvium*, *Portulaca*, and the salt-tolerant grasses of the wet areas are not found on the coastal ridge, for it is a dry habitat where rain filters quickly through the crushed shell aggregate. It is to be expected that *Calonyction* should clamber over the shrubs of the coastal shell ridge, but *Calonyction tuba* grows only on the low ridge at the inner side of the island where storms are not severe and *Calonyction aculeata* lives mostly one hundred fifty yards and more back from the gulf beach.

Common on the coastal ridge is *Baccharis halimifolia* and less frequent is *Baccharis dioica*. The ordinarily entire leaves of the latter are here sometimes indented, possibly from hybridization. It has the distinctive habit of extending its tap root horizontally just beneath the ground at right angles to its stem.

From one end of the island to the other on twelve miles of outer shell ridge many native, adventive, and waif species make their homes. *Solidago sempervirens* var. *mexicana* is present but not abundant. *Bidens pilosa*, with its bright yellow-centered flower heads, is much more abundant, and its barbed achenes, known as Spanish needles, cling tenaciously to everyone who brushes past the plant. Mention should be made of the chaff flower (*Achyranthes ramosissima*). This tropical herb of the amaranth family has a spreading manner of growth among the herbs and low shrubs. *Cakile* (Plate 1221, Fig. 17) is widespread through the sub-tropics, but only one species of it (*Cakile fusiformis*) is found on Sanibel and at only one spot on disturbed ground near a real estate development.

There is only one extensive broad beach area (Plate 1219, Fig. 13), and that toward the western end of the island. This beach is up to two hundred yards wide, and is composed of both quartz sand and shell fragments, but unlike typical sandy beaches drifts little. Such vegetation as manages to exist in the broiling sun and salt air includes *Sesuvium portulacastrum* (Plate 1219, Fig. 12), *Suriana maritima* (Plate 1220, Fig. 14), *Scaevola plumieri, Euphorbia buxifolia, Oenothera humifusa, Iva imbricata, Atriplex arenaria, Uniola paniculata, Sporobolus virginicus, Spartina patens*, and *Ipomoea pes-caprae*. The rolling beach grades downward into marshes with a varied border of *Dalbergia ecastophyllum, Coccoloba uvifera, Suriana maritima, Conocarpus erecta, Casuarina equisetifolia*, and other shrubs.

The white panicles of *Yucca aloifolia* do not last long but for a short time offer a spectacle to those "shellers" whose eyes are raised from the beach. No other *Yucca* grows on Sanibel. *Chloris petraea, Lochnera rosea, Rhus radicans, Cenchrus pauciflorus, Sporobolus virginicus, Euphorbia* spp., *Heliotropium parviflorum, H. polyphyllum, H. curassavicum, Conyza canadensis,* and *Asclepias verticillata* are a few of the vascular plants crowding the slopes and crest of the coastal shell ridge.

Eragrostis tracyi was described as a new species from a collection made on Sanibel in May, 1901. It was not collected again on Sanibel until April 13, 1954, but has never been found elsewhere. It is common on disturbed ground, roadsides, lawns, around homes, and in cleared areas. Diligent search over grasslands and savannas produced no plants. The habitat it occupies leads one to believe that *Eragrostis tracyi* has been introduced onto Sanibel. But from where did it come?

Check List

Nomenclature provides a problem for the taxonomists of the Southern States. No manual exists to which a botanist can go for names of southern plants in keeping with recent taxonomic studies and judgment, and in conformity with the International Code of Nomenclature. The author searched the monographs and writings of the last twenty years and has used the names which in large part conform to the best present-day usage.

Mr. Jason R. Swallen, of the United States National Museum, identified the grasses collected, and Professor Erdman West and Miss Lillian E. Arnold of the University of Florida helped with the determination of all other specimens. Specimens have been deposited in the United States National Museum, the Gray Herbarium, the herbarium of the New York Botanical Garden, the herbarium of the University of Florida, and the Cooley Herbarium of Rensselaerville, New York.

In the check list which follows seven habitat columns are used after Lemon (ms). The column headed Mangrove Swamps for convenience includes red mangrove swamp plants; *Spartina* Marshes include salt marsh plants; and Grasslands and Savannas combine both wet and dry areas. Frequent ancient shell ridges throughout the island increase the elevation slightly at many points, providing congenial habitats for plants of dry preference in the midst of damp and wet areas. No effort has been made to define these habitats precisely; rather general ecological names have been used.

DEFINITIONS

Dominant (D) Prevailing, tending to drive out all other plants and to resist invasion by them.
Abundant (A) Teeming, in copious supply.
Common (C) General, not local, so frequent as to be found easily.
Frequent (F) Often to be met with, but not general.
Infrequent (I) Isolated, sparse, occurring at considerable distances.
Rare (R) Seldom met with, so infrequent as to be unexpected.

	Old fields	Coastal shell ridge	Spartina marshes	Grasslands & savannas	Mangrove swamps	Palmetto jungles	Mixed woods
Chara zeylanica Klein in Willd.			I				
Psilotum nudum L.						I	I
Acrostichum danaeaefolium Langsd. & Fisch.			A				
Blechnum serrulatum Rich.	F					F	F
Nephrolepis exaltata (L.) Schott	I					I	
Phlebodium aureum L.						C	F
Polypodium polypodioides (L.) Watt							R
Pteridium aquilinum (L.) Kuhn, var. caudatum (L.) Sadebeck	I						
Pteridium aquilinum (L) Kuhn, var. pseudo-caudatum (Clute) Heller	I						
Vittaria lineata Sw.						F	F
Typha angustifolia L.			I				
Typha domingensis Pers.			F				
Pinus elliottii Engelm., var. densa Little & Dorm.							I
Najas guadalupensis (Spreng.) Morong			I				
Andropogon glomeratus (Walt.) BSP.	F		I	F			
Andropogon virginicus L.		F					
Aristida patula Chapm. ex Nash				F			
Aristida purpurascens Poir.				I			
Bouteloua hirsuta Lag.				A			
Cenchrus echinatus L.	F	F		I			
Cenchrus incertus M. A. Curtis	C	I					
Cenchrus pauciflorus Benth.	C	C		F			
Chloris petraea Swartz	C	C		C			
Cladium jamaicense Crantz			C				
Cynodon dactylon (L.) Pers.		I	C				
Dactyloctenium aegyptium (L.) Beauv.	I						
Digitaria sanguinalis (L.) Scop.	F						
Distichlis spicata (L.) Greene			C				
Eleusine indica (L.) Gaertn.	C	F					
Eragrostis ciliaris (L.) R. Br.						I	
Eragrostis elliottii S. Wats.	I						
Eragrostis pilosa (L.) Beauv.	I						
Eragrostis tracyi Hitchc.	C						
Leptochloa dubia (H. B. K.) Nees.	C	F		C			
Muhlenbergia capillaris (Lam.) Trin.				F			
Panicum adspersum Trin.	F						

	Old fields	Coastal shell ridge	Spartina marshes	Grasslands & savannas	Mangrove swamps	Palmetto jungles	Mixed woods
Panicum agrostoides Spreng.		F					
Panicum albomarginatum Nash	F						
Panicum amarulum Hitchc. and Chase		F					
Panicum bartowense Scribn. & Merr.	F						
Panicum dichotomiflorum Michx.	C						
Panicum neuranthum Griseb.	F			F			
Panicum virgatum L.				F			
Paspalum ciliatifolium Michx.	I			I			
Paspalum vaginatum Swartz		F		F			
Pennisetum glaucum (L.) R. Br.	I						
Rhynchelytrum roseum (Nees) S. & H.	C						
Setaria geniculata (Lam.) Beauv.	F	F	C				
Setaria glauca (L.) Beauv.	F			F			
Setaria macrosperma (Scribn. & Merr.) Schum.	I						
Sorgum halepense (L.) Pers.	I						
Spartina bakeri Merr.			D	I			
Spartina patens (Ait.) Muhl.		F					
Sporobolus domingensis (Trin.) Kunth		C					
Sporobolus juncea (Michx.) Kunth		I					
Sporobolus virginicus (L.) Kunth		A					
Triplasis purpurea (Walt.) Chapm.	R	I					
Uniola paniculata L.		C		I			
Cyperus globulosus Aubl.	I			I			
Cyperus ligularis L.	C	F		F			
Cyperus martindalei Britton	I						
Cyperus planifolius L. C. Rich.		I	F	C			
Cyperus polystachyos Rottb., var. texensis (Torr.) Fern.	F		C	I			
Cyperus pseudovegetus L.	I						
Cyperus rotundus L.	I						
Cyperus strigosus L.			I				
Dichromena colorata (L.) Hitchc.	C			C			
Eleocharis atropurpurea (Retz.) Kunth	C						
Eleocharis geniculata (L.) R. & S.			F				
Fimbristylis castanea (Michx.) Vahl	C			C			
Scirpus americanus Pers.			F				
Scirpus cyperinus (L.) Kunth, var. eriophorum Michx.				I			
Cocos nucifera L.	F	I					
Sabal palmetto (Walt.) Torr.	C	F		F		D	F
Serenoa repens (Bartr.) Small				D		F	
Lachnocaulon anceps (Walt.) Morong			R				
Tillandsia balbisiana Schult.					C		
Tillandsia circinata Schlech.					I		
Tillandsia fasciculata Sw.					C		
Tillandsia recurvata L.	I				I		I
Tillandsia tenuifolia L.					C		
Tillandsia usneoides L.					F		
Tillandsia utriculata L.					C		
Commelina erecta L.	F						
Juncus megacephalus M. A. Curtis				I			
Sansevieria guineensis Willd.	Escape						
Smilax auriculata Walt.						F	F

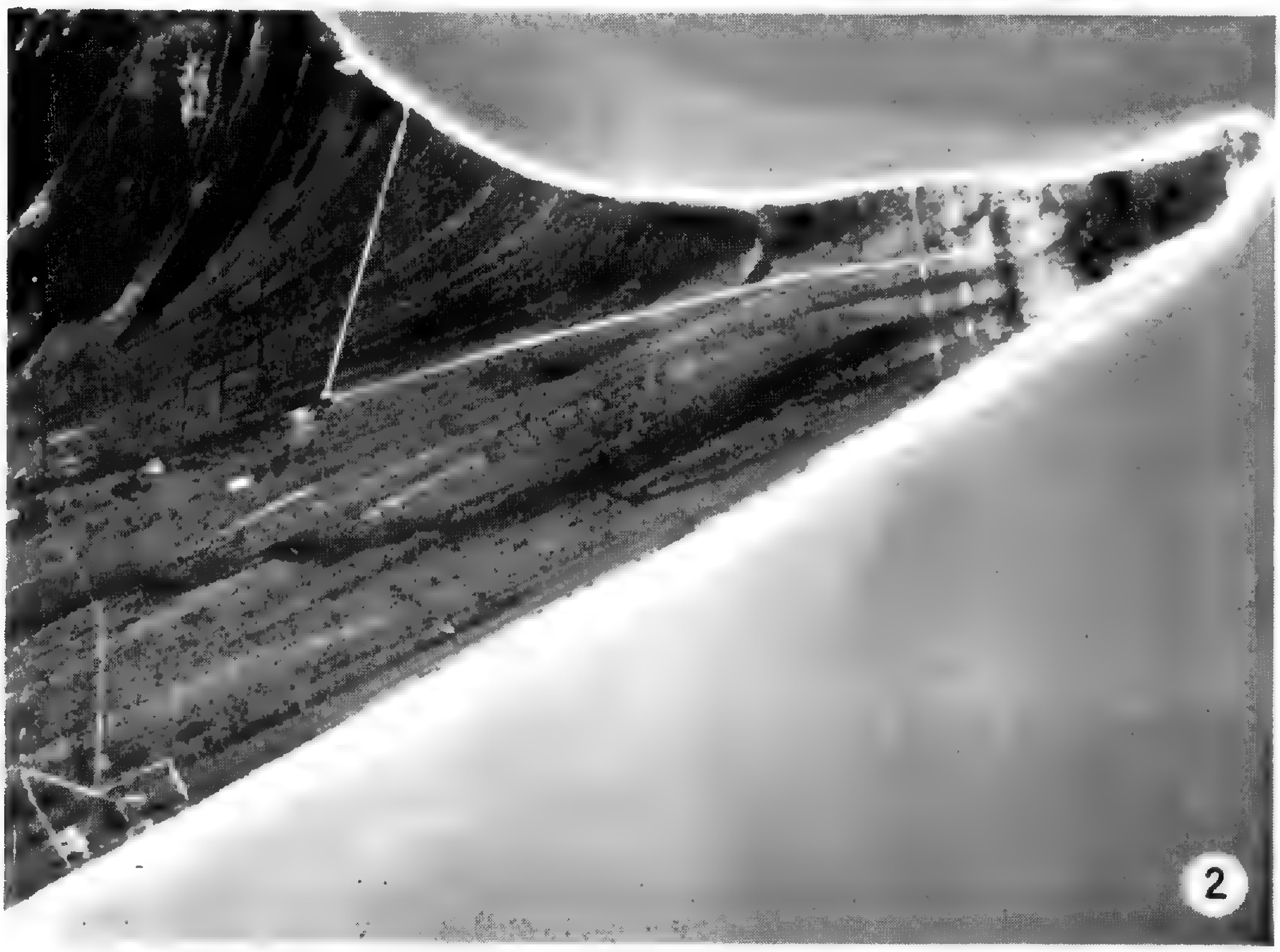


PLATE 1214. FIG. 1, Recently formed shell ridge. FIG. 2, Aerial photograph showing ancient shell ridges paralleling the south coast.

PLATE 1215. FIG. 3, Sanibel's most abundant tree, *Sabal palmetto*. FIG. 4, Adjacent communities of *Spartina* and *Conocarpus*.

PLATE 1216. FIG. 5, Strangling fig around cabbage palm at edge of mixed woods. FIG. 6, Typical button mangrove thicket, with *Tillandsia* in center.

PLATE 1217. FIG. 7, *Bacopa monnieri* dominant in low places of *Spartina* marshes. FIG. 8, *Spartina* marsh, showing cabbage palm "islands," on the slightly higher ground of ancient shell ridges.

PLATE 1218. FIG. 10, Thicket with *Conocarpus*, *Sabal*, and *Yucca* in transition zone between grassland and *Conocarpus* swamps. FIG. 11, Gumbo limbo at edge of Palmetto jungle.

PLATE 1219. FIG. 12, *Sesuvium portulacastrum* dominant on a low beach area with straggling *Conocarpus* in the background. FIG. 13. The broad beach at the western end of the island.

PLATE 1220. FIG. 14, The stretch of broad beach at the western end of the island, showing *Suriana maritima* and *Uniola paniculata*. FIG. 15, *Agave sisalana* persisting in an old field, after cultivation.

PLATE 1221. FIG. 16, *Solanum gracile*, a common weed of disturbed areas. FIG. 17, *Cakile fusiformis*, the only species of this genus found on Sanibel. FIG. 18, *Borrichia frutescens* dominating a salt marsh, with buttonwood in background.

	Old fields	Coastal shell ridge	Spartina marshes	Grasslands & savannas	Mangrove swamps	Palmetto jungles	Mixed woods
Yucca aloifolia L.	I	C					
Agave americana L.	I						
Agave decipiens Baker	I				I		
Agave sisalana Perrine	F						
Hymenocallis keyensis Small		I					
Sisyrinchium atlanticum Bickn.	F		F				
Epidendrum tampense Lindl.					F		
Zeuxine strateumatica (L.) Schltr.				I		I	
Casuarina cunninghamiana Miq.	R						
Casuarina equisetifolia Forst.	A	A		I			I
Salix longipes Anders.			I				
Myrica cerifera L.	F			F		C	C
Batis maritima L.		I		I	F		
Quercus virginiana Mill.							F
Ficus aurea Nutt.	F			F		F	F
Parietaria nummularia Small	I						
Coccoloba uvifera (L.) Jacq.	C	C		I	F	I	I
Atriplex arenaria Nutt.		A					
Chenopodium album L.	C						
Chenopodium ambrosioides L., var. anthelminticum (L.) Gray	I						
Salicornia perennis Mill.			C				
Suaeda linearis (Ell.) Moq.			C				
Achyranthes ramosissima (Mart.) Standley	C	F	I	F		I	I
Amaranthus hybridus L.	F						
Froelichia floridana (Nutt.) Moq.		F					
Iresine celosia L.		C					
Philoxerus vermicularis (L.) R. Br.			C	C			
Boerhaavia paniculata L. C. Rich.	I	F		I			
Phytolacca americana L.	F	I				I	
Rivina humilis L.						I	F
Sesuvium maritimum (Walt.) BSP.		F					
Sesuvium portulacastrum L.		C					
Portulaca oleracea L.	F						
Portulaca phaeosperma Urban	C			C			
Portulaca pilosa L.	I	I					
Annona glabra L.		I			F		
Cassytha filiformis L.	F			F			
Argemone leiocarpa Greene	I						
Argemone mexicana L.	I						
Capparis cynophallophora L.					I		
Cakile fusiformis Greene		I					
Lepidium virginicum L.	C			I			
Chrysobalanus icaco L.						I	I
Chrysobalanus oblongifolius Michx.				F			
Abrus precatorius L.	I						
Acacia farnesiana (L.) Willd.	I						
Caesalpinia bonduc L.		I					I
Caesalpinia crista L.		I					
Canavalia obtusifolia DC.	I	F					
Cassia tora L.	I						
Centrosema virginianum (L.) Benth.	C	I		I			
Chamaecrista aspera (Muhl.) Greene	I			F			I

	Old fields	Coastal shell ridge	Spartina marshes	Grasslands & savannas	Mangrove swamps	Palmetto jungles	Mixed woods
Crotalaria incana L.							
Crotalaria linaria (Small) Fern. & Schub.	F						
Crotalaria rotundifolia (Walt.) Poiret	F						
Crotalaria striata DC.	F						
Dalbergia ecastophyllum (L.) Britt.		I					
Desmodium tortuosum (Sw.) DC.	F			I			
Erythrina herbacea (L.) Small						I	
Galactia parvifolia Rich.	F	F					
Galactia volubilis (L.) Britton		C					
Neptunia lutea (Leavenw.) Benth.	I						
Piscidia piscipula (L.) Sarg.					I		
Pithecellobium unguis-cati (L.) Benth.					I		I
Rhynchosia lewtonii (Vail) Small	I		F				
Rhynchosia michauxii Vail	I		F				
Rhynchosia minima (L.) DC.				I			
Sesbania macrocarpa Muhl.	I						
Sophora tomentosa L.		I				F	F
Tamarindus indica L.	F						
Vicia acutifolia Ell.	C						
Vigna repens (L.) Kuntze			F				
Oxalis dillenii Jacq.	F						
Zanthoxylum clava-herculis L.							I
Zanthoxylum fagara (L.) Sarg.					F	F	I
Suriana maritima L.		A					
Bursera simaruba (L.) Sarg.	F					I	F
Asemeia cumulicola Small	F						
Asemeia grandiflora (Walt.) Blake, var. leiodes Blake	F						
Polygala incarnata L.				F			
Cnidoscolus stimulosus (Michx.) Engelmann & Gray	F						
Croton floridanus Ferguson	I			I			
Euphorbia ammannioides H.B.K.		F					
Euphorbia buxifolia L.		C					
Euphorbia heterophylla L.	C						
Euphorbia hirta L.	C	I		I			
Euphorbia hyssopifolia L.	I			I			
Euphorbia maculata L.		F					
Euphorbia pilulifera L.	F						
Euphorbia trichotoma H.B.K.		F					
Phyllanthus abnormis Baill.				F			
Ricinus communis L.	F						
Stillingia aquatica Chapm.	I						
Stillingia sylvatica L.	I						
Rhus radicans L.	C	I	I	I	I	C	C
Schinus terebinthifolius Raddi			I				
Maytenus phyllanthoides Benth.						I	
Cardiospermum halicacabum L.					I		
Dodonaea jamaicensis DC.	I			I		F	
Parthenocissus quinquefolia (L.) Planch.						F	F
Gossypium hirsutum L.						I	
Kosteletzkya virginica (L.) Presl			F	I			
Kosteletzkya virginica (L.) Presl, var. althaeifolia (Chapm.) A. Gray					R		

	Old fields	Coastal shell ridge	Spartina marshes	Grasslands & savannas	Mangrove swamps	Palmetto jungles	Mixed woods
Sida carpinifolia L. f.	C			I			
Waltheria americana L.	F						
Piriqueta caroliniana (Walt.) Urban, var. glabra (DC.) Urban	C						
Carica papaya L.	I						
Mentzelia floridana Nutt.	F						
Acanthocereus floridanus Small					I		
Opuntia austrina Small	F	F		F			
Opuntia dillenii (Ker.) Haw.		F					
Opuntia ficus-indica (L.) Mill.	I						
Opuntia keyensis Britton	I						
Ammannia latifolia L.	F						
Lythrum lanceolatum Ell.					F		
Rhizophora mangle L.		I			D		
Conocarpus erecta L.	I	F		I	D		
Conocarpus erecta L., var. sericea Forst. ex DC.	I						
Laguncularia racemosa (L.) Gaertn.		I			C		
Eugenia anthera Small					I	F	F
Eugenia axillaris (Sw.) Willd.				I			
Eugenia buxifolia (Sw.) Willd.							I
Psidium guajava Raddi	F						
Gaura angustifolia Michx., var. eatonii (Small) Munz.	F	I		I			
Ludwigia microcarpa Michx.			I	I			
Oenothera humifusa Nutt.		C		I			
Oenothera laciniata Hill	I						
Eryngium baldwinii Spreng.				I			
Hydrocotyle umbellata L.			F				
Ptilimnium capillaceum (Michx.) Raf.							
Jacquinia keyensis Mez.	F						
Ardisia escallonioides S. & C.	F			F			
Rapanea guianensis Aubl.					I		F
Samolus ebracteatus H.B.K.			C		I		
Samolus floribundus H.B.K.				I			
Bumelia angustifolia Nutt.	C				I		
Sideroxylon foetidissimum Jacq.							I
Forestiera porulosa (Michx.) Poir.	F	I					F
Ligustrum ovalifolium Hassk.	I						
Cynoctonum mitreola (L.) Britton				I			
Polypremum procumbens L.	C						
Eustoma exaltatum (L.) Griseb.					I		
Sabatia campanulata (L.) Torr.	C			F			
Lochnera rosea (L.) Reichenb.	C			C			
Rhabdadenia biflora (Jacq.) Muell-Arg.					I		
Urechites lutea (L.) Britton					I		
Asclepias verticillata L.	I	F					
Cryptostegia grandiflora R. Br.	I						
Cynanchum palustre (Pursh) Heller	C						
Cynanchum scoparium Nutt.	I						
Sarcostemma clausum (Jacq.) R. Br.							
Calonyction aculeatum (L.) House	F	I	F				
Calonyction tuba (Schlecht.) Colla		I					
Cuscuta campestris Yuncker		I					

	Old fields	Coastal shell ridge	Spartina marshes	Grasslands & savannas	Mangrove swamps	Palmetto jungles	Mixed woods
Ipomoea cathartica Poir.					F	I	
Ipomoea pes-caprae (L.) Sweet		C					
Ipomoea sagittata Cav.			I				
Heliotropium curassavicum L.		I					
Heliotropium parviflorum L.		I					
Heliotropium polyphyllum Lehm.		F					
Avicennia nitida Jacq.		I			C		
Lantana camara L.	C			C		I	
Lantana involucrata L.	C	I					
Lantana ovatifolia L.	F						
Lippia nodiflora L.	C		F	F			
Verbena scabra Vahl							
Trichostema suffrutescens Kearn.	F						
Physalis elliottii Kunze	C	F		C			
Physalis pubescens L.	R						
Solanum gracile Link.	C			F			
Bacopa monnieri (L.) Pennell			C				
Buchnera floridana Gandoger	F			F			
Capraria biflora L.	C			F			
Ernodia littoralis Sw.				C	C		
Gerardia maritima Raf.				F			
Scoparia dulcis L.	I						
Dicliptera assurgens Juss.							
Thunbergia fragrans Roxb.	I					I	
Chiococca alba (L.) A. Hitchc.	F					I	I
Chiococca pinetorum Britton							I
Galium hispidulum Michx.	F	F					
Galium tinctorium L., var. floridanum Wiegand	F						
Genipa clusiaefolia (Jacq.) Griseb.						I	C
Houstonia nigricans (Lam.) Fern.					C		
Houstonia procumbens (Walt.) Standley						R	
Psychotria undata Jacq.						F	F
Randia aculeata L.		I			F		
Sambucus simpsonii Rehder	I						
Melothria pendula L.			F	F			
Lobelia feayana A. Gray				F			
Scaevola plumieri Vahl		C		I			
Ambrosia artemisiifolia L., var. elatior (L.) Descourtils	C	I		F			
Ambrosia hispida Pursh		I					
Aster subulatus Michx.		I					
Baccharis angustifolia Michx.				F			
Baccharis dioica Vahl		I					
Baccharis glomerulifolia Pers.						I	
Baccharis halimifolia L.	C	C		F			
Berlandiera subacaulis Nutt.	I						
Bidens pilosa L., var. radiata Schultz-Bip.	C	C		C			
Borrichia frutescens (L.) DC.		I	A	F			
Cirsium horridulum Michx., forma elliottii (T. & G.) Fern.				C			
Conyza canadensis (L.) Britton, var. pusilla (Nutt.) Cronq.	C						

	Old fields	Coastal shell ridge	Spartina marshes	Grasslands & savannas	Mangrove swamps	Palmetto jungles	Mixed woods
Coreopsis leavenworthii T. & G.	C	C		F			
Emilia sonchifolia (L.) DC.	I						
Erechtites hieracifolia (L.) Raf.	R			F			
Erigeron quercifolius Lam.	C			F			
Eupatorium capillifolium (Lam.) Small	C						
Eupatorium mikanioides Chapm.	F			F			
Flaveria floridana J. R. Johnston	F			C			
Flaveria linearis Lag.	F			C			
Gnaphalium purpureum L.	C						
Iva frutescens L.							I
Iva imbricata Walt.		C					
Melanthera deltoidea Michx.	C	I		F			
Mikania batatifolia DC.	F		C	F			
Pectis linearifolia Urban	F			F			
Pectis prostrata Cav.	I						
Pluchea purpurascens (Sw.) DC.				F			
Pluchea rosea Godfrey			F	F			
Solidago sempervirens L., var. mexicana (L.) Fern.	I	F	I				
Sonchus oleraceus L.	F						
Verbesina virginica L., var. laciniata A. Gray	C						

NON-VALIDITY OF NUTTALLIAN NAMES IN FRASER'S CATALOGUE

Lloyd H. Shinners

In 1890 Edward L. Greene reprinted in Pittonia (vol. 2, pp. 116–119) "A Catalogue of New and Interesting Plants Collected in Upper Louisiana, and principally on the River Missourie, North America, [by T. Nuttall,] for sale at Messrs. Fraser's Nursery For Curious American Plants, Sloane Square, King's Road, Chelsea, London," dated 1813. The reprint was made from a copy at the Philadelphia Academy, in which Nuttall had inserted his name after the first part of the title, indicated above by brackets. Under present rules of nomenclature, commercial catalogues and newspapers are not to be accepted as media for effective publication of scientific names after 1 January 1953, but the regulation is unfortunately not retroactive. Following Greene's resurrection of Fraser's Catalogue, a number of names from it have come into circulation, credited to Nuttall. But an examination of the listings in the Catalogue, Pursh's Flora Americae Septentrionalis (1814), and Nuttall's The Genera of North American Plants (1818), shows that Nuttall himself did not accept most of the names in the Catalogue, and could scarcely have been its author.

Of the 89 names in Fraser's Catalogue, 71 are starred as new: 69 species (one not named beyond genus), 2 varieties. In his Genera, Nuttall mentions only 32 of the new species and one of the new varieties. Three are credited to other sources than the Catalogue: *Allium stellatum* "Sims, Bot. Mag."; *Bartonia decapetala* "Bot. Mag." (listed as synonym of *B. ornata* Nuttall, the only species, the genus starred as new); *Oenothera macrocarpa* "PH." (i. e., Pursh; listed as synonym of *O. alata* n. sp. by Nuttall). Ten names are starred as new in the Genera, without mention of previous publication, though all had appeared in the Catalogue: *Calymenia pilosa*, *Cactus viviparus*, *C. ferox*, *C. fragilis*, *Cheiranthus asper* (spelled *asperus* in the Catalogue), *Elaeagnus argentea* (spelled *argenteus* in the Catalogue), *Gaura coccinea*, *Oenothera caespitosa*, *O. serrulata*, *Rudbeckia purpurea* var. *serotina*. Fourteen names appear in the Genera credited to "T. N. in Fras. Catal."; two are misquoted (*Glycyrrhiza* *lepidota*, which in the Catalogue is *Liquiritia lepidota; Artemisia nutans*, as synonym of *A. cernua* n. sp., is *A. cernua* in the Catalogue); two (in addition to *Artemisia nutans*) are placed in synonymy (*Lactuca oblongifolia* under *L. integrifolia* n. sp., with *L. pulchella* Pursh as an additional synonym; *Seseli lucidum* under *S. divaricatum* Pursh); ten are accepted and starred as new though with reference to previous publication in the Catalogue (*Amorpha canescens, A. nana, Calymenia angustifolia, Dalea aurea, Lilium andinum, Malva coccinea, Phalangium esculentum, Psoralea esculenta, P. incana, Troximon glaucum*). Six more are credited in the Genera only to "Fras. Catal."; one is neither described nor starred as new (*Erigonum flavum*), the remaining five are both (*Astragalus gracilis, Oenothera albicaulis, Penstemon grandiflorum, P. cristatum, P. erianthera*).

Eighteen new names appear in Fraser's Catalogue with some descriptive remarks. In addition there is a brief joint description for two species of *Sideranthus*. Only four are acknowledged by Nuttall to have been his: *Amorpha nana, Lilium andinum, Malva coccinea, Phalangium esculentum*. Two are credited by Nuttall only to "Fras. Catal.": *Eriogonum flavum* (not described in the Genera), *Penstemon grandiflorum*. One is credited to Pursh without reference to the Catalogue, though first described there: *Oenothera macrocarpa* (as synonym of *O. alata* n. sp.). Ten are not mentioned by Nuttall in his Genera: *Astragalus crassicarpus, Dalea enneandra, Hyssopus anethiodorus, Rudbeckia columnifera, Sideranthus integrifolius, S. pinnatifidus, Thuraria herbacea, Virgilia grandiflora, Vitis campestris, Yucca glauca*. The first, second, fourth, and tenth of these are in current use, attributed to Nuttall, though he quite plainly disclaimed them. Three more are described as new in 1818 without reference to the Catalogue: *Cactus viviparus, Oenothera caespitosa* (spelled *cespitosa* in the Catalogue), *Rudbeckia purpurea* var. *serotina*.

It must be concluded from this record that Nuttall was not the author of Fraser's Catalogue, and did not consider it an accepted medium for publication of new names. His autograph on the Philadelphia copy was intended to mean not "A Catalogue, by T. Nuttall, of Plants Collected in North America," but "A Catalogue of Plants, Collected in North America by

T. Nuttall." He evidently supplied manuscript names with some of the plants which he sent to the Frasers. References in his Genera to their Catalogue were an effort to salvage some (not all) of these names. He was resentful of Pursh's having anticipated him in publishing them, as some of his remarks indicate. Under *Amorpha canescens* he says, "Mr. Pursh places his *usual* mark of *v.v.* to this species, although he had never seen a flowering specimen except in my herbarium." In a footnote under *Bartonia ornata* he writes, "Mr. Pursh, before he had perused the notes which I had made from the living plant on the Missouri, with an intention of rendering them public, had not then, by his own acknowledgment, anything like materials for publishing this genus, . . . This unfortunate want of fidelity, prevented me from communicating to Mr. F. Pursh, many of the plants which now appear in this work. . . . It was surely not honorable in Frederick Pursh, whom I still esteem as an able botanist, to snatch from me the little imaginary credit due to enthusiastic researches made at the most imminent risk of personal safety!"

It would be unjust to accuse Pursh of totally unethical behavior. Nuttall was a shy and secretive man, and it is altogether likely that he did not confide to Pursh his plan to publish a North American flora when the German botanist visited him and examined his herbarium. Pursh must have guessed that at least some of the names in Fraser's Catalogue had originated with Nuttall, but he did not know which ones, nor did he know precisely Nuttall's intentions concerning them. Communication was slow and difficult, and Nuttall himself, in his frequent travels, not easily accessible.

But the fine etiquette of the matter, as seen at this late date, cannot be our basis for determining the validity of the names published in the Catalogue. These were anonymous as published. We do not know whether the Catalogue was prepared by one of the Frasers or by a clerk in their employ. Since the names were not avowedly accepted by any author, they were not validly published. (Cf. Jacques Rousseau, "One Plant Name in Search of an Author," Taxon 4: 40–42, 1955.) It might be argued that we must at least keep the names claimed later by Nuttall. We should then have to keep those not claimed by him also. Nuttall himself did not retain all the names which he acknowledged to be his. We cannot very well allow that he could legitimize some parts of the Catalogue and not others. His inconsistent treatment gives us sufficient legal grounds, if anonymity be not enough, to disregard all names in the Catalogue.

Nor can it be held that usage gives any support to retention of the names. The inconsistencies of later authors are strikingly shown in the eighth edition of Gray's Manual. "*Yucca glauca* Nutt." was an anonymous name explicitly disclaimed by Nuttall, who does not mention it in his Genera, but lists *Y. angustifolia* Pursh. "*Psoralea esculenta* Pursh" first appeared in Fraser's Catalogue as a *nomen subnudum*, but unlike *Yucca glauca*, was claimed by Nuttall in 1818. The same is true of *Amorpha nana* (*A. microphylla* Pursh). "*Dalea enneandra* Nutt." is an identical case with that of *Yucca glauca;* Nuttall in 1818 called it *D. laxiflora* Pursh, and did not mention the binomial later erroneously attributed to him. *Astragalus caryocarpus* Ker is inconsistently (but correctly[1]) adopted in place of *A. crassicarpus*, another anonymous name never accepted by Nuttall. "*Glycyrrhiza lepidota* (Nutt.) Pursh should strictly be credited to Pursh alone: if dated from 1813, it may be considered a misprint corrected by Nuttall in 1818 from *Liquiritia* to *Glycyrrhiza*. "*Sphaeralcea coccinea* (Pursh) Rydb." is correct, but again inconsistent, since the basonym (*Malva coccinea*) first appeared in Fraser's Catalogue accompanied by a description, and was subsequently claimed by Nuttall as his. *Mamillaria vivipara* (Nutt.) Haw. has basonym dated from 1818, not 1813. "*Penstemon grandiflorus* Nutt." (credited by him only to Fraser's Catalogue, not to himself) must give way to *P. Bradburii* Pursh. *Ratibida columnifera* (Nutt.) Woot. & Standl. (basonym never acknowledged by Nuttall) returns to its long familiar name, *R. columnaris* (Pursh) Rafinesque.

[1] Correctly under then existing rules of nomenclature, which outlawed names based on mixtures. As since revised, Article 76 of the International Code requires the adoption of *A. carnosus* Pursh for this species: though based in large part on the later-named *Sophora sericea* Nutt., there is no doubt but that the name *carnosus* was intended to describe the fruit of *Astragalus caryocarpus* (also named later). Nuttall by implication, and Torrey & Gray explicitly, typified Pursh's epithet with the *Astragalus* element, for which it must now be revived.

THE ARCHER METHOD FOR MOUNTING HERBARIUM SPECIMENS

REED C. ROLLINS

SINCE the publication by W. Andrew Archer[1] in 1950 of an article entitled, "New Plastic Aid in Mounting Herbarium Specimens", there has been an increasing interest in the use of plastic for this purpose. In presenting his formula five years ago, Dr. Archer invited prospective users to further improve it and to modify methods of procedure to suit particular needs. We have been using the Archer Method with some slight modifications at the Gray Herbarium with excellent results for several years. The frequent calls for information concerning our present formula and procedure have prompted me to put these into print for the convenience of those interested.

ORIGINAL ARCHER FORMULA

Toluene—800 cc.
Methanol—200 cc.
Ethel cellulose (Dow Chemical Ethocel[2])
standard 7 cps.—250 grams.
Dow Resin 276 V-2—75 grams.

NEW YORK BOTANICAL GARDEN MODIFIED FORMULA

Toluene—720 cc.
Methanol—180 cc.
Ethocel—250 grams
Dow Resin—75 grams

GRAY HERBARIUM MODIFIED FORMULA

Toluene—880 cc.
Methanol—220 cc.
Ethocel, standard 10 cps.—1750 cc. (560–650 grams).
Dow Resin—75 grams

First mix methanol and toluene; then add and dissolve the resin completely. Finally mix in the ethocel adding it gradually. The resulting stiff coarse mixture should be stirred slowly until the ethocel is partly dissolved. There will be many bubbles

[1] Rhodora **52**: 298–299. 1950.

[2] Ethocel and Dow Resin are obtainable from the Dow Chemical Company, Midland, Michigan. At present the Ethocel may not be purchased in less than 50 pound lots at a cost of about $40.00. The Dow Resin is sold in a 5 gallon container. This may seem expensive, but fifty pounds of Ethocel and five gallons of Dow Resin together with appropriate amounts of the solvents have provided the plastic for mounting over 40,000 specimens.

and large particles present at this stage, but the solution will clear in about 24 hours.

It will be quickly noted that the users at both New York and at Gray found the original formula less viscous than desirable. In the New York modification, less solvent is used, and the proportions of Toluene and Methanol are maintained. In working toward greater viscosity, my own procedure was to obtain Ethocel of standard 10 cps. (to replace standard 7 cps.) and to increase the proportion of ethel cellulose. The first combination that came close to meeting with satisfaction was based on the use of 1000 cc. of solvent. However, this proved to be difficult to use in the dispensers; hence, another 100 cc. of the solvent was added to the formula. It should be understood that the formula was arrived at by trial and error, and I feel sure that several different combinations of the basic materials originally put together for this purpose by Archer would be very satisfactory.

In a recent letter, Dr. Archer notes that the Gray Herbarium Formula, using 625 gms. of ethocel, has proven to be too thick for some dispensers. He is now using the following formula: toluene 880 cc.; methanol 220 cc.; ethocel (standard 10 cps.) 575 gms.; resin 75 gms. I feel sure that the use of a weight measure for the ethocel is at the base of the inconsistencies experienced by different persons in making up the formula. For example, the weight of 1750 cc. of one lot of ethocel was 659.7 gms., while the weight of 1750 cc. of another lot was 560.5 gms. It appears that volume measure is more reliable than weight measure. At least, we have always used and gotten consistent results with a volumetric measure in handling the ethocel. It may be necessary to make minor adjustments in the formula with each new lot of ethocel. However, I do not believe the proportions are at all critical and they may be shifted somewhat without materially devaluing the final product.

We find it possible to mount large woody materials, even pine cones, by use of the above formula. The viscosity is such that it will hold well on the sides of a branch or stem and not produce a weak point in the strand by thinning at the vertical part. Our aim is to put the plastic in a strap-like form over the stem or a portion of the leaf etc., in such a way as to have each end of the plastic strap firmly anchored on the mounting sheet. On large leaves, holes are punched with a paper punch a centimeter or two from the edge at intervals around the leaf. The plastic strap is spread from the mounting paper to the hole through which it reaches the paper beneath the leaf. Thus, a large leaf can be as firmly strapped to the mounting sheet as can stems and other parts of the plant. This procedure essentially eliminates the need or the desirability of smearing the specimen with plastic on the side placed downward on the mounting sheet. The mounting job, then, is essentially one of strapping the specimen to the sheet with plastic straps squirted from a pressure oil can. Occasionally on especially bulky materials or where a specimen will not lie flat, plastic is used beneath the projecting part of the specimen to provide a kind of seat upon the paper. It is important to have a strap stretch from paper at one end to paper at the other. The bonding of the plastic with the specimen itself is often imperfect and cannot be relied upon to hold. This is not true with the plastic to paper bonding which is exceptionally strong.

Some users of plastic as a mounting medium have experienced difficulty from having stacked the sheets before the plastic was fully dry. The sheets stuck together and produced real difficulty. Actually, the plastic dries quite rapidly, and the sheets can usually be safely stacked in about 40 minutes to an hour. Also, some users require a large amount of table space for their mounting operation because the specimens are laid out on the sheets side by side on tables. After a group of specimens are laid out and weights put into position, the mounter applies the plastic. While these are drying, a second group of specimens is laid out, etc. When the first group is dry, the sheets of specimens are then stacked. We have eliminated the need for a large amount of table space and made the time factor in drying unimportant by two simple procedures. Furthermore, the mounter is permitted to sit down while working.

The sheet of mounting paper is placed upon a double-faced corrugated cardboard slightly larger in size than the sheet. The label is affixed to the sheet; the specimen is placed and weighted;[3] and finally the plastic is applied. The mounter

[3] For weights, we have found broken up type-plates to be ideal. These lead sheets

then puts four small wooden blocks or, other objects of similar nature, on the cardboard near the four corners. The cardboard carrying the mounted specimen with the plastic still wet is then stacked. Each successive cardboard in the stack is held above the wet plastic of the sheet below, and the stack may be left until the plastic is dry without inconvenience. The wooden blocks are of two or three lengths so that four blocks as much as an inch long may be selected if the thickness of the specimens requires it. The cardboards are easily obtained from paper box manufacturers. For us, the double-faced corrugates commonly used in plant presses serve very well.

Dispensing the plastic provides no great problem. We find the "pistol grip" pressure oil can of the type used for spraying the springs of automobiles very satisfactory. This type of dispenser, called to my attention by Dr. David D. Keck, can be used continuously for several months without cleaning. At first, we were careful to cover the end of the spout while not in use, thinking the plastic would harden in it. However, this proved to be an unnecessary precaution, for the plastic seals the end of the spout very quickly; and the short plug formed is easily squeezed out even after several days have elapsed. If the plastic hardens in the spout, the nozzle can be soaked in the solvent. The spout of the dispenser is made of brass, and the copper present reacts with the plastic to make the plastic greenish in color. If the dispenser has not been used for several days, the plastic in the spout will be quite colored. For those who find this objectionable, it is a small waste to squeeze that amount away before starting the mounting of specimens. The barrel of the dispenser should not be brass, for the whole of the contents will then become colored. Whenever the dispenser becomes fouled after long usage, it can be cleaned by disassembling it and submerging the parts in the solvent for several days.

Our mounters find it worthwhile to wipe the end of the spout of the dispenser frequently to keep the flow of plastic smooth. This produces a neater strap and prevents unnecessary threading of the plastic itself. In fact, they find it convenient to work

---

can be readily broken into many different sizes. Of course, any relatively heavy bits of metal will do very well.

with the dispenser in one hand and a small cloth in the other wiping the nozzle after every few straps extruded.

The plastic once made up appears to have excellent keeping qualities if kept in an airtight container. Once dried after use in mounting, it is tough and durable and not easily broken even by a direct hit with a metal object.[4] There is some contraction of the plastic on drying, and this tends to pull the specimen tight against the paper giving the full value of support to the specimen that the paper can provide. The fact that the plastic does contract makes it inadvisable to use long straps, especially if several are put parallel to one another. Several long parallel straps will contract enough to pull the mounting paper into wrinkles. We use straps mostly below an inch in length although occasional longer ones are required and can be safely used. The first tendency of the mounter in using the plastic is to put long straps over several culms of grass or similar specimens. This should be avoided not only because it tends to form wrinkles in the sheet, but also produces unsightly mounted specimens as well. While the strap should be kept relatively short, its thickness may be increased by passing the stream of plastic back and forth several times.

Some feel it is too early to evaluate completely the Archer Method from the point of view of what may happen to the plastic straps after forty or fifty years in the herbarium. However, if the plastic holds after five years, it seems to me that it might be expected to hold indefinitely. One thing we do know is that the plastic does not appear to become brittle with the passage of time. And there are apparently no *a priori* grounds upon which to predict any appreciable change in the chemical or the physical nature of the plastic straps unless they are subjected to a powerful solvent. The latter seems highly unlikely in a well kept herbarium.

The chief advantage of the Archer Method is the speed-up possible in the mounting. In rough calculations, we have found that a mounter can prepare and mount three or four specimens using this technique in the time required to mount one specimen

[4] Paradichlorobenzene has been reported to soften the plastic even after it has dried thoroughly. Our own tests with a high concentration of p d b at room temperature did not produce any noticeable affect. However, no tests were made under varying conditions of temperature and moisture.

using paste and gummed cloth strips. Where heavy specimens are sewed, the time saved is even greater, for sewing is not required. A second advantage comes from the possibility of repairing specimens in the herbarium itself. A dispenser filled with plastic can be kept handy for remounting loose specimens or broken parts by the botanist while he is actually working in the herbarium. This eliminates the necessity of having the specimen out of the herbarium in the hands of the mounter and of having to refile it in the herbarium at a later time. Personally, I believe the use of plastic makes a better looking mounted specimen. However, all botanists may not agree on this point.—GRAY HERBARIUM OF HARVARD UNIVERSITY.

PINUS RIGIDA MILLER IN QUEBEC.—Owing to the lack of authentic records, the presence of *Pinus rigida* Miller in the province of Quebec had always been in doubt. During a field trip in the region of Saint-Chrysostôme, Chateauguay County, made on September 4th, 1954, Mr. Lionel Cinq-Mars and the author have found a natural stand of *Pinus rigida* at Cairnside. The mixed stand covers an area of about a square mile. The trees growing in the forest attain around thirty-five feet in height and about eight inches in diameter. When they grow on the bare Potsdam sandstones, they are stunted and the lower branches are heavily covered with cones. *Pinus resinosa* Ait. and *Pinus Strobus* L. are also present in the area.—ERNEST ROULEAU, HERBIER MARIE-VICTORIN, UNIVERSITÉ DE MONTRÉAL.

Volume 57, no. 681, including pages 241–268, was issued 4 October, 1955.

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Vol. 57 November, 1955 No. 683

CONTENTS:

The New England Botanical Club, Inc.

8 and 10 West King St., Lancaster, Pa.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of the Gray's Manual Range and regions floristically related. Price, $4.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) of not more than 24 pages and with 1 plate, 40 cents, numbers of more than 24 pages or with more than 1 plate mostly at higher prices (see 3rd cover-page). Back volumes can be supplied at $4.00. Some single numbers from these volumes can be supplied only at advanced prices (see 3rd cover-page). Somewhat reduced rates for complete sets can be obtained on application to Dr. Hill. Notes and short scientific papers, relating directly or indirectly to the plants of North America, will be considered for publication to the extent that the limited space of the journal permits. Illustrations can be used only if the cost of engraver's blocks is met through the author or his institution. Forms may be closed five weeks in advance of publication. Extracted reprints, if ordered in advance, will be furnished at cost.

Address manuscripts and proofs to Reed C. Rollins,
Gray Herbarium, 22 Divinity Ave., Cambridge 38, Mass.

Subscriptions (making *all remittances* payable to RHODORA) to

Dr. A. F. Hill, 8 W. King St., Lancaster, Pa., or, preferably, Botanical Museum, Oxford St., Cambridge 38, Mass.

Entered as second-class matter March 9, 1929, at the post office at Lancaster, Pa., under the Act of March 3, 1879.

Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 57 November, 1955 No. 683

CONTRIBUTIONS TO THE FLORA OF NOVA SCOTIA:

V. RESULTS OF EXPLORATION IN CUMBERLAND COUNTY

W. B. Schofield

Cape Blomidon, Kings County, has long been known as a botanically rich area containing a number of interesting montane species. *Saxifraga Aizoön* Jacq. (var. *neogaea* Butters) was reported from the area many years ago (Lawson, 1884), but no substantiating specimen seems to have survived.[1] A. E. Roland (1938, 1947) reported *Draba arabisans* Michx. and *Arabis Drummondii* Gray which are locally quite abundant on an exposed boulder slope. Recently J. S. Erskine (Smith & Erskine, 1954) has collected *Lycopodium Selago* L., *Poa glaucantha* Gaudin, and *Trisetum spicatum* (L.) Richter, var. *pilosiglume* Fernald from Amethyst Cove, a short distance from the Cape; these are local on the cooler cliff shelves.

A relationship of the flora of Cape Blomidon to that of northern Cape Breton Island has been implied on the basis of rather inadequate botanical evidence, but much evidence is accumulating as the floras of both areas become better known. The relation of Blomidon's flora to that of Cumberland County has been practically unknown, but the few collections from that county had suggested a positive relationship (Smith & Erskine, 1954).

Intensive botanical exploration in the northern portion of Cape Breton Island has stimulated interest in the montane

[1] A recent re-collection of this species from Cape Blomidon indicates that it is still present there: scattered plants on dry soil, shelves and pockets of lower portion of cliff, about 2 miles south of Cape Split, Cape Blomidon, Kings County, *W. B. Schofield and D. H. Webster 5873*.

element of Nova Scotia's flora. It was one of the aims of the writer to accumulate evidence from Cumberland County either supporting or refuting the implied relationships of its flora to more northerly areas. This exploration, carried on during the summers of 1953 and 1954, was done under the sponsorship of the Nova Scotia Research Foundation. The results have been most gratifying.

Unquestionably the most interesting association of montane species known in peninsular Nova Scotia is to be found in the vicinity of Cape d'Or, Cumberland County. The montane aspect of the west-facing cliff-top is quite remarkable. There the strong winds have so blasted the area behind the precipice that a narrow treeless border has been left wherein one finds the following association of species: *Saxifraga Aizoön* Jacq., var. *neogaea* Butters; *Astragalus Robbinsii* (Oakes) Gray; *Oxytropis johannensis* Fern.; *Chrysanthemum Leucanthemum* L., var. *pinnatifidum* LeCoq & LaMotte; *Festuca rubra* L.; *Sedum Rosea* (L.) Scop.; *Plantago juncoides* Lam, var. *decipiens* (Barnéoud) Fern.; *Poa pratensis* L. (*sensu lato*); *Poa compressa* L.; *Oenothera biennis* L.; *Cardamine parviflora* L., var. *arenicola* (Britt.) Schulz; *Antennaria canadensis* Greene; *Campanula rotundifolia* L.; *Trisetum spicatum* (L.) Richter, var. *pilosiglume* Fern.; *Cirsium arvense* (L.) Scop.; *Draba arabisans* Michx.; *Achillea lanulosa* Nutt.; *Solidago bicolor* L., and *Agropyron trachycaulum* (Link) Malte, var. *novae-angliae* (Scribn.) Fern.

As can be noted by the list, highly competitive weedy species are producing a marked change in the vegetation of the cliff-top. Doubtless the rare species will continue to persist in the more exposed areas where they tend to flourish.

Behind this narrow band is the tangled barrier of alder, which forms another distinct border to the cliff-margin vegetation. In areas among these alders are found small open patches of *Potentilla fruticosa* L., and *Heracleum maximum* Bartr.

Other areas that harbor interesting species include a high cliff at New Prospect, near Parrsboro, where *Draba arabisans* Michx.; *Carex rosea* Schkuhr; *C. convoluta* Mackenz.; *Muhlenbergia mexicana* (L.) Trin.; *Milium effusum* L.; and *Festuca obtusa* Biehler, are found in abundance (although not montane, these species are extremely local in the province). At Advocate, above the salt marsh, on the eastern bank of Burke Brook, *Montia lamprosperma* Cham. abounds near a cold springy area and *Stellaria humifusa* Rottb., carpets large patches of the marsh near the brook.

The cliffs of Isle Haute, the largest of Nova Scotia's Bay of Fundy islands, also hold several interesting species, among which are *Draba arabisans* Michx.; *Arabis Drummondii* Gray; *Poa glaucantha* Gaudin and *Lycopodium Selago* L. (the final species being exceedingly rare).

The deeper brook valleys yielded rather sparse collections of montane species. McAlese Brook, New Prospect, was by far the richest, possessing on the moist slope near its waterfall *Carex atratiformis* Britt., and on the cliff above *Lycopodium Selago* L., and *Dryopteris fragrans* (L.) Schott., var. *remotiuscula* Komarov.

The flora of Cumberland County cannot be considered completely known on the basis of these two summers' collections, but these certainly point out the importance of intensive exploration in one area. In the following list are four species new to the province and numerous records of very local species.

All collections mentioned are from Cumberland County unless noted otherwise; all numbers given without the name of a collector are those of the writer. Specimens have been deposited at the Acadia University Herbarium.

Special acknowledgement is due the sponsoring institution: Nova Scotia Research Foundation, without whose support much of this exploration could not have been done. The writer is also most grateful for the considerable aid and helpful advice received from Dr. E. C. Smith of Acadia University and J. S. Erskine of Wolfville, Nova Scotia.

Lycopodium Selago L. Cliff-top, south side, Isle Haute (J. S. Erskine & W. B. Schofield, JSE *53.038*); locally abundant in rock crevices of river bank, West Moose River (*3170*); local colony on moist cliff facing McAlese Brook, New Prospect (*3234*). The species, widely distributed, but local, in northern Cape Breton Island, is very rare in peninsular Nova Scotia.

Sparganium minimum Fries. Very abundant in marginal water of Wigmore Lake (*4245*). Known from a few local stations in the province; the above colony covered an area of about fifteen square yards.

Potamogeton spp. Several interesting species of this genus were collected and are to be treated later by D. H. Webster in a paper devoted to the genus.

Najas flexilis (Willd.) Rostk. & Schmidt. This species is now known to be fairly widespread (cf. Smith & Schofield, 1952). The following collections from Cumberland County mark its wide distribution there: rare in marginal shallows of Leak Lake (*3557*); marginal shallows of Lake Killarney (4165); on sand of shallow water, Newville Lake (*3606*); in wrack of Mattatall Lake (*3996*); small riverside pond, Head of River Hebert (W. B. Schofield & D. H. Webster *5632*).

Sagittaria graminea Michx. Common on gravelly shore of Newville Lake (*3562*); wet margin of Dewar's Lake (*4073*); rare in mud of lake margin, Lake Killarney (*4156*); margins of Big Lake, Victoria (*5394*). The above collections do not support the suggestion of Roland (1947), "apparently local and rare in the northern and central parts of the peninsula." Although it often does not flower, the stiffly arching, thick, underwater leaves readily distinguish it from any other known Nova Scotian species of *Sagittaria*.

Festuca obtusa Biehler. Abundant on hardwood slope, New Prospect (*3453*); very abundant on rich hardwood slope about one mile east of Refugee Cove (*5191*). A collection from Kings County is also of interest: occasional among small trees at base of high cliff, Cape Blomidon (Schofield & Webster *5230*). Previously known only from Five Mile River, Hants County (Fernald, 1921).

Poa alsodes A. Gray. Damp margin of McGahey Brook (W. B. Schofield & P. A. Bentley *4795*). This very slender species of *Poa* is readily distinguished in the field from any other Nova Scotian species, for the very capillary rachillas and culms, that often tumble over, are quite different from the far coarser aspect of most species. Known from a few locations in N. S.; in the above location it grew abundantly on the damp shaded flood plain of the brook.

P. glaucantha Gaudin. The following collections are all from Isle Haute: occasional in cliff crevices, usually damp, near Pigeon Point, North Side (*3760*); rock crevices, North Side, Boar's Head (*3835*); abundant on upper slopes and crevices, central North Side (*3838*); rare in cliff crevices, Wrack Cove (*3886*); rock crevices, Western Slope (*3904*). Previously known from a number of stations in northern Cape Breton (Smith & Schofield, 1952) and from Cape Blomidon, Kings County (Smith & Erskine, 1954).

Schizachne purpurascens (Torr.) Swallen. Very rare in rock crevices, West Moose River (*3160*). Hitherto, in peninsular Nova Scotia, this species was known from only Moore's Falls, near Kentville, Kings County. Two further collections mark its presence on North Mountain, Kings County: rare in spruce woods, Cape Split (*3310A*); occasional clumps on grassy slopes above boulder scree, Cape Blomidon (Schofield & Webster *4550*). The species is locally abundant in northern Cape Breton Island.

Sphenopholis intermedia Rydb. Damp cliff gully, Moose Island, Colchester County (*5041*); seepy, mucky slope near Indian Springs Brook, Cape Blomidon, Kings County (Schofield & Webster *5233*). Dore and Roland (1942) remarked that this grass was found "where its roots were in contact with limestone or gypsum." The basalt of the above stations (plus inclusions of gypsum found in the sandstone) would probably produce a similar basic soil. Very local in Nova Scotia and previously unknown from the north-central counties.

Trisetum spicatum (L.) Richter, var. *pilosiglume* Fern. Frequent on exposed cliff headlands, Cape d'Or (Schofield & Bentley *4798*). Locally abundant in northern Cape Breton Island and known in peninsular Nova Scotia from the Cape Blomidon area.

Muhlenbergia mexicana (L.) Trin. Common at moist base of cliff and in crevices, New Prospect (*3449*); banks of Wallace River, Wentworth (*5248*). Known previously from Kings, Hants, and Halifax Counties (Smith & Erskine, 1954). The station in Wentworth is most interesting, in that it is the first to be discovered on a river not emptying into the Minas Basin.

Milium effusum L. Occasional under hardwoods of slope at base of cliff, New Prospect (*3142*); damp woodland margin of McGahey Brook (Schofield & Bentley *4785*). A species fairly frequent in the rich hardwood stands of northern Cape Breton Island, it was previously known from the mainland of the province from Cape Blomidon, Kings County, and Five Mile River, Hants County. In the hardwood forests of Cape Chignecto the species flourishes.

Eleocharis nitida Fernald. Rare on road to Cape d'Or (Schofield & Bentley *4817*). Other collections of this rare species: occasional in moist soil over basalt, Elliott Lake, Annapolis County (W. B. Schofield & J. S. Erskine *3113*); frequent on woods road, Cape Split, Kings County (*3308*, *3319*); damp woodland roadside, Economy Mountain, Five Islands, Colchester County (*4949*); damp pockets in burned-over area, north east end, Scatari Island, Cape Breton County (E. C. Smith, W. B. Schofield, D. H. Webster, L. Slipp & J. Taylor *8596*). The above collections were all found in association with soils derived from volcanic rock; this agrees with Fernald's remark about this species (Fernald, 1922).

E. ovata (Roth) R. & S. var. *ovata*. In small tufts, margin of pond, Truemanville (*4200*). This is a re-collection of the typical variety where Fernald (1950A) collected var. *Heuseri* Uechtritz and, apparently, the species, for he reports both from N. S. in the 8th edition of Gray's Manual (Fernald, 1950B). A collection of J. S. Erskine from Sandy Cove, Digby County (Erskine *52.1268*) is also the species. On the margin of a dried-up pond behind the barrier beach at Black Point, Halifax County, the species abounds (E. C. Smith, W. B. Schofield, D. H. Webster & P. A. Bentley *12644*).

E. ovata var. *Heuseri* Uechtritz. This is very abundant at Truemanville, being far more abundant than the species (*4200a*). A collection from the shore of Earltown Lakes (E. C. Smith, D. H. Webster & P. A. Bentley *11749*) is also this variety. Previously known from Truemanville (Fernald 1950A). It is interesting to note that both of these taxa are found on soils derived from basic rock. Even the collections from Black Point are found on a small local area of Carboniferous limestone.

Scirpus cespitosus L., var *callosus* Bigel. A single clump in rock crevice, Moose River (*3251*). This species, although exceedingly common on the Atlantic slope of Nova Scotia, seems to be very rare and local in the north-central counties.

S. hudsonianus (Michx.) Fern. Abundant in wet cliff crevices, West Moose River (*3174*). This species is also rare in the north-central counties, being represented by only one collection (in the vicinity of River Hebert) on Roland's distribution map of the species (Roland, 1947).

Rhynchospora fusca (L.) Ait. Abundant on boggy margin of Leak Lake (*3385*); common on moist margin of swamp, west end, Dewar's Lake (*4045*). Commonest in the south-western counties of the province, these mark further collections in the central portion.

Rhynchospora capitellata (Michx.) Vahl. Abundant on the swampy margin of Dewar's Lake (*4064*). This is also best known from the south-western counties. The above collection marks its extension into the northern part of the province. In common with all collections made outside the south-western counties, the above material was very much slenderer than that common to those counties.

Cladium mariscoides (Muhl.) Torr. Abundant on margin of Leak Lake (*3481*); marginal water of Mattatall Lake (*4007*); common on beach of Dewar's Lake (*4041*); damp swamp of Big Lake (*4249*). This species is much commoner in the province than previous records indicate.

Carex rosea Schkuhr. Abundant under hardwoods of slope near base of cliff, New Prospect (*3143*). Known from a few local stations in the province.

Carex Mackenziei Krecz. Wet quaking areas of salt marsh, Five Islands, Colchester County (*4951*); mucky area of salt marsh, Advocate, Cumberland County (*5103*). The distribution of this species is poorly known, but as Roland (1947) remarks, it is "probably general."

Carex pedunculata Muhl. Rich hardwood slope about one mile east of Refugee Cove (*5190*). Sterile plants of this species were noted on Moose Island, Colchester County, but were not collected. This species was previously reported from only two stations on North Mountain: Cape Blomidon, Kings County and north of Annapolis, Annapolis County. Another collection: from dryish open woods, top of North Mountain, Arlington, Kings County (D. S. Erskine *906*). A collection of J. S. Erskine indicates its presence in Hants County: swamp, Oulton's Ridge, near Windsor (J. S. Erskine, June 8, 1947).

C. atratiformis Britt. Local on moist cliff facing waterfall, McAlese Brook, New Prospect (*3226*). Known only from northern Cape Breton Island, the above collection marks its first report from peninsular Nova Scotia.

C. capillaris L. var *capillaris.* Tiny plants forming rounded cushions on seepy exposed slope at cliff-top, Cape d'Or (Schofield & Bentley *4804*, Schofield *5168*). Var. *major* Blytt is known from a number of stations in northern Cape Breton Island. The typical variety is readily distinguished from this by its possession of darker green leaves, shorter stature and in its formation of very dense tussocks rather than single erect clumps. New to Nova Scotia.

C. comosa Boott. Roadside behind dyke, Advocate (*5155*); abundant clumps in swamp, Truemanville (*4192*). Reported only from the Annapolis Valley, the above collections indicate its presence in north-central Nova Scotia.

C. Tuckermanii Boott. Local in meadow swale, Wallace River, Wentworth (*5352*). Known from Sweet's Corner, Hants County (Smith & Erskine, 1954).

Juncus Vaseyi Engelm. Abundant cespitose clumps in cranberry bog, Linden (*5400*). New to Nova Scotia; this fills in a range gap, for it is known from adjacent New Brunswick.

Luzula parviflora (Ehrh.) Desv., var. *melanocarpa* (Michx.) Buchenau. Wet wooded margin of McGahey Brook (Schofield & Bentley *4783*); damp margin of Mill Brook (Schofield & Bentley *4825*); rare on banks of Soldier Brook (*5202*). Reported once from peninsular Nova Scotia (Erskine, 1951), this from Three Sisters, Cumberland County. The above collections show that it is widespread (but never abundant) in the Cape Chignecto area.

Trillium erectum L., forma *albiflorum* R. Hoffm. Occasional among typical plants, alder thicket, North Side, Isle Haute (J. S. Erskine & W. B. Schofield *JSE 53.041*). This form was previously reported from North Mountain, Annapolis County (Roland, 1947).

Malaxis brachypoda (Gray) Fern. Rare in wet area beside trickle near

Indian Flats, Isle Haute (*3773*). Previously unknown from the province, the above collection fills in a gap in the range of this species, found locally in the neighbouring provinces and states.

Liparis Loeselii (L.) Richard. Rare in damp area in field near road, Isle Haute (*3830*); springy area, roadside near Folly Lake (*3981*); abundant in railroad ditch, Pineo Lake, Conn's Mills (*5462*). Its presence in the northern part of the province had not previously been suspected.

Geocaulon lividum (Richards.) Fern. Among heaths of bog, Spicer's Cove (Schofield & Bentley *4838*). This is the second collection from peninsular Nova Scotia. A collection from among heaths of a moist heath bog, Auburn, Kings County (*3097*) is very close to the previously known station at Kingston. The species is widespread, but local, in Cape Breton Island.

Polygonum hydropiperoides Michx., var. *hydropiperoides*. In water of River Hebert, near south end of Newville Lake (*3559*). This species was previously known only from south-western Nova Scotia.

Stellaria humifusa Rottb. Brackish marsh near Cape d'Or (*3948*); forming mats near upper part of salt marsh, Advocate (*5125*). Previously reported as mainly from eastern Nova Scotia and Cape Breton Island, the above collections indicate its presence in the north-central portion of the province. A collection from the margin of a salt marsh, Five Islands, Colchester County (*4950*) indicates its presence in the adjacent county as well.

Montia lamprosperma Cham. Abundant on cold trickle margin, upper salt marsh, east side of Burke Brook, Advocate (*3618*). This species is known from three other widely separated stations (Brier Island, Digby Co.; Port Hawkesbury, Inverness Co.; and Northwest Arm, Halifax Co.). The above collection falls within the expected range of the species.

Ceratophyllum demersum L. On sludge-bottomed margin of Newville Lake (*3607*); in water of River Hebert, Newville (Schofield & Webster *5645*); in wrack of Pineo Lake, Conn's Mills (*5463*). Reported from two other stations in the province, both in Kings County.

Draba arabisans Michx. Abundant in crevices of high cliff facing road, New Prospect (*3150*); cliff crevices, South Side, Isle Haute (J. S. Erskine & W. B. Schofield *JSE 53.035*, Schofield *3696*); rare in cliff crevices and on exposed cliff top, Cape d'Or (Schofield & Bentley *4805*); small moist rock outcrop on rich hardwood slope, one mile east of Refugee Cove (*5199*). Hitherto known very locally from Cape Blomidon, Kings County and from Cape Breton Island. It is relatively common on the cliffs of Isle Haute.

Cardamine parviflora L., var. *arenicola* (Britt.) Schulz. Among rocks near boat-house, East End, Isle Haute (*3659*); talus on cliff, North Side, Pigeon Point, Isle Haute (*3786*); seepy area of gully on cliff, Cape d'Or (*5182*). This taxon is doubtless much commoner than was suspected by the single reported station near Halifax (Roland, 1947). The following collections help to support this suggestion: very rare under damp shade of overhanging boulder, near P. Jack Cove, Brier Island, Digby County (*1625*); abundant in moist humus pockets of boulder talus, Cape Blomidon, Kings County (*3084*).

Arabis hirsuta (L.) Scop., var. *pycnocarpa* (M. Hopkins) Rollins. Small moist outcrop on rich hardwood slope about one mile east of Refugee Cove (*5200*). This species has been reported from Indian Brook, Victoria County (Smith & Erskine 1954). The following collection indicates its presence in Colchester County: talus slope, north-west side, Moose Island (*4962*). At the latter locality it was fairly abundant.

Arabis Drummondii Gray. Talus slopes near Western Slope, Isle Haute (J. S. Erskine & W. B. Schofield *JSE 53.036*, Schofield *3692*); one plant on talus slope, central North Side, Isle Haute (*3839*). Another species known previously from Cape Breton Island and Cape Blomidon, Kings County.

Sarracenia purpurea L., forma *heterophylla* (Eaton) Fern. Peat bog, Spicer's Cove (Schofield & Bentley *4834*). An interesting colour form known from a few local stations (Smith & Schofield, 1952).

Saxifraga Aizoön Jacq., var. *neogaea* Butters. Locally abundant on sheltered cliff shelves, Cape d'Or (Schofield & Bentley *4802*, Schofield *5164*). Previously known from Cape Breton Island and Cape Blomidon, Kings County.

Potentilla fruticosa L. Exposed cliff-top headlands, Cape d'Or (Schofield & Bentley *4811*); cliff crevices above sea-stack near Refugee Cove (Schofield & Bentley *4819*). Common at both the extreme northern and south-western ends of the province, the above collections note its local abundance in the north-central portion.

Astragalus Robbinsii (Oakes) Gray, var. *Robbinsii*. Depressed clumps on exposed cliff headlands, Cape d'Or (Schofield & Bentley *4800*); depressed tussocks on talus above sea stack near Refugee Cove (Schofield & Bentley *4818*). The treatment of Barneby in the *New Britton & Brown* has been followed. The above specimens differ only superficially from the description in the above-mentioned manual, and have therefore been included under the typical variety. These collections are of particular interest since they represent the rediscovery of a taxon thought to be extinct from its type area on "dry calcareous ledges, Winooski R., Vt." (Fernald, 1950B). It is relatively common and easily accessible at Cape d'Or. New to Canada.

Oxytropis johannensis Fern. Frequent in cliff crevices and on exposed cliff headlands, Cape d'Or (Schofield & Bentley *4799*, Schofield *5183*). This species has been known for many years from remote St. Paul Island, Victoria County. The above collection marks its first report from peninsular Nova Scotia.

Geranium Bicknellii (Britt.) Fern. Abundant on talus overgrown with poison ivy, base of cliff, New Prospect (*3134*). This species has been reported from very few localities.

Impatiens pallida Nutt. Luxuriant on slope, North Side, Isle Haute (*3828*). A rather uncommon species in the province, the above collection indicates its local occurrence in Cumberland County.

Elatine minima (Nutt.) Fisch. & Meyer. Occasional in shallow water of Leak Lake margin (*3396*); abundant on mucky margin of Lake Killarney (*4180*). This species appears to be widely distributed in Nova Scotia, but has been overlooked (cf. Smith & Schofield, 1952).

Myriophyllum tenellum Bigel. Abundant in marginal water of Leak Lake (*3482*); abundant in marginal water of Newville Lake (*3601*). Previously unknown from the north-central counties, but now found to be relatively frequent in lakes throughout the province.

Conioselinum chinense (L.) BSP. Seen, but not collected, on the banks of West Moose River; dry headland, Cape d'Or (Schofield & Bentley *4810*). A rather rare species in the province, previously unknown from the north-central counties.

Bartonia paniculata (Michx.) Robinson, var. *iodandra* (Robinson) Fern. Damp margin of swamp, west end of Dewar's Lake (*4048*). The plants were unusually etiolated, possibly due to their submergence during at least part of their growth period. This collection notes the appearance of this taxon in the north-central portion of the province, where it has been unknown.

Lindernia dubia (L.) Pennell. Damp gravel pit near Shinimecas Bridge (*4218*) (these tiny plants—up to 3 cm.—were growing among *Ludwigia palustris* and were flowering cleistogamously); damp, muddy bank of River Philip, near Oxford (*5371*). Known from only two other localities in the province.

Littorella americana Fern. In marginal shallows of Folly Lake (*3999*). All plants were sterile. This marks its first report from the north-central portion of Nova Scotia and its second collection from the peninsula. It is also of local occurrence in Cape Breton Island (cf. Smith & Schofield, 1952).

Galium boreale L., var. *intermedium* DC. A single colony on hill-top pasture, New Prospect (*3262*); dry field, Cross Roads (Schofield & Bentley *4700*). Known previously from Cape Blomidon, Kings County.

Campanula aparinoides Pursh. Abundant on banks of Parrsboro River (*3506*); common in moist area near Frog Pond, Isle Haute (*3722*). This species appears to be more common than was previously suspected (cf. also Smith & Erskine, 1954).

Lobelia spicata Lam. Locally abundant in dry field near shore, Linden (*5404*). Previously known from Blomidon, Kings County.

Megalodonta Beckii (Torr.) Greene. In wrack of Mattatall Lake (*3998*). This appears to be the third report of this species from the province.—PERRY BIOLOGICAL LABORATORIES, ACADIA UNIVERSITY, WOLFVILLE, NOVA SCOTIA.

Literature Cited

BARNEBY, R. C. in Gleason, Henry A. 1952. Astragalus in the New Britton & Brown Illustrated Flora of the Northeastern United States and Adjacent Canada, Vol. 2, N. Y. Botanical Garden.

DORE, W. G. & A. E. ROLAND. 1942. Grasses of Nova Scotia. Trans. N. S. Inst. Sci. **20**: 179–288.

ERSKINE, D. S. 1951. Species newly or rarely reported from Nova Scotia and Cape Breton Island. RHODORA **53**: 264–270.

ERSKINE, J. S. 1953. Additions and extensions to the Flora of Nova Scotia. RHODORA **55**: 17–20.

FERNALD, M. L. 1921. The Gray Herbarium Expedition to Nova Scotia, 1920. RHODORA **23**: 89–111, 130–152, 153–171, 184–195, 223–246, 257–278, 284–301.

FERNALD, M. L. 1922. Notes on the Flora of Western Nova Scotia. RHODORA **24**: 157–164, 165–180, 201–208.

FERNALD, M. L. 1950A. Three additions to the Flora of Nova Scotia. RHODORA **52**: 18–19.

FERNALD, M. L. 1950B. Gray's Manual of Botany, Eighth Edition, American Book Company, New York.

LAWSON, G. 1884. Notice of New and Rare Plants. Trans. N. S. Inst. Sci. **6**: 68–75

PERRY, L. M. 1931. Vascular flora of St. Paul Island, Nova Scotia. RHODORA **33**: 105–126.

ROLAND, A. E. 1938. Notes on the flora of Cape Breton Island. Can. Field Nat. **52**: 104–106.

ROLAND, A. E. 1947. Flora of Nova Scotia. Trans. N. S. Inst. Sci. **21**: 95–642.

Roland, A. E. & W. G. Dore. 1942. Notes on the Flora of Nova Scotia III. Rhodora **44:** 334–338.

Schofield, W. B. & E. C. Smith. 1953. Contributions to the Flora of Nova Scotia III: Some interesting white forms. Can. Field Nat. **67:** 93–94.

Smith, E. C. & W. B. Schofield. 1952. Contributions to the Flora of Nova Scotia I & II. Rhodora **54:** 220–228.

Smith, E. C. & J. S. Erskine. 1954. Contributions to the Flora of Nova Scotia IV. Rhodora **56:** 242–252.

PLANTS NEW TO MISSOURI

E. J. Palmer and J. A. Steyermark

Since the publication in 1935 of the Catalogue of the Flowering Plants of Missouri (Ann. Mo. Bot. Gard. **22:** 375–758), work has continued on the further botanical exploration of the state of Missouri and a large number of plants, including several genera not previously known in the state, have been added. The junior author of the Catalogue and of this paper has been particularly active and has made many collecting trips into nearly all parts of the state, resulting in some surprising discoveries. The senior author, since returning to Missouri in 1948, has devoted what time he could to an intensive exploration of several of the southwestern counties, with a few excursions into other sections.

The resulting new discoveries have been reported in Rhodora from time to time in several short papers contributed by the junior author and one by the senior author, as well as in a joint paper on new fern discoveries in the American Fern Journal **42:** 61–66. 1952. William B. Drew also reported the discovery of four new records for the state (Rhodora **44:** 248. 1942), George B. Van Schaack reported *Calamagrostis insparata* new to the state (Rhodora, **56:** 43. 1954), and C. L. Kucera published his findings of *Lyonia ligustrina* in Missouri (Rhodora, **55:** 155. 1953). The large number of additional plants now known in the state, as well as many changes in nomenclature and the interpretation of species necessary to bring it into conformity with the eighth edition of Gray's Manual, have made a revision of the Catalogue desirable, and it is hoped that such a revision can be published in the near future. The present paper is a further report of progress and a review of what has been done up to this time in increasing our knowledge of the state flora.

Hystrix patula Moench var. Bigeloviana (Fern.) Deam. This variety has not been reported previously from Missouri. It was found on wooded north-facing ravine slopes tributary to Mill Creek ditch of Missouri River valley, T59N, R38W, sect. 14, 4 mi. south of Oregon, Holt Co., July 20, 1952, *Steyermark 73829.*

Lolium multiflorum Lam. var. diminutum Mutel. Not previously reported from Missouri, this variety was found in open grassy woodland near lake, Lewis and Clark State Park, T55N, R37W, sect. 33 and 28, ½–1 mi. southwest of Armour, Buchanan Co., August 20, 1950, *Steyermark 70116.*

Muhlenbergia mexicana (L.) Trin. forma ambigua (Torr.) Fern. The record for this form is based uopn the following specimen: gravelly open places along South Fork of Spring Creek along highway A, T23N, R8W, south ½ sect. 33, 8 mi. south of West Plains, Howell Co., September 3, 1949, *Steyermark 69076.*

Panicum consanguineum Kunth. This species, primarily of Atlantic and Gulf Coastal Plain distribution from northern Florida to eastern Texas north to southeastern Virginia, Tennessee, and Arkansas, has not been reported previously from Missouri. It is based upon the following collection: wooded oak-hickory sandy knoll, T26N, R14E, sect. 34, 4½ mi. southeast of Sikeston, New Madrid Co., May 18, 1950, *Steyermark 69667.* This station is in the southeastern corner of Missouri, where occur many species the affinities of which align them with the flora of the Mississippi Embayment of the Gulf Coastal Plain.

Paspalum laeve Michx. (typical). The typical form of this species with the spikelets 2–2.5 mm. broad and with the leaf-blades and sheaths glabrous or nearly so has not been reported previously from Missouri. It is now known by the following collections: marshy springy ground at base of slopes of ravines bordering east-facing escarpment on Crowley Ridge, just south of Stephens Cemetery, T24N, R10E, sect. 30, 1½ mi. south of Pyletown, Stoddard Co., August 29, 1948, *Steyermark 66187;* knolls and depressions, T22N, R4E, sect. 35, 4 mi. south of Naylor, Ripley Co., October 20, 1948, *Steyermark 66943;* wet sedgy swales, wet woods, and swampy thickets along highway 25, 3 mi. west of Arbor, Cape Girardeau Co., September 22, 1946, *Steyermark 64158.*

Scirpus polyphyllus Vahl. This addition to the state flora is based upon the following collections: swampy meadow along Bee Fork, on property of Joe Goforth, T32N, R2W, sect. 23, 4½–4¾ mi. east of Bunker, Reynolds Co., July 7, 1951, *Steyermark 72041;* swampy meadow along Bee Fork, T32N, R2W, sect. 22, on property of Mr. Reese, 4 mi. southeast of Bunker, Reynolds Co., July 7, 1951, *Steyermark 72002.*

Carex abdita Bickn. Whether or not this taxon can be maintained as distinct from *C. umbellata* Schkuhr is questionable. It perhaps should be considered only as a variety of *C. umbellata.* On the basis of the characters used for separating the two taxa, the following Missouri collection, with perigynia 2.2–2.8 mm. long with short beaks 0.5–0.6 mm. long and acute pistillate scales below becoming more attenuate in the upper ones, may be cited: rocky ground east of highway K, T33N, R33W, sect. 27, 2 mi. northwest of Liberal, Barton Co., April 16, 1949, *Steyermark 67176*.

Carex Buxbaumii Wahlenb. forma dilutior Kükenth. This form, in which the pistillate scales are whitish or pale brown, has not been reported previously from the state. It was found in a calcareous swampy meadow associated with other species of which the ranges in the United States are northward or northeastward: swampy meadow along West Fork of Black River, on property of D. C. Miner, T33N, R3W, sect. 23 and NE sect. 26, 3–3½ mi. northwest of Greeley, Reynolds Co., July 6, 1951, *Steyermark 71984*.

In this collection some of the terminal spikes are staminate at the base as well as at the summit, while others are staminate only in the upper half. Dr. F. J. Hermann, who has kindly verified the junior author's determination, writes of the collection as follows: "The scales of *Carex Buxbaumii* normally tend to bleach out with age, as they do in many other species found in exposed habitats, so that typical *Buxbaumii* must often become f. *dilutior* late in the season. In the sheet you sent me both terminal spikes are staminate at the base as well as at the apex, the perigynia being restricted to the central portion. However, I doubt that sexual aberration in the terminal spike of this species is anymore deserving of recognition than scale-color. I have f. *heterostachya* and the typical form on the same plant in a collection from northern Michigan."

Carex debilis Michx. (typical). The typical form of this species has not been reported previously from Missouri. It is known from the following collection: depressions in swamp dominated by *Lindera melissaefolium*, surrounded by sandy, wooded and cultivated knolls, T22N, R4E, SE part of sect. 35, 4¾ miles south of Naylor, Ripley Co., May 28, 1951, *Steyermark 71228*, In this collection the perigynia are 8–8.5 mm. long, but the pistillate scales are greenish-white.

Carex digitalis Willd. var. macropoda Fern. This variety, previously unknown from Missouri, is represented by the following collections: north-facing slopes along Crooked Creek, T31N, R9E, sect. 16, 2–3 mi. southeast of Bessville, Bollinger Co., May 17, 1950, *Steyermark 69613a;* rich, north-facing ravine along tributary of Dry Fork of Charrette Creek, T46N, R2W, sect. 19, 4 mi. northwest of Hopewell, 7 mi. southwest of Warrenton, Warren Co., June 8, 1952, *Steyermark 73327*.

Carex stricta Lam. var. strictior (Dewey) Carey. Dr. F. J. Hermann has kindly verified the junior author's determination of this species, neither the typical form of the species nor any of its varieties having been previously identified correctly from the state. The following collections are given: swampy meadow along Bee Fork, T32N, R2W, sect. 23, 4½ mi. southeast of Bunker, Reynolds Co., May 29, 1951, *Steyermark 71303;* swampy meadow along Bee Fork, on property of Joe Goforth, T32N, R2W, sect. 23, 4½–4¾ mi. east of Bunker, July 7, 1951, *Steyermark 72032*, "in dense colonies; leaves dark green; perigynia appressed."

Populus nigra L. var. italica Muenchh. Several small specimens escaped from cultivation and spreading form the basis for the following collection: open ground, border of woods, 4 mi. northwest of Webb City, Jasper Co., Sept. 27, 1952, *Palmer 55194*.

Ulmus pumila L. This species, now becoming common in cultivation, seems to be well established in the rocky valley of Hickory Creek, in Newton County, where a number of specimens of different sizes were seen. At the McDonald County station only one tree was seen. Rocky waste ground along Hickory Creek, Neosho, Newton Co., Oct. 19, 1953, *Palmer 57208;* same locality, Nov. 3, 1953; same locality (in bloom), March 6, 1954, *Palmer 57218;* near Beaver Brook Spring, Anderson, Mc Donald Co., Oct. 19, 1954, *Palmer 59240*.

Pilea pumila (L.) Gray. (typical). The typical form of this species is based upon the following collection: along Bookout Branch and ravines tributary to Spring Creek, T64N, R18W, SW ¼ sect. 21 and NE ½ sect. 28, 4½ mi. northeast of Green City, Sullivan Co., August 25, 1950, *Steyermark 70149*.

Cerastium viscosum L. forma apetalum (Dumort.) Mert. & Koch. This form, not previously reported from the state, is represented by the following collection: open grassy ground on top of ridge in sect. 24, cherty limestone upper slopes above northwest-facing wooded bluffs along Flat Creek, T45N, R21W, 2½ mi. south of Sedalia, Pettis Co., May 20, 1949, *Steyermark 67973*.

Nymphaea odorata Ait. forma rosea Guillon. This form of the water-lily, in which the petals are roseate, was found well established in an artificial lake in northern Missouri. It has not been previously reported from the state. According to Mr. Raymond Buster of Ethel, Missouri, the plants were purchased from Vaughan's Seed Store in Chicago and planted in the lake ten to fifteen years ago. These plants are established, growing in a colony in which the flowers open in the morning and close about 2 p.m. The petals, on several flowers examined, number about 28 and vary from obtuse to rounded at the apex; there are 4 sepals present. The flowers are fragrant, the petioles are coiled at the base, and the leaves are all floating and purple beneath. The data for this collection are as follows: near shore of Ethel Lake, T59N, R17W, S part of sect. 25 and N part of sect. 36, ¾ mi. west of Ethel, Macon Co., Sept. 14, 1954, *Steyermark 77311*.

Draba verna L. var. boerhaavii Van Hall. This variety, not previously reported from the state, is based upon the following collection: grassy, rocky, open places along road bordering limestone wooded banks along creek along highway 21 and 49, just northeast of Centerville, Reynolds Co., March 30, 1949, *Steyermark 67107*.

Sedum sarmentosum Bunge. This is an evident escape from cultivation and it may have been originally planted in the vicinity, but is now well established and locally abundant in a wild spot near one of the spring heads. The data for the collections cited are: on moist mossy rocks, Haddock Spring, Newton Co., Nov. 3, 1953, *Palmer 57195;* same locality, May 19, 1954, *Palmer 57624.*

Spiraea prunifolia Sieb. and Zucc. This species, not recorded in the 8th edition of Gray's Manual, has become thoroughly established in at least two places in Missouri, and is based upon the following collections: escaped from old cemetery in woods on ridge top and established as a shrub forming thickets on north-facing, steep, wooded bluffs with limestone at top along Missouri River, T44N, R10W, sect. 16, just north and northwest of Osage City, Cole Co., May 20, 1950, *Steyermark 69747;* planted at edge of cemetery, but escaping and thoroughly established along fence row, above ravines bordering Wyaconda River, T62N, R6W, sect. 18, 7 mi. northwest of Canton, Lewis Co., July 27, 1952, *Steyermark 74161.*

Pyrus melanocarpa (Michx.) Willd. This remarkable addition to the state flora of an essentially boreal and northerly distributed species was discovered, not in the northern section of Missouri, where it might have been expected, but in the southeastern corner of the state ordinarily occupied by species of an essentially Mississippi Embayment-Gulf and Atlantic Coastal Plain distribution. The data for the collection are as follows: in midst of dense alder thickets along spring branch east and southeast of Pleasant Valley Church, east of spring-fed creek, along flood plain and Crowley Ridge junction, on property of E. Walker, T25N, R11E, sect. 6, 3½ mi. southeast of Bloomfield, Stoddard Co., August 20, 1954, *Steyermark 76825,* "plants 3 feet tall."

Rubus allegheniensis Porter var. plausus Bailey. Not previously reported for Missouri, this variety is based upon the following collection: in open ground of valley between ravines tributary to wooded slopes along north side of North River, "Miller's Hills," T59N, R9W, west part of sect. 2, 2½ mi. southeast of Burksville, Shelby Co., June 5, 1951, *Steyermark 71705.*

Rosa micrantha Sm. This species has not been recorded previously from the state. It is based upon the following collection: fallow pasture above wooded slopes following ravine along tributary to Salt River, T60N, R13W, NE ¼ sect. 1 and sect. 36, 1½ mi. northwest of Locust Hill, Knox Co., Sept. 18, 1950, *Steyermark 70672.*

Geranium dissectum L. This and the following record of *Geranium molle* were originally brought to the attention of the junior author by Mr. Oscar Petersen, poet-naturalist and amateur botanist of St. Louis Co. Both species are of spontaneous occurrence and have become well established on his property since 1951. The data for this collection are as follows: on property of Mr. Oscar Petersen, 267 Elm Ave., Glendale, St. Louis Co., June 7, 1952, *Steyermark 73314.*

Geranium molle L. Collected on property of Mr. Oscar Petersen, 267 Elm Ave., Glendale, St. Louis Co., June 7, 1952, *Steyermark 73315.*

Euphorbia Geyeri Engelm. This species, not previously known from a definite Missouri collection, was found near the Iowa line and is based upon the following data: natural sandy prairie on slopes of old river terrace on beach paralleling Des Moines River, T65N, R6W, sect. 9, 1½ mi. southeast of St. Francisville, Clark Co., August 13, 1949, *Steyermark 68876*, "plant prostrate; leaves pale beneath."

ACER RUBRUM L. forma TOMENTOSUM (Desf.) Dansereau. This form, not previously reported from Missouri, is based upon the following collection: cherty upper slopes of ravine tributary to Little Niangua River, T38N, R18W, sect. 4, 4½ mi. southeast of Barnumtown, Camden Co., July 6, 1952, *Steyermark 73743*.

JUSSIAEA URUGUAYENSIS Camb. This South American plant has become quite abundant and grows in large colonies for some distance along the creek in association with several other introduced plants, including *Phalaris arundinacea* L., *Vicia Cracca* L., *Myriophyllum brasiliense* Camb., and *Myosotis scorpioides* L. The garden Forget-me-not is also very abundant along rocky margins for some distance up and down the creek. It had previously been recorded from the vicinity of St. Louis. The data for the *Jussiaea* collection are as follows: in shallow running water of Hickory Creek, Neosho, Newton Co., Oct. 12, 1953, *Palmer 57068*.

GAYLUSSACIA BACCATA (Wang.) K. Koch. Another remarkable discovery, this species can now be definitely added to the known flora of the state, where it was found in an unglaciated section of east-central Missouri north of the Missouri River, where *Trillium nivale* also occurs. It was growing with *Vaccinium vacillans* and was almost mistaken in the field for that species. The data for the collection are as follows: cherty upper slopes above north-facing limestone bluffs along West Fork of Cuivre River, T50N, R3W, sect. 32, 8½ mi. northeast of Bellflower, Montgomery Co., Sept. 16, 1954, *Steyermark 77419*.

DODECATHEON MEADIA L. var. BRACHYCARPUM (Small) Fassett forma PALLIDUM Fassett. This form of the variety, without red at the base of the leaves, is based upon the following collection: north- and northeast-facing, limestone, wooded, small bluffs along Camp Ground Creek, T40N, R11W, sect. 6, 6 mi. northwest of Tavern, Maries Co., May 19. 1950, *Steyermark 69701*.

BARTONIA PANICULATA (Michx.) Muhl. (typical). This surprising discovery was made at the head of a sandy spring branch where *Ilex opaca* and *Fraxinus tomentosa* occurred at the base of Crowley Ridge in the southeastern section of Missouri, noted for its prominence of species following a Mississippi Embayment-Atlantic and Gulf Coastal Plain distributional pattern. The locality was not far from the alder thickets where *Pyrus melanocarpa* (reported above) was discovered on the same day. In the Missouri collection the corolla lobes are creamy-white above, 1 mm. wide, the anthers are yellow, and the filaments white below and lavender above. The data for this collection are as follows: on mossy ground at head of sandy spring branch, at base of sandy ravine near junction of Crowley Ridge and lowland, T25N, R11E, NW ¼ sect. 6, 3½ mi. southeast of Bloomfield, on property of Mr. Martin, Stoddard Co., August 20, 1954, *Steyermark 76784*.

CONVOLVULUS SEPIUM L. var. REPENS (L.) Gray. Although Missouri is in the general range stated in the 8th edition of Gray's Manual for this variety, it has not been recorded previously for the state. The record for its occurrence is based upon the following collection: swales in bottoms of Missouri River valley, T59N, R38W, SW sect. 14 and N part of sect. 23, 4–4½ mi. south of Oregon, Holt Co., July 20, 1952, *Steyermark 73846*.

Phlox divaricata L. var. Laphamii Wood, forma **candida** Palmer & Steyermark, f. nov. A typo differt floribus albis.—Low, rich, alluvial woods, 1 mile west of Nashville, Barton County, Missouri, April 30, 1953, *Ernest J. Palmer 55411*, holotype, in Palmer Herb., isotype in Herb. Chi. Nat. Hist. Mus.; terrace along alluvial bottoms of Grand River along route 36, 4 mi. southwest of Chillicothe, Livingston Co., May 1, 1950, *Julian A. Steyermark 69584*, paratype, in Herb. Chi. Nat. Hist. Mus.

It is necessary to give a name to the white-flowered form of *Phlox divaricata* var. *Laphamii*. Dr. Wherry lists this white-flowered form in Bartonia **12:** 34. 1930, but as stated by him in a recent communication with the present authors, his reference to the albino form, without a diagnosis or type specimen indicated, is not validly published.

Lithospermum canescens (Michx.) Lehm. forma **pallidum** Palmer & Steyermark, f. nov. A typo recedit corollis pallido-luteis.—Along southeast side of highway 54, ½ mi. southwest of junction with highway 154, T53N, R4W, W part of sect. 25, 4 mi. WSW of Curryville, Pike Co., Missouri, April 30, 1952, *Julian A. Steyermark 73223*, holotype, in Herb. Chi. Nat. Hist. Mus., isotype in Mo. Bot. Gard. Herb.

This form of the common *Lithospermum canescens* has cream-colored to pale yellow, instead of orange flowers. About a dozen plants were found growing scattered among the orange-flowered ones. Individual plants transplanted to the garden of the junior author have maintained the pale color of the corolla.

Lithospermum caroliniense (Walt.) MacMill. I. M. Johnston (Journ. Arn. Arb. **33:** 339–340. 1952) combines *L. croceum* Fernald with *L. caroliniense*, noting that (p. 340) "the floral differences used by Fernald to distinguish *L. croceum* from *L. caroliniense* are those which distinguish the short- and long-styled flowers of the species." We are in agreement with Dr. Johnston in combining the two species, as the differences between the two taxa, as given in the 8th edition of Gray's Manual, intergrade. If, however, *L. caroliniense* is maintained as distinct, the following Missouri collection should be cited: sandy open banks of formerly original sandy prairie, along west side of road, T25N, R14E, sect. 10, 6½ mi. southeast of Sikeston, New Madrid Co., May 18, 1950, *Steyermark 69674*.

Verbena canadensis (L.) Britt. forma **candidissima** (Haage & Schmidt) Palmer & Steyermark, comb. nov. *V. canadensis* var. *candidissima*, in Royal Hort. Soc. Dict. Gardening **4:** 2210. 1951.

The white-flowered form of this species has not been recorded previously from Missouri. It is based upon the following collection: exposed limestone bluff along road, along Long Creek, just north of Oasis, T22N, R22 W, sect. 10, 11, and 3, Taney Co., April 28, 1949, *Cora Steyermark* s.n. In this collection the corolla lobes are whitish and the corolla tube is whitish with pale lilac suffused throughout.

VERONICA DIDYMA Ten. This species has not been reported previously from Missouri. It is based upon the following collection: near gas station one mile north of Kohler City, Jefferson Co., April 20, 1952, *H. E. Ahles 5848.*

GALIUM TRIFLORUM Michx. × G. CIRCAEZANS var. HYPOMALACUM Fern. The data for this collection are as follows: in wooded ravines tributary to Thorp Branch, T59N, R8W, NE sect. 12, 4½ mi. southeast of Oregon, Holt Co., July 20, 1952, *Steyermark 73804.* The present collection, growing with *G. circaezans* (*Steyermark 73804a*), consists of plants having the leaves in 6's and elliptic-lanceolate as in *G. triflorum*, but with pubescent stems and the midrib of the lower leaf surface pilose as in *G. circaezans* var. *hypomalacum.* So far as known, this apparent natural hybrid has not been recorded previously in literature.

HOUSTONIA PUSILLA Schoepf forma ALBIFLORA Standl. The form of the species with white corollas has not been recorded previously from Missouri. The following collection is representative: open ground in valley of Ottery Creek, along highway A, northeast of Redmondville, Iron Co., April 26, 1952, *Steyermark 73101.* In this collection the plants are of a much lighter green color than in typical purple-flowered *H. pusilla* (*H. patens* Ell.). The width and length of the white corollas vary considerably within a given colony of the plants. Other Missouri collections which may be referred to this form are *Steyermark 4599* from Pulaski Co. and *4592* from Phelps Co. Although the corollas in these last two collections vary from white to white with pale blue or lilac, they are generally white throughout.

SPECULARIA LAMPROSPERMA (McVaugh) Fern. × S. LEPTOCARPA (Nutt.) Gray. In a colony of the two species named above, with *S. lamprosperma* predominating, were found a few plants with characters quite intermediate between the two and of evident hybrid origin. The data for this collection are: chert glades along Shoal Creek, 4 mi. southwest of Joplin, Newton Co., May 29, 1952, *Palmer 54078.*

LOBELIA CARDINALIS L. forma ROSEA St. John. Not previously recorded from Missouri, this form of the cardinal flower was collected in a wet, calcareous meadow along Parker Branch of West Fork of Black River, T33N, R3W, west part of sect. 15, ¼ mi. northwest of Marcoot, 5 mi. northwest of Greeley, Reynolds Co., Sept. 24, 1951, *Steyermark 72729.* In this collection the corolla tube is pink to rose-colored, the corolla lobes are pink on the outside, white on the inside, and the staminal tube is white.

ASTER AZUREUS Lindl. forma LAEVICAULIS Fern. The following collection may be referred to this form, not previously reported from the state: upland roadside banks, T59N, R31W, sect. 4, 3¼ mi. southwest of Fairport, Dekalb Co., Sept. 27, 1951, *Steyermark 72869.* This collection represents an unusually floriferous specimen, which may actually be a hybrid between *A. laevis* and *A. azureus,* with both of which species the plants were growing. The upper surface of the leaves in this collection are scabrous as in *A. azureus* and the stems are glabrous as in *A. laevis.*

ASTER CORDIFOLIUS L. var. MORATUS Shinners. Not previously reported for the state, this variety is based upon the following collection: along base of La Motte sandstone bluffs along Terre Bleue Creek, T37N, R6E, south part of sect. 20 and north part of sect. 29, 2–2½ mi. south of Thurman, 5–6 mi. northwest of Sprott, Ste. Genevieve Co., October 3, 1950, *Steyermark 71041*.

Aster cordifolius L. var. polycephalus Porter. In the 8th edition of Gray's Manual, the range for this variety is given as "SW. Que. to Ind., s. to N.E. and Ga." In addition to a specimen from Boone County previously recorded in our catalogue, it may be credited to Missouri on the basis of the following collection: limestone glade along highway 131, on south side of South Fork of Blackwater River, T46N, R28W, NW ¼ sect. 26, 3 mi. north of Holden, Johnson Co., Sept. 25, 1951, *Steyermark 72751*.

Aster dumosus L. var. strictior T. & G. Not previously reported from Missouri, this variety may be added to the state flora on the basis of the following collection: meadow along north side of highway 80, 4.9 mi. southwest of West Plains, Howell Co., Sept. 25, 1949, *Steyermark 69336*.

Aster oblongifolius Nutt. forma roseoligulatus (Benke) Shinners. This form has not been recorded previously from the state. It is based upon the following collection: edge of limestone escarpment of SE-facing Chapel Bluff along Niangua River, T37N, R18W, sect. 26, 8–8½ mi. southeast of Macks Creek, Camden Co., October 24, 1954, *Steyermark 78223*. The rays in this collection varied from pink to rose-colored.

Aster vimineus Lam. (typical). Although the var. *subdumosus* Wieg. is known from Missouri, the typical variety of the species has not previously been reported from the state. It is based upon the following collection: alluvial lower part of north-facing limestone slopes along Salt River, Mark Twain State Park, T54N, R8W, sect. 9 and 16, 1–2 mi. southwest of Florida, Monroe Co., Sept. 25, 1948, *Steyermark 66529*. In this collection the ray florets vary from 16 to 20 in number, the lobes of the corollas of the disk florets are erect, about ⅖ the length of the throat, and are 0.9–1 mm. long.

Helianthus annuus L. var. nanus fl. pl. Hort. This double-flowered variety with the stems averaging about 3 feet high is locally common in Holt Co., northwestern Missouri. It has not been previously reported for the state. The collection upon which it is based is as follows: common escape throughout this area in low ground in extensive swale, T62N, R40W, sect. 25, 3¾ mi. southeast of Craig, Holt Co., July 20, 1952, *Steyermark 73788*. The robust-stemmed (averaging 6 feet tall), double-flowered variety is referred to var. *chrysanthemoides* Cockerell (Am. Nat. **49:** 617. 1915), but the present collection is better referred to the dwarf type.

Liatris scabra (Greene) K. Schum. This species has not been previously reported from the state. It is based upon the following collection: ravine slopes tributary to river, along Little Black River, between Greenville Ford and Pennington Ford, T24N, R3E, sect. 10, 15, 22, 23, 26, 24, and 25, 10–13 mi. northeast of Doniphan, Ripley Co., Sept. 1, 1946, *Steyermark 63966*.

CICHORIUM INTYBUS L, forma ALBUM Neum. This form with the flowers entirely white has not been recorded previously from Missouri. It is based upon the following collection: along route 129, 2.3 mi. south of Green City, Sullivan Co., August 25, 1950, *Steyermark 70127*.—WEBB CITY, MISSOURI, CHICAGO NATURAL HISTORY MUSEUM.

CONTRIBUTIONS TO THE FLORA OF SOUTHERN ILLINOIS.—Field work in southern Illinois the latter part of 1954 produced several species of plants new to Illinois. In addition, the ranges of other uncommon species have been extended by further collections.

Areas of particular interest occur in Randolph County; here are found such rare species for Illinois as *Pinus echinata*, *Asplenium bradleyi*, *Ranunculus harveyi*, *Talinum calycinum*, *Rhamnus caroliniana*, *Carex torta*, *Carex aquatilis* var. *altior*, and *Solidago buckleyi*.

Herbaria and their abbreviations for specimens cited in this paper are as follows: Southern Illinois University (SIU), University of Illinois (UI), Illinois State Museum (ISM), Illinois Natural History Survey (NHS), and that of the author (A).

SPECIES NEW TO ILLINOIS

CAREX DEBILIS Michx. The habitat in Illinois for this species is near the base of a densely shaded east-facing hillside. Its common associates at this station are *Spigelia marilandica* and *Pedicularis canadensis*. The species occurs in south-central and south-eastern Indiana, the nearest stations to ours being in Lawrence and Crawford Counties.[1] COLLECTION DATA: rich woods near Cave-in-Rock State Park, Hardin County, June 20, 1954, *Mohlenbrock 4257* (A).

CAREX SWANII (Fern.) Mackenz. The only report of this species from Illinois is based on a questionable specimen from Vermilion County, although it is not uncommon in western Indiana. It apparently is unknown from Missouri. Two plants at our station are growing at the base of a sweet gum (*Liquidambar styraciflua*). COLLECTION DATA: dry soil at the edge of a marsh, one mile north of Murphysboro, Jackson County, June 5, 1954, *Mohlenbrock 3327*. (A).

TALINUM CALYCINUM Engelm. Although this species is known from eastern Missouri, it appears that the present collection represents the first from Illinois.[2] A single plant was found growing along the edge of a sandstone bluff in Randolph County on August 15, 1954. A search for additional plants of this species a week later in the same area proved

[1] DEAM, CHARLES C. Flora of Indiana. 1940.

[2] Personal correspondence with Mr. Harry E. Ahles, University of Illinois Herbarium.

successful as some one hundred specimens were seen, many in full flower. They were associated with *Isanthus brachiatus*, *Opuntia humifusa*, and *Polygonum tenue*. This station in southwestern Illinois extends the range of the species to the east. COLLECTION DATA: thin soil on a dry sandstone bluff, "Castle Rock", near Leanderville, Randolph County, August 15, 1954, *Mohlenbrock 4550* (SIU, A).

Ranunculus parviflorus L. This species, naturalized from Europe, is uncommon in the midwest. It is unreported from Indiana and is known in Missouri only from Butler and Dunklin Counties.[3] It grows in an open wet place in a mesic woods. COLLECTION DATA: low woods, Saltpeter Cave, five miles south of Murphysboro, Jackson County, *Mohlenbrock 1936*.

Ptilimnium costatum (Ell.) Raf. It had been thought that two species of *Ptilimnium* occurred in Illinois—*P. nuttallii* (DC.) Britt. and *P. capillaceum* (Michx.) Raf.[4] However, when the author was asked to collect specimens of these two species, the first *Ptilimnium* collected keyed out to *P. costatum*. Upon checking the herbarium specimens of *Ptilimnium* at Southern Illinois University, University of Illinois, Illinois State Museum, and the Illinois Natural History Survey (the last three by Mr. Harry Ahles), it was discovered that all sheets labelled *P. capillaceum* were actually either *P. costatum* or *P. nuttallii*. In addition, some *P. costatum* specimens had been identified as *Carum carvi*. Further field work led only to the discovery of more *P. costatum*. So far, no authentic specimens of *P. capillaceum* have been located for Illinois. SPECIMENS EXAMINED: Union County: wet soil, Big Muddy River bottoms, July 29, 1941, *G. D. Fuller* and *R. Fisher 746* (UI, NHS, ISM); river bottom forest, Clear Creek, Sept. 12, 1940, *Fuller 289*. Jackson County: rich woods northeast of Howardton, Sept. 13, 1941, *McCree 1197* (SIU, UI); Campbell Lake area near Elkville, July 17, 1941, *McCree 929* (SIU, UI); wet soil, Carbondale, Sept. 13, 1941, *G. D. Fuller* and *W. B. Welch* 1197 (ISM); six miles east of Elkville, low woods, *Mohlenbrock 1912* (A). Pulaski County: without definite locality or date, *Fricke*.

Ptilimnium nuttallii (DC.) Britt. Randolph County: roadside in low ground, two miles northwest of Sparta, July 13, 1950, *G. S. Winterringer 4848* (ISM). Jackson County: north of Makanda, August 2, 1950, *Bailey and Swayne 1114* (SIU).

Ruellia caroliniensis (Walt.) Steud. The discovery of this species in Illinois is not too surprising since it is found rather frequently in southern Indiana and Missouri. Its associates at our station include *Scutellaria ovata* and *Monarda fistulosa*. COLLECTION DATA: edge of woods, near Cave-in-Rock State Park, Hardin County, June 20, 1954, *Mohlenbrock 4286* (A).

Veronica polita Fries. (*Veronica didyma* Tenore of Pennell[5]). This

[3] Palmer, E. J. and J. A. Steyermark. An Annotated Catalogue of the Flowering Plants of Missouri. Ann. Mo. Bot. Gard. Vol. 22. 1935.

[4] Jones, G. N. Flora of Illinois. 1950.

[5] Pennell, Francis W. The Scrophulariaceae of Eastern Temperate North America. 1935.

species is adventive from Eurasia. In southern Illinois, it has been found on a semi-weedy lawn, growing with *Veronica arvensis* but flowering much earlier. COLLECTION DATA: lawn, Murphysboro, Jackson County, March 10, 1955, *Mohlenbrock 4984* (A).

ADDITIONAL DISTRIBUTION RECORDS OF SOME ILLINOIS PLANTS

LOPHOTOCARPUS CALYCINUS (Engelm.) J. G. Sm. forma MAXIMUS (Engelm.) Fern. The giant form of this species was found growing in a drainage ditch in the southwestern part of Murphysboro. The width of the leaves slightly surpassed three decimeters. The "typical" form is present in Lake Murphysboro. In addition to Jackson County, the species is known in Illinois from Pope, Piatt, Mason, Fulton, Peoria, and Henderson Counties. Only Pope and Jackson are in the southern part of the state. COLLECTION DATA: drainage ditch, Murphysboro, Jackson County, August 14, 1954, *Mohlenbrock 4735* (A).

PANICUM LANUGINOSUM Ell. var. IMPLICATUM (Scribn.) Fern. This taxon, found in dry soil at the edge of a woods in Jackson County, is generally more widespread to the north in Illinois. COLLECTION DATA: Giant City State Park, Jackson County, June 19, 1954, *Mohlenbrock 3206* (A).

HEMICARPHA MICRANTHA (Vahl) Pax. Previous to its discovery in Jackson County, this tiny sedge was known in Illinois only from the northern and central counties (the most southern record being from Piatt County). This species was found at two stations along the Mississippi. COLLECTION DATA: in sand, Mississippi River cutoff, one mile south of Grand Tower, Jackson County, August 20, 1954, *Mohlenbrock 4640* (UI, A): near Cora, Jackson County, August 24, 1954, *Mohlenbrock 4648* (UI, A).

CAREX BRACHYGLOSSA Mackenz.. The Jackson County collection extends the range of this primarily northern Illinois species to the south. COLLECTION DATA: edge of Walker Hill Pond, Grand Tower, Jackson County, July 15, 1954, *Mohlenbrock* 4753 (A).

CAREX SPARGANIOIDES Muhl. The habitat for this species is rich mesic woodlands. The Jackson County locality is about 175 miles south of the nearest station in Illinois for this species (Menard County). COLLECTION DATA: rich, moist woods, Lake Murphysboro area, Jackson County, June 12, 1954, *Mohlenbrock 2679* (A).

ALLIUM STELLATUM Fraser. This is one of the species characteristic of the hilltop prairies found along the southwestern border of the state. These prairies, atop limestone bluffs, are minute replicas of the prairies to the west. Other species which grow in this type of community include *Bouteloua curtipendula, Andropogon scoparius, Andropogon gerardi, Petalostemum purpureum, Petalostemum candidum*, and *Kuhnia eupatorioides*. The *Allium* is known in Illinois only from Jackson, McHenry and Union Counties. COLLECTION DATA: hilltop prairie north of the Pine Hills, Jackson County, August 6, 1954, *Mohlenbrock 4760* (UI, A).

HEXALECTRIS SPICATA (Walt.) Barnh. A colony of seventeen plants of this rare orchid was discovered growing on an east-facing slope in an oak-hickory woods in Jackson County. Only two other locations are known for this species in Illinois (Randolph and Pope Counties). COLLECTION DATA: dry wooded slope, Fountain Bluff, Jackson County, July 20, 1954, *Sanders, Voigt, and Mohlenbrock 4330* (SIU)

RUMEX MARITIMUS L. var. FUEGINUS (Phil.) Dusen. This species, like *Hemicarpha micrantha*, was found growing in sand one mile south of Grand Tower. It now is known in Illinois from McHenry, Tazewell, Whiteside, and Jackson Counties. COLLECTION DATA: in sand, Mississippi River cutoff, one mile south of Grand Tower, Jackson County, August 20, 1954, *Mohlenbrock 4641* (A).

POTENTILLA PARADOXA Nutt. Specimens of this plant were found growing in sand along the Mississippi River in close association with *Hemicarpha micrantha* and *Rumex maritimus* var. *fueginus*. In addition to Jackson County, it is known in Illinois from Randolph and St. Clair Counties. COLLECTION DATA: Mississippi River cutoff, one mile south of Grand Tower, Jackson County, August 20, 1954, *Mohlenbrock 4637* (UI, A).

GEUM VIRGINIANUM L. Since this species was first reported from Illinois in 1954,[6] it has been found in three additional counties. The habitat at each station is in an open oak-hickory woods. COLLECTION DATA: Pounds Hollow, Gallatin County, summer, 1954, *Mohlenbrock, Voigt, and Sanders 1921* (SIU); Panther's Den, Williamson County, summer, 1954, *Mohlenbrock, Voigt, and Sanders 1976* (SIU); Jackson Hollow, Pope County, July 15, 1954, *Mohlenbrock 4311* (A).

CORNUS ALTERNIFOLIA L. f. This dogwood is not too uncommon in northern Illinois, but the Pope County collection is the first reported from southern Illinois. It grows in abundance in a rich beech-maple forest at Belle Smith Springs. COLLECTION DATA: rich woods, Belle Smith Springs, Pope County, June 23, 1954, *Mohlenbrock 3889* (A).

ONOSMODIUM HISPIDISSIMUM Mackenz. This species is not common in southern Illinois, the present collection being the first from Jackson County. It grows on an outcrop of limestone along the Mississippi River. COLLECTION DATA: atop a limestone bluff, Devil's Bake Oven, near Grand Tower, Jackson County, June 27, 1954, *Mohlenbrock 3206* (A).

LIATRIS CYLINDRACEA Michx. This is another of the hilltop prairie species of southwestern Illinois. The Jackson County station is the only extreme southern Illinois record. COLLECTION DATA: hilltop prairie north of the Pine Hills, Jackson County, Sept. 9, 1954, *Mohlenbrock 4758* (A, UI).

The author wishes to thank Mr. Harry E. Ahles of the University of Illinois Herbarium who supplied the distributional records for each species in Illinois.—ROBERT H. MOHLENBROCK, DEPARTMENT OF BOTANY, WASHINGTON UNIVERSITY, ST. LOUIS, MISSOURI.

[6] MOHLENBROCK, R. H. RHODORA **56**: 227–228. 1954.

AN ADDITIONAL SPECIES OF THE LICHEN GENUS BUELLIA FROM THE WEST INDIES

Henry A. Imshaug[1]

The present author has recently (Imshaug 1955) published a revision of the West Indian species of *Buellia*. Since then he has studied the West Indian species of the closely related genus *Rinodina*. Only three saxicolous species of *Rinodina* have been reported from the West Indies and all three were described by Wainio from material collected in the Virgin Islands by F. Børgesen in 1906; *R. antillarum* from St. Thomas, *R. boergesenii* from St. Croix and *R. pyxinoides* from St. John. Each species was collected from only one locality, each on a different island. I have been able to examine these collections through the courtesy of Dr. M. Skytte Christiansen to whom I would like to express my sincere appreciation.

All three collections represent the same species which is identical with *Buellia microphylla* Malme. Wainio's three names, however, antedate *B. microphylla*. Of the three names only the specific epithet *pyxinoides* has not previously been used in *Buellia*.

A description of the West Indian material follows:

Buellia pyxinoides (Wain.) Imshaug, comb. nov., based on *Rinodina pyxinoides* Wain. Ann. Acad. Sci. Fenn. A. 6(7): 75. 1915. *Rinodina boergesenii* Wain. Ann. Acad. Sci. Fenn. A. 6(7): 76. 1915. *Rinodina antillarum* Wain. Ann. Acad. Sci. Fenn. A. 6(7): 77. 1915. *Buellia microphylla* Malme, Ark. Bot. 21A(14): 40. 1927.

Type Collections: *R. pyxinoides*—Collected on non-calcareous rocks at Cruzbay, St. John (West Indies) by F. Børgesen on March 13, 1906. Holotype in C. *R. boergesenii*—Collected on non-calcareous rock at Hams Bluff, St. Croix (West Indies) by F. Børgesen on Feb. 6, 1906. Holotype in C. *R. antillarum*—Collected on non-calcareous rock at Magensbay Estate, 800 ft. elev., St. Thomas (West Indies) by F. Børgesen on Dec. 28, 1906. Holotype in C. *B. microphylla*—Collected "in rupe praerupta subumbrosa" in Paraguay (Paraguari, Santo Tomas) by G. O. Malme, no. 1508 B. Isotype seen in MO.

hypothallus composed of many black patches which tend to become continuous. thallus initiated as small, round, flat areoles which expand to become convex and lobate or squamulose, rarely becoming contiguous or rimose-areolate; cinereous or sometimes ± ochraceous. apothecia at first immersed but soon emergent with superficial thalloid covering

[1] Department of Botany, University of Idaho, Moscow, Idaho.

which soon disappears, round or occasionally crenate, 0.3–0.7 mm. across; disks black, plane, naked; margins rather thick and concolorous. HYPOTHECIUM ± colorless; exciple ± colorless inside but with thick, dark brown margin. HYMENIUM 70–75 μ thick, colorless, not inspersed with oil drops; paraphyses enlarged at apices and fusco-capitate, forming a light brown epithecium. Spores 8 in ascus, mischoblastiomorph, fumose, (14) 15–21 (24) × (7) 8–11 (12) μ. CHEMICAL REACTIONS: Thallus section KOH—; apothecial tissues KOH—.

MATERIAL SEEN: ST. CROIX—Hams Bluff, Børgesen, 1906 (C). ST. THOMAS—Magensbay Estate, 800 ft. elev., Børgesen, 1906 (C). ST. JOHN—on maritime rocks, Cruzbay, Børgesen, 1906 (C).

Wainio recognized the similarity between *Rinodina pyxinoides* and *R. boergesenii*. The latter species was separated only by apothecia with thinner margins and non-mamillate disks. These were the same characters Wainio used to separate *Buellia gyrosa* Wain. (Syn. *B. trachyspora*) from *B. trachyspora* Wain. Wainio did not compare *Rinodina antillarum* with *R. pyxinoides* but the only significant difference I could find was in the spore size. Since the spore size seems rather variable and since my measurements do not agree with those given in the original descriptions they are recorded here:

	Author's measurements (in KOH)	Original description
R. pyxinoides (holotype)	17–24 x 10–12 μ	16–21 x 8–9 μ
R. boergesenii (holotype)	17–21 x 9–11 μ	13–17 x 7–9 μ
R. antillarum (holotype)	(14) 15–17 x 7– 8 μ	(10) 12–16 x 5–8 μ
B. microphylla (isotype in MO)	18–24 x 10–14 μ	16–21 x 8–9 μ

LITERATURE CITED

IMSHAUG, H. A. 1955. The lichen genus *Buellia* in the West Indies. Farlowia **4** (4): 473–512. 1955.

Volume 57, no. 682, including pages 259–299, was issued 31 October, 1955.

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club, by

REED CLARK ROLLINS, Editor-in-Chief

ALBERT FREDERICK HILL
STUART KIMBALL HARRIS
RALPH CARLETON BEAN
RICHARD ALDEN HOWARD
CARROLL EMORY WOOD, JR.
} Associate Editors

Vol. 57 **December, 1955** **No. 684**

CONTENTS:

The New England Botanical Club, Inc.

8 and 10 West King St., Lancaster, Pa.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of the Gray's Manual Range and regions floristically related. Price, $4.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) of not more than 24 pages and with 1 plate, 40 cents, numbers of more than 24 pages or with more than 1 plate mostly at higher prices (see 3rd cover-page). Back volumes can be supplied at $4.00. Some single numbers from these volumes can be supplied only at advanced prices (see 3rd cover-page). Somewhat reduced rates for complete sets can be obtained on application to Dr. Hill. Notes and short scientific papers, relating directly or indirectly to the plants of North America, will be considered for publication to the extent that the limited space of the journal permits. Illustrations can be used only if the cost of engraver's blocks is met through the author or his institution. Forms may be closed five weeks in advance of publication. Extracted reprints, if ordered in advance, will be furnished at cost.

Address manuscripts and proofs to Reed C. Rollins,
Gray Herbarium, 22 Divinity Ave., Cambridge 38, Mass.

Subscriptions (making *all remittances* payable to RHODORA) to

Dr. A. F. Hill, 8 W. King St., Lancaster, Pa., or, preferably, Botanical Museum, Oxford St., Cambridge 38, Mass.

Entered as second-class matter March 9, 1929, at the post office at Lancaster, Pa., under the Act of March 3, 1879.

Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 57 December, 1955 No. 684

FRENCH'S SHOOTING STAR IN SOUTHERN ILLINOIS

John W. Voigt and Julius R. Swayne

French's shooting star *Dodecatheon frenchii* (Vasey) Rydb.[1] is of local interest. It was first discovered and named for George Hazen French an early teacher of biology at Southern Illinois State Normal (now Southern Illinois University), at Carbondale, Illinois. A specimen bearing the date 1870 is located in the herbarium of Southern Illinois University. The label bears the following inscription, "Dodecatheon Frenchii V., this is thought to be a new species as it differs much from D. meadia." The word type is written on the sheet near the label. The species name, authority initial and the word type are written in pencil while the label is written in ink. The specimen is in a fruiting condition. A second sheet collected on May 6, 1871, also from "Fern Rocks" is probably of the same collection as that marked type at the Chicago Natural History Museum. According to Fassett (1944) the sheet at Chicago was designated the type presumably by McBride. The original description did not designate a type or date of collection. The earliest collection date previously stated in print was 1871. Thus the 1870 date on the type specimen establishes the date of collection of the type series as one year earlier than previously indicated.

The last complete work on the genus in eastern North America was that of Fassett (1944). Before Fassett's treatment French's shooting star had been known at different times as a variety, subspecies, and species. On the basis of Fassett's work French's

[1] The nomenclature is that of Jones 1950. Flora of Illinois, University of Notre Dame Press, Notre Dame, Ind.

shooting star has been accepted by many as a variety of Mead's shooting star (*D. meadia* L.).

Dodecatheon frenchii has been described as a plant having "leaves abruptly narrowed to the petiole . . . extreme plants with broad oval subcordate blades. The inclusion of all plants with leaves tending to be abruptly narrowed to the petiole has led to various interpretations of range as being much wider than it is" (Fassett, 1944). Vasey gave the range as Pennsylvania to southern Illinois and Arkansas. Rydberg (1932) gave it as Illinois, Minnesota, Arkansas, and Pennsylvania. Fassett (1944) restricts the range to the Illinois Ozarks with a single specimen of doubtful determination being cited from Wisconsin. Recent intensive searches in southern Illinois for the plant recognized by Fassett as *D. frenchii* show that it is restricted to a belt of about 10 miles width across the State (Fig. 1).

Dodecatheon frenchii has always been found in canyons of streams flowing primarily southward and under sandstone ledges which may face any direction. It is found most often under north and east facing bluffs. *D. meadia* is found in several central and northern counties of Illinois, in the Illinois Ozarks and southward.

It has been reported that *D. frenchii* differs genetically from the widespread phases of *D. meadia*, but that special ecological conditions are required for a phenotypic expression of the varietal phase (Fassett, 1944). He also reported that *D. frenchii* is changed to the likeness of *D. meadia* when grown under increased amounts of light and a longer light period. *D. meadia* is reported to be replaced by, or to grade into, *D. frenchii* under cliffs and shaded places. This ecological behavior has not been noted by us. The plants have been found to be distinct. The discovery of *D. frenchii* in open well-lighted upland woods at Jackson Hollow still maintaining its distinctive vegetative characteristics demonstrates that this plant may occasionally be found away from the cliff habitat though it exhibits a strong "preference" for it. It also shows that the leaf-shape which so characterizes this taxon may also be manifested in brighter light and that reduced light is not necessary for its phenotypic expression. These plants were growing some fifty yards from the cliff where other plants of *D. frenchii* were growing.

Light readings in the habitat of *D. meadia* ranged from 5,000 to 6,000 foot candles when readings in the open recorded 10,000 foot candles. The readings in the habitat of *D. frenchii* were usually about 14–25 per cent less than the light recorded in the habitat of *D. meadia.* The light meter was held directly over the plants in such a position as to receive the fullest amount of sunlight. In addition to these readings, which were taken from several locations, the light was measured in the upland habitat of the open woods where about 40 plants of *D. frenchii* were found growing at Jackson Hollow. Over a five hour period seven readings were made. The average of these read-

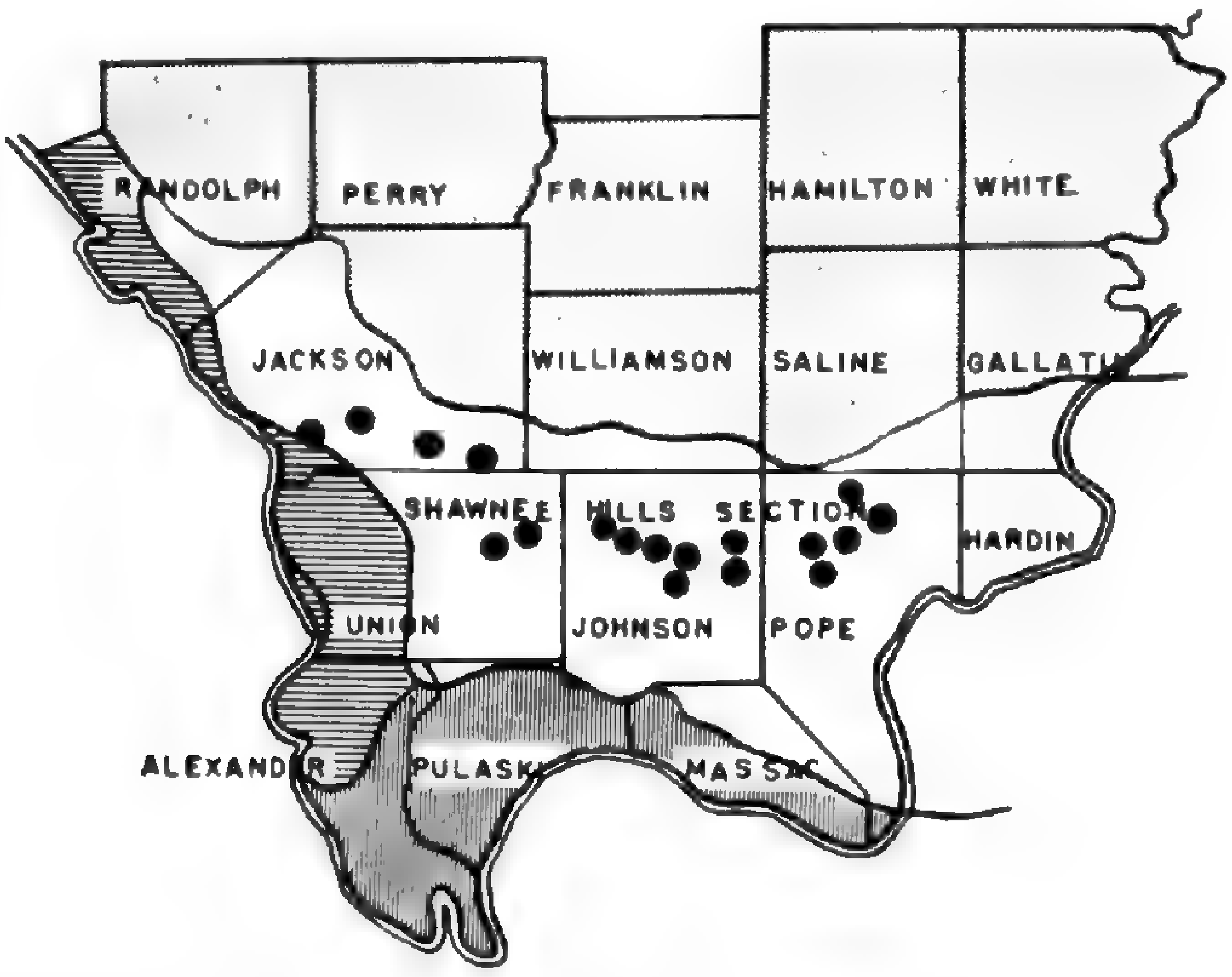


Fig. 1. The southern sixteen counties of Illinois. The white area represents the Shawnee Hills Section. The area to the north is glaciated. Dots represent stations for the occurrence of *D. frenchii*. Horizontal hatch is the Salem Plateau section; vertical hatch is the Coastal Plain province. Map adapted from Leighton, Ekblaw, and Horberg.

ings, where most of the plants were growing, was about 5,000 foot candles. The readings were started at 11:00 a.m. and terminated at 4:00 p.m. The average of seven readings over the same period of time for a station 3 feet distant from the first, where a few more plants were growing, was about 6,500 foot candles. It is realized that averages of factor intensities are ordinarily of little value, but here the amount of light and its duration is equivalent to and often exceeds that found in the habitats of *D. meadia.* Light readings taken under the bluff and down the hill some 50 yards away where most of the *D. frenchii* plants were growing, showed only 11 foot candles at the edge of the bluff. At 3:45 p.m. the reading here was only 8–10 foot candles. The plants growing under the bluff never receive direct sunlight and for only half of the day do they receive as much as 200 to 300 foot candles.

The effect of increased lighting on *D. frenchii* and decreased lighting on *D. meadia* was studied in the greenhouse. Several dozen resting buds of *D. frenchii* and *D. meadia* were collected on January 17, 1952 and planted. The natural light was supplemented by two fluorescent tubes (30 watt) which were placed over the plants at a distance of about 20 inches. The total day length period was 15 hours. The greenhouse temperatures were set for 60 degrees at night and 80 degrees during the day. The plants appeared above ground in about a week, grew rapidly and initiated flower stalks at the end of the third week. The buds opened into flowers during the sixth week at which time the plants were harvested. The time for the development and appearance of flowers was close to that required in nature. No important differences of leaf shape were noted between these plants and any others of *D. frenchii* that had been seen. Both taxa were subjected to diminished light by placing the same number of resting buds of each under a cubicle of plastic material which reduced the light to about 25 per cent of full sunlight. The only major change was in the length of the leaves of *D. meadia*. They became longer and thinner but did not otherwise change shape or bear any likeness to *D. frenchii*.

The plants of *D. frenchii* and *D. meadia* were started again after 2 months of storage in the bottom of a refrigerator. They were once more subjected to increased lighting and started their vegetative growth promptly. This time they were grown under three mazda bulbs (300 watts each). The bulbs were approximately 3 feet from the plants, and timed for a 15 hour day. These plants also showed no change of leaf shape. A third trial was made, following the same procedure as in the second, and again negative results were obtained.

Fassett's observation of intergradation of *D. frenchii* with *D. meadia* or the change of leaf shape of *D. frenchii* to the likeness of *D. meadia* is suspected to be due to the variation of the populations of *D. frenchii*. A considerable number of plants in any population of *D. frenchii* will be found to vary some in leaf shape. However when plants that are growing side by side show leaf shape variation which does not approach the shape, color, or texture of leaves of *D. meadia* then one wonders what environmental influences can be so subtle as to change the leaves of one *D. frenchii* plant and not another growing next to it.

Other environmental factors were investigated. These included measurements of organic matter, moisture content, pH, evaporation, temperature and humidity. Only the last three factors showed any appreciable differences in the two habitats. The maximum difference in temperature for any 24 hour period was 12 degrees Fahrenheit, and the average over a 5 week period was 7.5 degrees. The lower temperature always prevailed in the habitat of *D. frenchii* as did the higher humidity and lower evaporation rate.

Morphological Analysis

The shape of the leaf in both taxa has been found to be distinct and unchanged by a change in the lighting of the environment. When width of leaves is plotted against the length of leaves on logarithm paper for both taxa the points for each fall mostly on separate straight lines. These slope determinations, figured by least squares, were 0.9 for *D. frenchii* and 0.88 for *D. meadia*. Measurements were made from 201 samples of which 126 were for *D. frenchii* and 75 were for *D. meadia*. The samples were random and from all known stations. A few points from this plotting do fall between the two slope lines indicating

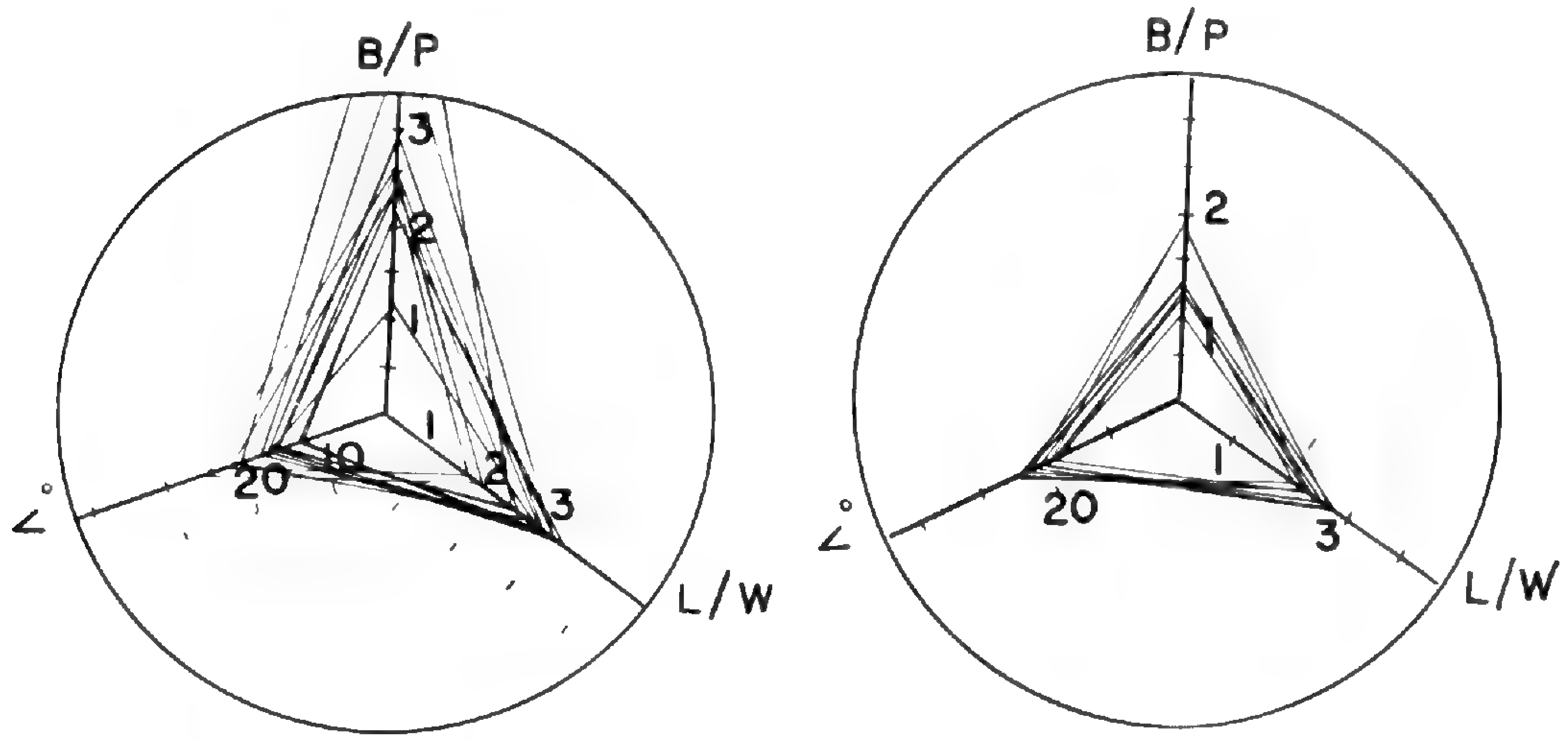


Fig. 2a. Polygonal graph showing blade/petiole, length/width relationships and angle of contraction of blade to petiole of leaves of *D. meadia* which seemed "intermediate" by logarithmic plotting of length vs width of leaves.

Fig. 2b. Polygonal graph showing relationships of blade/petiole, length/width and angle of contraction of blade to petiole of *D. frenchii*. These measurements were selected from leaves of plants which were "intermediate" in logarithmic plotting of length vs. width of leaves.

that some leaves of each taxon are intermediate as to length and width. The length-width relationship of the leaves however does not show the character that is most important in distinguishing the two taxa, namely, the abrupt angle of contraction of blade of leaf to the petiole in *D. frenchii*.

The angle at which the blade joins the petiole was calculated for both taxa from the individuals which seem to be intermediate by the logarithmic plotting of length vs width of leaves. The measurement of the angle of contraction of blade to petiole was done according to the method of Voigt (1952). The individuals which seem to be intermediate as to leaf length and width were plotted on polygonal graphs (fig. 2a & b) and are seen to be distinctly different.

The blade-petiole ratio (B/P) was always greater for *D. meadia*. The length-width (L/W) ratio was also more variable for *D. meadia*. The angle (<) of contraction made by the base of the blade to the petiole was always greatest for *D. frenchii*. Polygonal projection of other individuals whose measurements fall more closely to the slope lines would only have these differences more greatly emphasized. This method of graphing has the advantage of giving an objective comparison while portraying several characters (Davidson, 1947). When the graphs of the

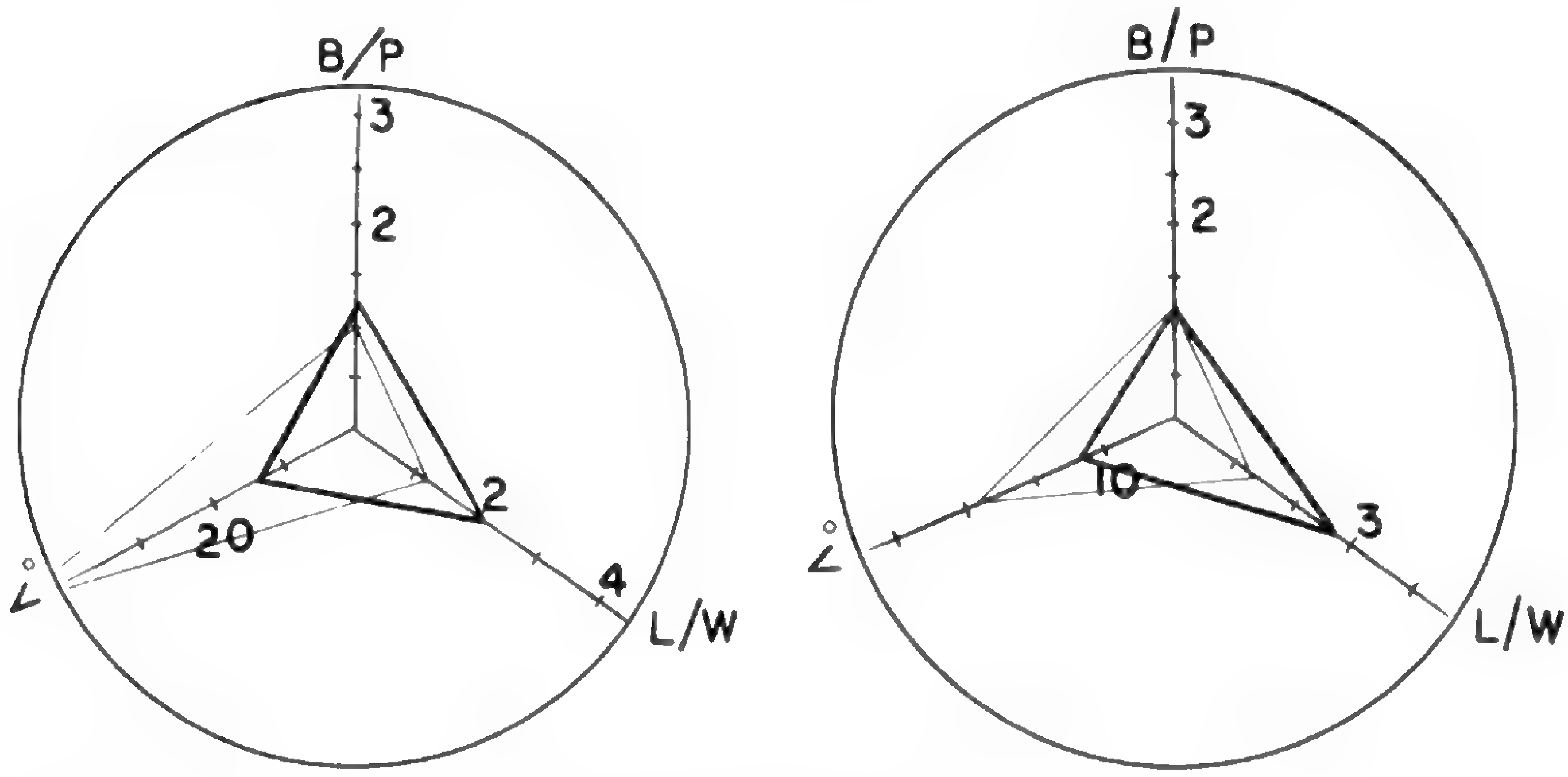


Fig. 3a. Polygonal graph showing morphological comparison of leaves of *D. meadia* and *D. frenchii* found growing in the same habitat. The individuals were six feet apart. Measurements were made of blade/petiole, length/width, and angle of contraction of blade to petiole. Heavy line is for *D. meadia*.

Fig. 3b. Polygonal graph as previously done. The plants were found in the same area fifteen feet apart. The heavy line is for *D. meadia*.

two entities are superimposed a high degree of crossing of the lines emphasizes remoteness of morphological similarity whereas a high degree of paralleling denotes a closer morphological similarity.

Measurements made in the manner just described are shown (fig. 3a) for *D. frenchii* and *D. meadia* growing together in the same habitat. Single individuals are shown. In each case only one individual of *D. meadia* was found. The plants rarely occur in the same habitat (in two cases, the habitat was that of *D. frenchii*). The nearest plant of *D. frenchii* to the single individual of *D. meadia* was selected for comparison. The distance apart in fig. 3a was 6 feet, and in fig. 3b the distance was 15 feet. In both instances the distinctness is quite apparent.

Colonies of *D. frenchii* are not usually recognized by the color of the corolla lobes because white corolla lobes are found in nearly every plant. A dark purple color as given by Rydberg (1932) and Jones (1950) has not been found in the corolla lobes of *D. frenchii.*

Plants of *D. frenchii* transplanted into the habitat of *D. meadia* at Giant City State Park in Illinois have remained distinct through three seasons of growth. They flowered in the third year. Plants of *D. meadia* transplanted into the habitat of *D. frenchii* have remained distinct as to leaf shape and have even retained their darker color. The leaves did become thinner.

A change of *D. meadia* into *D. frenchii* has not been observed. The vegetative morphological distinctness together with the lack of intergrading forms and the differences in ecological behavior of these presumed species are probably significant. However, a more complete investigation including genetic and cytological studies are required for a final determination of the taxonomic status of these taxa.

Detailed collection data are on file at the herbarium of Southern Illinois University. As indicated by the map (fig. 1) stations for *D. frenchii* are known from Jackson, Union, Johnson amd Pope Counties.—SOUTHERN ILLINOIS UNIVERSITY, CARBONDALE, ILLINOIS.

Literature Cited

Davidson, J. F. 1947. The polygonal graph simultaneous portrayal of several variables in population analysis. Madrono, **9:** 105–110.

Fassett, N. C. 1944. Dodecatheon in eastern North America. American Midland Naturalist No. 2, **31**: 455–486.
Jones, G. N. 1950. Flora of Illinois. American Midland Naturalist, monograph No. 5., The University of Notre Dame Press, Notre Dame, Indiana.
Leighton, M. M., G. E. Ekblaw, and L. Horberg. 1948. Physiographic Divisions of Illinois. The Journal of Geology, Vol. 56, No. 1.
Rydberg, P. A. 1932. Flora of the prairies and plains of central North America. New York.
Voigt, J. W. 1952. A technique for morphological analysis in population studies. Rhodora **54**: 217–220.

PEDANTICISM RUNS AMUCK

H. A. Gleason

It is now seventeen years since the article* was published and for seventeen years I have considered a reply to it. At first I remained silent out of respect to my friend Alfred Rehder, who was unfortunately, and I suspect rather unwittingly concerned with it.

The title of the paper is misleading. Botanists who may at this point fear that they have been asked or will now be asked to learn a fourth name for this beautiful, valuable, and widely distributed tree may be at ease. The article leaves the name *Pseudotsuga taxifolia* unchanged and refers only to the author-citation for it, that is, to the botanists who are responsible for the name in the recommended form. Nevertheless it is significant that the authors betray in their title something of the growing tendency to convert the ordinary binomial system of nomenclature into a trinomial or quadrinomial system, in which the "authorities" constitute the third and fourth terms. Every teaching taxonomist still tells his students that the name of a species consists of two terms which together are sufficient to designate the species and at the same time show something of its place in the scheme of classification. The International Code, in the formation of which the authors played such a prominent part, still affirms the binomial system. But this growing tendency is often apparent.

Since the Kew Bulletin, as well as the original sources on which Sprague and Green base their conclusions, may not be

* Sprague, T. A., and M. L. Green. The botanical name of the Douglas Fir. Kew Bulletin **1938**: 79, 80. 1938.

generally accessible to American readers, the statements of the authors may be briefly summarized.

The first binomial given to the Douglas Fir was *Pinus taxifolia* by Lambert in 1803. Later the tree received two other specific epithets, *mucronata* from Rafinesque and *Douglasii* from Lindley. All three of these have been transferred to *Pseudotsuga,* resulting in three binomials, of which two must be synonyms and only one, if any, can be valid. All three have been in general use in American botany and forestry. Under prevailing rules of nomenclature, the oldest of these specific epithets must be used, provided it was valid when published and after its transfer produces a valid binomial.

The oldest epithet is actually invalid, the name *Pinus taxifolia* as used by Lambert being a later homonym of *Pinus taxifolia* as previously used by Salisbury. Under the International Code an invalid epithet can not be validly transferred. Therefore *Pseudotsuga taxifolia* (Lambert) Britton is also invalid. Apparently the next available epithet is *mucronata* and the valid name *Pseudotsuga mucronata* (Raf.) Sudworth. Sprague and Green, however, claim that the Douglas Fir was also named *Abies taxifolia* by Poiret in 1804 and that this name is validly published and transferable. They then proceed (on behalf of Rehder) to transfer this epithet, which is considerably older than those of Rafinesque and Lindley, to *Pseudotsuga,* giving us the same name with different authors, *P. taxifolia* (Poir.) Rehder.

Sprague and Green are expert in all the intricacies of modern nomenclatural etiquette and their interpretation of the rules, as applied to this particular case, may be accepted without question. In brief, the applicable rules are three:

1. An invalid epithet (*taxifolia* in *Pinus taxifolia* Lamb.) upon combination with another generic name (*Pseudotsuga*) produces an invalid binomial (*Pseudotsuga taxifolia* Britt.)

2. A later homonym (*Pseudotsuga taxifolia* Rehder) is not invalidated by an older one (*Pseudotsuga taxifolia* Britton) if both are based on the same type.

3. The invalidity of an epithet in one genus (*taxifolia* in *Pinus,* as used by Lambert) does not preclude its valid use in another genus, even for the same species, provided it is described there as new and not merely transferred.

These rules are the ones invoked by Sprague and Green and I agree with them completely. The sole question to be determined is whether Poiret described the Douglas Fir as a "new" species, thereby creating a valid and transferable specific epithet.

Lambert's description (1803) reads as follows:

Tab. 33.

27. Pinus taxifolia.

Nootka Fir.

Pinus taxifolia, foliis solitariis planis integerrimis, strobilis oblongis, antheris inflato-didymis.

Habitat ad Americae borealis oras occidentales.

Descriptio.

Habitus P. canadensis, at *folia* angustiora et paululum longiora, integerrima. Amenta mascula ovata, subsessilia, multiflora; antheris inflato-didymus, crista reflexa, minima.

The figure was taken from a specimen in the Banksian Herbarium, brought home by Mr. Menzies, by whom it was discovered on the Northwest coast of America, and who has favored me with the following particulars respecting this species.

In general habit this tree resembles *P. canadensis*, and attains considerable height and size. The *leaves* are also very like those of the species just mentioned, but narrower and their edges are entire, whereas the others are visibly serrated. The *inflorescentia* is much larger than in *P. canadensis* and there are more antherae. As for the *Cones*, I can give no account of them, those which were brought by Mr. Menzies having been unfortunately mislaid. That gentleman however informs me that they differ in their form from the cones of *P. canadensis*, and that they are longer.

During the single year after this publication no other specimen of the Douglas Fir was brought to Europe. In 1804 Poiret had occasion to write about trees and the only source of information on the Douglas Fir was Lambert's description and plate. It is conceivable that he borrowed the specimen from the Banks herbarium, but not probable, since England and France were not on good terms at that time. Poiret's description now follows, and the reader is advised to compare it carefully, clause by clause, with that of Lambert, remembering that the order of presentation is considerably changed.

15. Sapin à feuilles d'if. Abies taxifolia. Lambert.

Abies foliis solitariis, planis, integerrimis; strobilis oblongis, antheris inflato-didymis. Lambert, Descript. of Pin. pag. 51. tab. 33.

Cette espèce a de grands rapports avec le *Pinus canadensis* par son port, & même par l'élévation de son tronc. Ses rameaux sont un peu diffus, opposés ou alternes; ses feuilles sont plus étroites & plus longues, très entieres, glabres à leurs deux faces, planes, solitaires. Les chatons mâles sont ovales, presque sessiles, très entieres, très chargés de fleurs; les antheres renflées & à deux longes; leur crête réfléchie & fort petite; on soup conne que les cones sont beaucoup plus longs que ceux du *Pinus canadensis*.

Cet arbre croît sur les côtes occidentales de l'Amérique septentrionale.

Careful comparison of the two descriptions will show that almost all information given by Poiret has been taken, usually by literal translation, from Lambert. There is a little additional matter, as "rameaux sont un peu diffus, opposés ou alternes," or "feuilles plus étroites, planes, solitaires," and this might have been taken from Lambert's plate. The only significant difference is the substitution of the generic name *Abies* for *Pinus*. It is not mere plagiarism; he cites Lambert's work accurately. It is merely the transfer of a specific epithet to a new generic position. *Transfer of an invalid specific epithet produces an invalid binomial.* If Lambert's *taxifolia* produced an invalid binomial when transferred to *Pseudotsuga* by Britton, then it also produces one when transferred to *Abies*.

Abies taxifolia, as used by Poiret, can not possibly be regarded as a "new" species. It is a transfer, if there ever was one. The basonym and its author are clearly stated, the description is a mere translation into French.

Was the epithet *taxifolia* ever used elsewhere in a description of the Douglas Fir as a "new" species? No such use is known to exist in the few years between its first and invalid appearance in 1803 and the publication of *mucronata* by Rafinesque. If such use was made of it at any later time, it would have resulted merely in an invalid synonym. The use of *taxifolia* as the specific epithet for the Douglas Fir is definitely and finally excluded, and the name of the tree is once again *Pseudotsuga mucronata*, the specific epithet by Rafinesque, the combination by Sudworth. Under that name it was known for many years in most American literature.—GREENWICH, CONN.

A Dark-hooded Variant of Asclepias amplexicaulis.—*Asclepias amplexicaulis* Sm. is a strikingly-formed Milkweed, with a solitary (rarely 2 or 3), long-peduncled, ample umbel, and crisped-margined, broad, glaucous leaves. It is familiar in dry, open situations in the eastern United States. Normally, its hoods are pinkish, or flesh-colored. Small,[1] however, describes the hoods as "maroon." It seems odd, therefore, that while this term is hardly apt for the usual hood color of the usual colonies of the species, it can, with tolerance, be applied to the dark-colored hoods of a certain population I encountered on August 1, 1954, in the upland pine-sand country of southwestern North Carolina, at Lake Osceola, Hendersonville, Henderson County. No other specimens of *A. amplexicaulis* were noted nearby, and the only other asclepiad seen in the vicinity was *A. incarnata* L., abundant on the lake shores a few rods away. A single specimen of this aberrancy was collected, later deposited in the New York Botanical Garden Herbarium. This specimen exhibits no deviation from typical *A. amplexicaulis* in any character other than hood coloration. Technically, this color approaches Ridgway's[2] chip of "Dahlia Carmine." For a more immediately practical concept, the color of the hoods of this variant quite fairly approximates the well-known, living flower color of *Trillium erectum* L.

The literature on *A. amplexicaulis* seems to be free of reference to flower color variation, but I am apparently not the first to encounter the present deviation. Mr. Joseph Monachino, of the New York Botanical Garden, who, incidently, verified my specimen, wrote me that he once encountered a "dark-purple hooded" plant in New Jersey. Similarly, Mr. Roy Latham, of Orient, New York, informs me he has seen dark-hooded plants on Long Island. It appears, therefore, that there exists a wide-ranging color form of *A. amplexicaulis*, wherein the usual anthocyanic pigmentation of the hoods is grossly intensified, the flowers (crown) thus appearing dark maroon-purple in life, more vivid and showy than typical plants. The dark form has not been adequately collected, and, therefore, awaits acquisition of supporting material for its proper delineation. Therefore,

[1] Small, J. K. 1933. Manual of the Southeastern Flora. p. 1070.
[2] Ridgway, R. 1912. Color Standards and Nomenclature. Pl. XXVI.

field workers are asked to watch for dark-hooded *A. amplexicaulis*, and to collect specimens with proper notations. I would be very grateful to learn of any such observations and collections.

The hood color of most herbarium specimens of *A. amplexicaulis* is a meaningless strawy hue. Occasionally a dried specimen turns up in which the hoods have turned a deep plum shade. My specimen turned this color on drying. Yet, with all the variables to consider, this can hardly be taken to indicate a pattern. It is especially deplorable, that there is rarely a collector's note on flower color with these herbarium specimens. Because flower color is so useless in identifying dried Milkweeds, Carr[3] prepared an asclepiad key to circumvent this character. Happily, the color of my aberrant specimen will be preserved. The living plant was photographed in color, and a print was deposited with the specimen. In addition, for comparative purposes, a color photograph of a normal pinkish Long Island plant was included.—LEONARD J. UTTAL, 1258 BEACH ROAD, RIVIERA BEACH, FLA.

SCOTCH HEATHER.—In the town of Hartland, in the northwestern part of Hartford County, Connecticut, at an elevation of 1200 feet, there is a good stand of *Calluna vulgaris*, which extends over an area of about an acre. Since it is rather unusual to find this shrub in such a location, which has very little protection from the winter cold, the writer attempted to trace the history of the introduction of the plant to this part of Connecticut. Mr. L. E. Pearson, a forester in Connecticut, first noticed it when looking over the woodland of the present owners, Dr. and Mrs. Henry A. Sturman.

Most of the following information was obtained by the Sturmans in conversation with local inhabitants of the area. The present Sturman farm was owned by one John Schwaller and his wife, who came to America from Alsace-Lorraine in the 1870s and settled on the property in Hartland. It is reported that the original seeds of the present stand of heather were sent in a letter from Mrs. Schwaller's mother who told her daughter that the shrub would be valuable for winter forage for the cows.

[3] CARR, K. 1942. A Key to North American Asclepiads. Castanea 7: 1–7.

The exact year the seeds were sent is not known but presumably at least 40 years ago, and possibly 50 or 60 years ago. It would probably be safe to assume that the stand has been in existence for 50 years.

The present site is an old field which has commenced to grow up with gray birch, white pine and some juniper, as well as mountain laurel. It would appear that the pines offer some protection from the winter storms. However, the site being on the top of a rather exposed hill, does not appear to be a location in which the heather would thrive. The remarkable thing is that it has apparently continued to spread slowly for about half a century.

Some of the plants show evidence of winter killing in the tops but the branches underneath seem to remain protected so they leaf out again each spring and come into full flower each summer.

At this writing, the sixth of August, the plants are in full bloom and present a beautiful sight. In conversation with Dr. and Mrs. Sturman a few days ago they said some Scottish friends of theirs, now living in this country, actually had tears in their eyes when they viewed the shrubs in full bloom.—S. E. Parker, PLEASANT VALLEY, CONNECTICUT.

Volume 57, no. 683, including pages 301–324, was issued 16 December, 1955.

ERRATA

Page 139, last line; for *cordifolius* read *cordifolium*.
Page 221, line 1; for *americanum* read *americana*.
Page 278, line 31; for *deltoides* read *deltoidea*.
Page 280, line 16; *for* occur *read* occurring.
Page 281, line 5; for *aculeata* read *aculeatum*.
Page 291, line 12; for *Erigonum* read *Eriogonum*.
Page 291, line 14; for *grandiflorum* read *grandiflorus*.
Page 294, line 18; *for* Ethel *read* Ethyl.
Page 310, line 30; for *insparata* read *insperata*.

INDEX TO VOLUME 57

New scientific names and combinations are printed in boldface type