SIDA CONTRIBUTIONS TO BOTANY

Volume 2

1965-1966

DATES OF PUBLICATION

No. 1, pp. 1—113: 3 March 1965

No. 2, pp. 115—175: 31 December, 1965

No. 3, pp. 177—268: 6 April 1966

No. 4, pp. 269—348: 20 July 1966

No. 5, pp. 349—394: 27 September 1966

No. 6, pp. 395—449: 30 December 1966

Pages 114, 176, 450 are blanks. For Contents, see the unnumbered pages which form the front covers of the separate issues.

ERRATA GRAVIORA

p. 76. Map on this page should be on p. 78.

p. 78. Map on this page should be on p. 76.

p. 138, par. 3, l. 5. For *Parnassia caroliniana*, read *Parnassia glauca*.

p. 150, par. 1, l. 7. For *Dodecatheon pulchellum* and *D. amethystinum* read *Dodecatheon pulchellum* (incl. *D. amethystinum;* cf. Iltis & Shaughnessy, 1960).

p. 150, par. 2, l. 17. For *Parnassia glauca—P. caroliniana*, read *Parnassia glauca—P. parviflora.*

p. 185, caption to Fig. 10. For *X. equisetifolia*, read *X. isoetifolia.*

p. 390. For correction regarding first U.S. record of *Juncus capitatus*, see p. 436.

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SIDA CONTRIBUTIONS TO BOTANY

VOLUME 2 **NUMBER 1** **MARCH 1965**

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SIDA is privately published by Lloyd H. Shinners, SMU Box 473, Dallas, Texas 75222, U.S.A. Subscription price $6 (U.S.) per volume of about 360—400 pages, parts issued at irregular intervals.

VIOLETS (VIOLA) OF CENTRAL AND EASTERN UNITED STATES: AN INTRODUCTORY SURVEY

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"VIOLA — Viola, in *Botany,* the common and well known name of a charming flower, most probably originated in its Greek synonym iov. At least, the vague and forced etymologies of this word, for which Latin authors have ransacked their own language, prove it not to have come from thence. Nor are the explanations of the Greek much more satisfactory, though the fable of this plant having sprung up on purpose to be the food of the metamorphosed Io, is too poetical to be forgotten. The names of the Violet in modern languages all proceed from the Latin, or from the same source, whatever it may be. The poetry, the romance, the scenery, of every country, is embroidered with the violet, from Caledonia to Arcadia, and the very same individual species is, or has been, the object of homage in both those distant countries. Yet it must be remembered that iov, *Viola,* and even the English Violet, are names of more wide-extended and indefinite application, than those of perhaps any other flower, even the Rose not excepted; so as to be nearly synonymous with the word *flower* itself. . . ."

"The arrangement of the species of this ample and interesting genus might, doubtless, be greatly improved, provided any able botanist could compare the leading ones together, in a sufficiently perfect state. . . . In the addition of new species, we have passed over many American ones, mentioned by M. Poiret, because they are probably superceded by the labors of Mr. Pursh. We could not, therefore, undertake, nor did it appear requisite, to settle their synonymy; especially as we have reason to think that the American *Viola* are yet not all well known . . . but we do not scruple to declare that a full scientific botanical essay on Viola, might display as much skill and learning, and be made subservient to as much philosophical illustration of botany, as any monographical subject that could be chosen." (J. E. Smith in the Cyclopaedia of Abraham Rees, 1817.)

Following is my attempt to improve "the arrangement of the species of this ample and interesting genus" for the central and eastern United States. I have not included other areas, such as the western states, Canada, and Mexico, for I am not yet familiar enough with their violets to make taxonomic judgments.

The present paper is an attempt to render more discernible the morphological and taxonomic differences of the violets. I have made no effort to explain the origin or evolutionary importance of the differ-

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ences. These subjects have been and will be discussed in other, more technical papers. Brainerd's splendid monograph of the violets of North America has served us well since 1921, and I hope this small survey will further improve our understanding of the beautiful and popular violets.

The discussions of the species of violets have been arranged in the apparently natural groupings followed by Gershoy (1928). For the most part the groups are quite distinct both morphologically and cytologically and may represent separate evolutionary lines. Keys, distribution maps, and line drawings are offered as aids to the identification of the 47 species and 4 additional varieties or subspecies of violets recognized as occurring naturally in the central and eastern parts of the United States.

For the beautiful line drawings I am indebted to Miss Wilma Monserud of the University of Minnesota and Mrs. Judith Strong (initials JL on the drawings) of Scottsdale, Arizona. I am further indebted to the curators of over 100 American herbaria (too many to list here) for the loan of specimens. Data obtained from these specimens were used in the preparation of the distribution maps. My studies could not have been accomplished without the aid of a series of National Science Foundation grants, which financed them for eight of the fifteen years they have lasted.

My greatest debts are to many students from Grinnell College, Arizona State University, and the Rocky Mountain Biological Station, who have contributed to this paper. Among these the following people were especially helpful: William Bowen, Shirlee Cavaliere, Miwako Cooperrider, Frank Crosswhite, Jeanette Graham, Millicent Kalil, Stephen Koch, Theodore McConnell, and Arthur Risser. I am also extremely grateful for the varied assistances of dozens of botanists, both professional and non-professional, who have loaned me specimens, given me needed but sometimes ignored or misused advice, taken me to obscure habitats to see obscure violets, and often shared with me their delights in the mysteries of violets and forests.

I dedicate this monograph, with appreciation and respect, to Mrs. Margaret Bergseng, a sympathetic and helpful friend of the violets and of mine for many years, in memory of a field trip after violets that ended in an encounter with a headstone in a cemetery.

KEY TO CENTRAL AND EASTERN UNITED STATES VIOLETS

(Based principally on the appearance during the spring flowering period)

1a. Plants with leafy, aerial stems

2a. Plants annual

3a. Petals equalled or surpassed by sepals in length . . . . . . 43. *V. arvensis*, p. 102

3b. Petals surpassing sepals in length (see also excluded species *V. tricolor*, p. 109) . . . . 44. *V. rafinesquii*, p. 104

2b. Plants perennial

4a. Petals white or yellow, with purple veins or sometimes purple-tinged

5a. Petals white on inner surface, sometimes purple-tinged on outer

6a. Stem leaves with blades the same shape as basal leaves, as long as broad; sepals toothed; petals white on both surfaces 5. *V. striata*, p. 16

6b. Stem leaves with blades narrower than basal leaves, longer than broad; sepals entire; petals often purple-tinged on outer surface

7a. Basal leaf blades as long as broad; rootstock short and thick, not stolon-like . . . . 41a. *V. canadensis* var. *canadensis*, p. 96

7b. Basal leaf blades wider than long, broadly reniform; rootstock long and stolon-like . . . . 41b. *canadensis* var. *rugulosa*, p. 98

5b. Petals yellow, sometimes purple-tinged

8a. Leaf blades narrow, 1.5 to 3 times as long as broad; first peduncle produced at base of aerial stems; western . . . . 32. *V. nuttallii*, p. 74

8b. Leaf blades broader than long; first peduncles produced near apex of aerial stems; central and eastern

9a. Leaf blades divided . . . . . 34. *V. tripartita*, p. 80

9b. Leaf blades not divided

10a. Leaf blades halberd-shaped (triangular), often tinged with purple . . . . 31. *V. hastata*, p. 72

10b. Leaf blades cordate, rarely or never tinged with purple

11a. Plants moderately or heavily pubescent, bearing 1 or 2 flowering stems and none or 1 or 2 root leaves

12a. Stem with no stipules below first leaf; upper stipules small, inconspicuous; southeastern . . . . . 34. *V. tripartita*, p. 80

12b. Stem with stipules near base; upper stipules large, conspicuous . 33a. *V. pubescens* var. *pubescens*, p. 76

11b. Plants slightly pubescent, bearing 3 or more flowering stems and 3 or more root leaves . . . . 33b. *V. pubescens* var. *eriocarpa*, p. 78

4b. Petals blue or purple

13a. Spur long (7—12 mm.), narrow and curved . . . . . . 4. *V. rostrata*, p. 14

13b. Spur shorter, thicker

14a. Plants prostrate, rooting at the nodes; leaves often suffused with purple; southeastern . . . . . 6. *V. walteri*, p. 18

14b. Plants erect; leaves green

15a. Leaf blades cordate, up to 5 cm. wide; petals light blue . 2. *V. conspersa*, p. 10

15b. Leaf blades triangular, with truncate or subtruncate bases, rarely more than 2 cm. wide; petals light or dark blue

16a. Plant with thick stems, short and much branched; sepals rather broad, toothed . . . . 1. *V. adunca*, p. 8

16b. Plant with slender stems, sparingly branched; sepals linear, almost entire . . . . . 3. *V. labradorica*, p. 12

1b. Plants without leafy, aerial stems

17a. Petals yellow . . . . 42. *V. rotundifolia*, p. 100

17b. Petals blue, purple or white

18a. Rootstocks (rhizomes) slender, fibrous; plants often with stolons

19a. Petals blue or purple

20a. Spur 1—2 mm. long; leaves oval, with inconspicuous rounded teeth . . . . 45. *V. palustris*, p. 106

20b. Spur 5—7 mm. long; leaves cordate, with conspicuous rounded teeth . . . . 46. *V. selkirkii*, p. 106

19b. Petals white with purple veins

21a. All petals glabrous; plant lacking leafy stolons; leaves reniform . . . . 40. *V. renifolia*, p. 94

21b. Basal or lateral petals pubescent; plant with vigorous leafy stolons; leaf blades variously shaped

22a. Leaf blades 1.5 or more times as long as broad, their bases cuneate

23a. Leaf blades ovate, 1.5 to 2 times as long as broad . . 39. *V. primulifolia*, p. 92

23b. Leaf blades lanceolate to linear, 3.5 to 15 times as long as broad

24a. Leaf blades lanceolate, 3.5 to 5 times as long as broad 37a. *V. lanceolata* ssp. *lanceolata*, p. 86

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22b. Leaf blades as long as broad or shorter, their bases cordate

25a. Lower pair of petals glabrous; leaf blades about as broad as long . . . . 35. *V. blanda*, p. 82

25b. Lower pair of petals bearded; leaf blades broader than long

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26b. Leaf blades glabrous; lateral petals with a slight tuft of hairs . . 38. *V. macloskeyi* ssp. *pallens,* p. 90

18b. Rootstocks (rhizomes) thick and fleshy; plants not stoloniferous (except the introduced *V. odorata)*

27a. Stolons well developed; flowers sweet-scented . . . . . 47. *V. odorata,* p. 108

27b. Stolons absent; flowers not sweet-scented

28a. Rootstock vertical, short; petals all colored alike, or upper two dark violet, lower three light purple . . . . 21. *V. pedata,* p. 48

28b. Rootstock horizontal, often elongate; petals all colored alike

29a. Leaves lobed or divided

30a. Leaves lobed or deeply toothed at base only, 1.5 to 3 times as long as broad

31a. Leaves densely pubescent petioles about half as long as the blades . . . . 12. *V. fimbriatula,* p. 30

31b. Leaves moderately pubescent; petioles as long as the blades or longer . . . . 24. *V. sagittata,* p. 54

30b. Leaf blades deeply lobed, as wide as long or wider

32a. Leaves moderately to densely pubescent

33a. Leaf blades with 5—9 or more long, linear lobes

34a. Leaves moderately pubescent with long hairs; eastern . . . . 20. *V. palmata,* p. 46

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33b. Leaf blades with 3—5 broad lobes

35a. Central lobe elongate; south-central . . . . 16. *V. lovelliana,* p. 38

35b. Central lobe not elongate; central and eastern

36a. Leaf blades with 3 broad, shallow basal lobes 28a. *V. triloba* var. *triloba,* p. 64

36b. Leaf blades with 5 narrow lobes cut almost to midrib . . . 28b. *V. triloba* var. *dilatata,* p. 66

32b. Leaves glabrous or very finely pubescent

37a. Leaf blades pedately cut, with narrow lobes

38a. Leaf blades with 9—11 linear lobes . . . . . 8. *V. brittoniana,* p. 22

38b. Leaf blades with 5—7 narrowly oblanceolate lobes

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37b. Leaf blades palmately cut, with broad lobes

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40b. Leaf blades with 5 or more lanceolate or linear lobes; all leaves cut; midwestern . . . . 29. *V. viarum,* p. 68

29b. Leaf blades not lobed or divided

41a. Leaf blades moderately to densely pubescent on one or both surfaces

42a. Leaf blades 1 to 1.5 times as long as broad; northern 19. *V. novae-angliae,* p. 44

42b. Leaf blades as broad as long or broader

43a. Leaf blades equally pubescent on both surfaces

44a. Leaf blades large, broader than long; peduncles as long as the petioles or shorter . . . . . . 27. *V. sororia,* p. 60

44b. Leaf blades small, as long as broad; peduncles up to twice as long as the petioles; southeastern . 30. *V. villosa,* p. 70

43b. Leaf blades more heavily pubescent on one surface

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45b. Leaf blades heavily pubescent on lower surface, sparsely pubescent on upper, green . . . . . . 26. *V. septentrionalis,* p. 58

41a. Leaf blades glabrous or finely pubescent on upper surface

46a. Leaf blades entirely glabrous

47a. Leaf blades uniformly toothed to the acute apex; midwest prairies . . . . . . 23. *V. pratincola,* p. 52

47b. Leaf blades with somewhat attenuate apex bearing fewer, more widely-spaced teeth than rest of margin

48a. Upper third of leaf with 10—14 teeth, narrowly triangular; peduncles exceeding the petioles

49a. Leaf blades cordate; peduncles about 1.5 times as long as petioles; southeastern . . . . . . 13. *V. floridana,* p. 32

49b. Leaf blades triangular; peduncles about 2 times as long as petioles; southern to midwestern . . 15. *V. langloisii,* p. 36

48b. Upper third of leaf blade with 0—6 teeth, broadly triangular; peduncles not exceeding the petioles . 17. *V. missouriensis,* p. 40

46a. Leaf blades pubescent with short, stiff hairs on upper surface of basal lobes

50a. Hairs rather large, visible without magnification; peduncles about equalling petioles; eastern and southeastern woodlands . . . . 7. *V. affinis,* p. 20

50b. Hairs tiny and inconspicuous without magnification; peduncles exceeding petioles; northern bogs, wet meadows, and shores

51a. Earliest leaves with cordate blades; spur petal glabrous, laterals with clavate hairs . . . . . 9. *V. cucullata,* p. 24

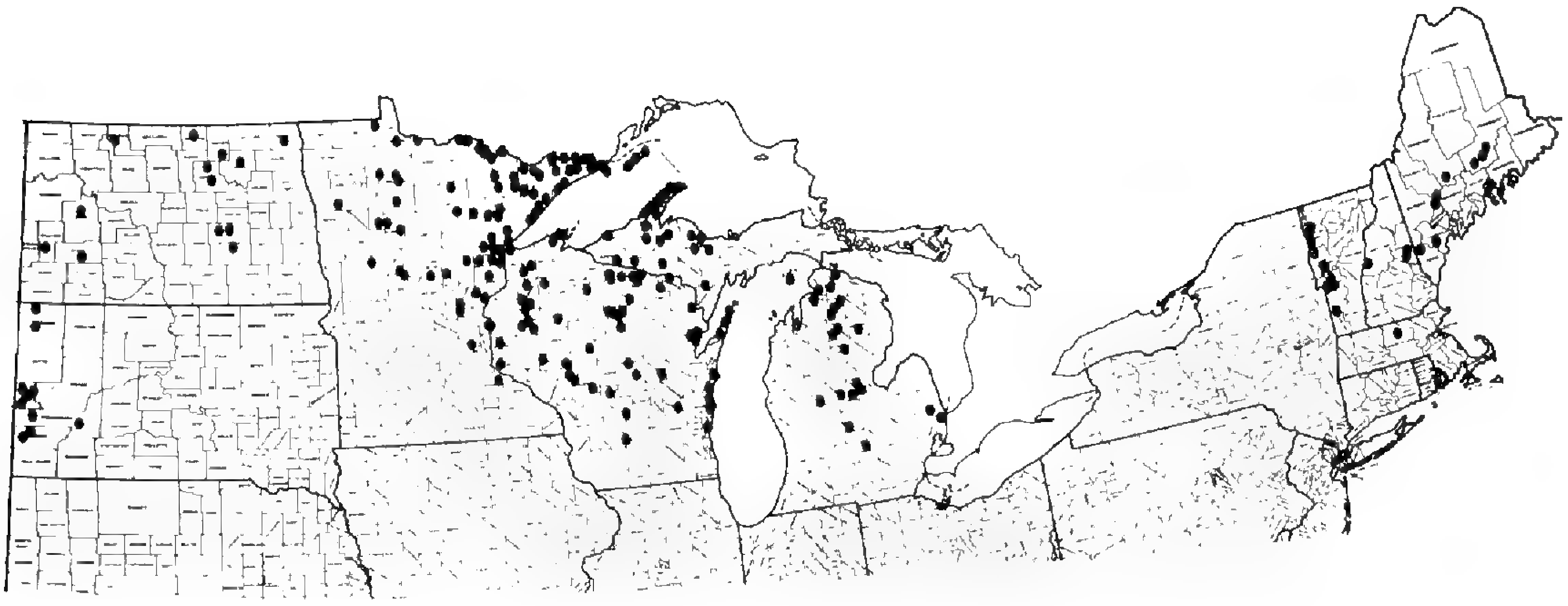
51b. Earliest leaves with reinform blades; spur petal pubescent, laterals with cylindrical hairs . . . . 18. *V. nephrophylla,* p. 42

GROUP I. STEMMED BLUE VIOLETS.

1. **Viola adunca** J. E. Smith in Rees, Cyclopaedia 37: Viola no. 63. 1817.

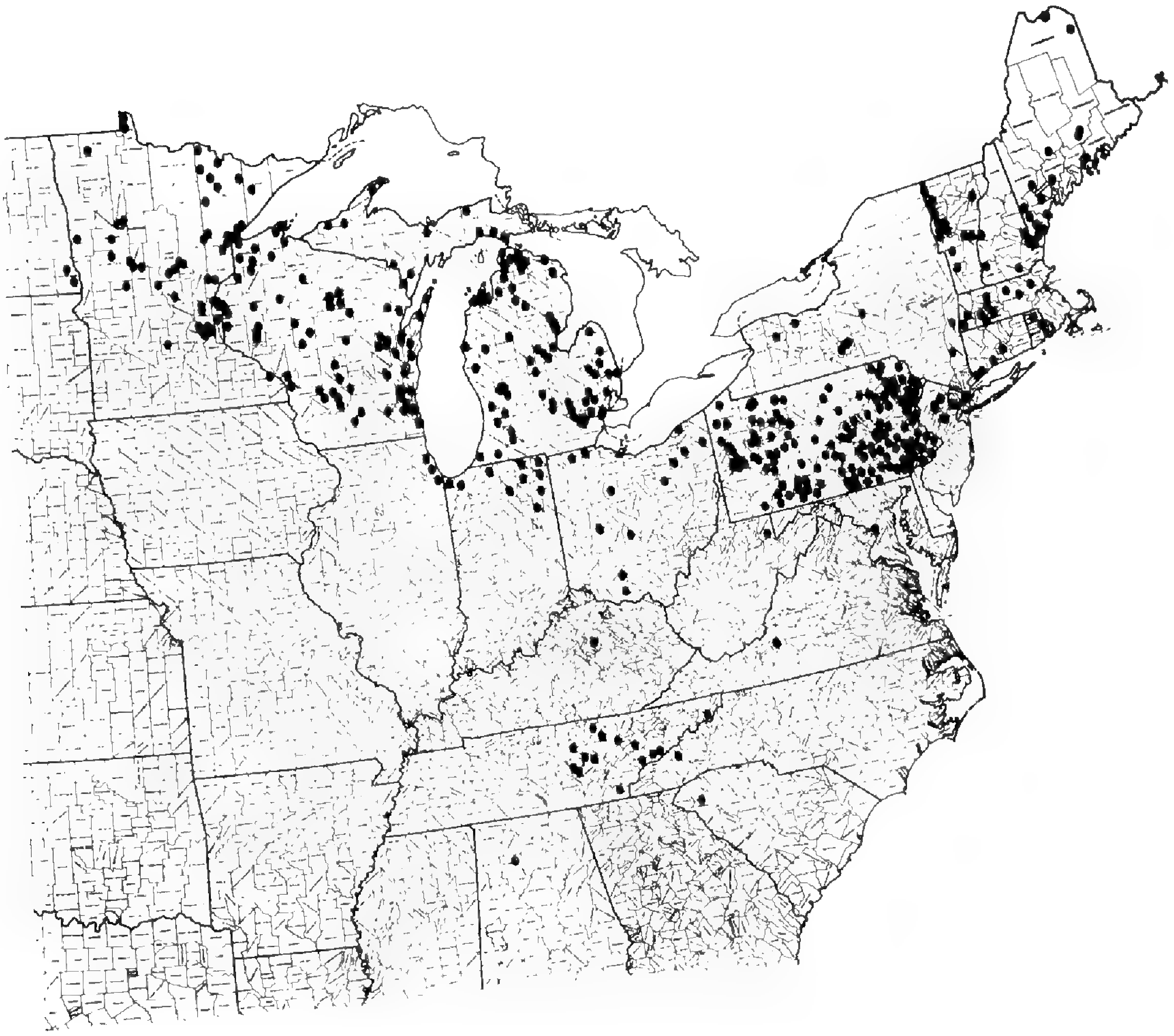
This widely distributed and highly variable northern species has had and continues to have a tortuous nomenclatural history. Brainerd reviewed its early history in his monograph (1921). Since that time a number of other names have been applied to morphological variants in the Rocky Mountains. These will not be dealt with here. In the eastern United States this is usually a small plant with dark blue corollas having long, straight or curved basal spur. The best distinguishing character is the shape of the leaf blade, which is broadly triangular with a truncate or only slightly cordate base.

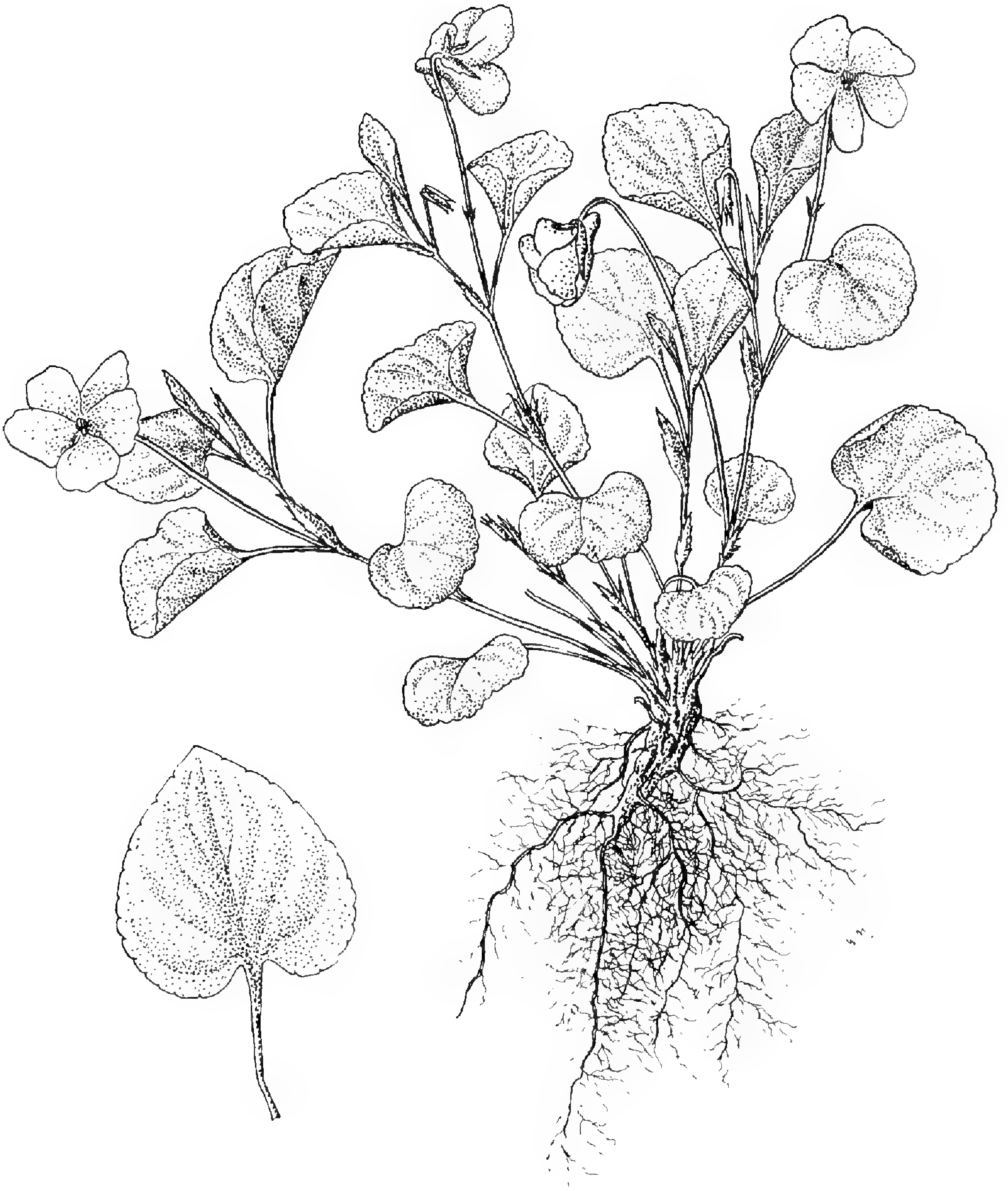
Viola adunca hybridizes occasionally with *V. conspersa* when they occur in close proximity (Brainerd, 1924; Fernald, 1950). Normally, however, they occur in non-contiguous habitats, and hybridization is prevented by distance. *V. adunca* usually occurs in open, dry habitats such as clefts of boulders, dry, sandy areas near streams or lakes, and open, dry aspen forests on rocky slopes.



2. **Viola conspersa** Reichenb., Plantae Criticae 1: 44, pl. 52, Fig. 108. 1823.

The "dog violet" is one of the commonest species of central and northeastern United States, occurring in a variety of habitats, principally in disturbed stream forests on sandy soil. Here it may occasionally form dense mats. It may grow with *V. affinis, V. sororia,* and *V. striata,* a stemmed species it somewhat resembles. Where it comes into contact with *V. walteri* (southern Ohio and eastern Tennessee) and with *V. rostrata* (especially in New England), it grades into them. The intergrading specimens may be considered hybrids when between *V. conspersa* and *V. rostrata,* as these two species are sympatric but morphologically distinct through most of their ranges. It might be better to consider *V. conspersa* and *V. walteri* as regional subspecies of a single species, as they do not remain distinct when sympatric. Another "species" which might be best considered as subspecific with *V. conspersa,* is *V. labradorica,* which replaces it to the north.





3. **Viola labradorica** Schrank, Denkschr. Bot. Ges. Regensb. 2: 12. 1818.

I know of but three locations for this violet in the United States: a bog near the shore of Lake Superior at Grand Marais, Cook County, Minnesota, the Susie Islands offshore from Grand Marais, and the White Mountains (Mt. Washington) of New Hampshire. In Canada it occurs from Newfoundland to Alaska, and it is also found in Greenland. Fernald's (1950) report of it in other states (under the name of *V. adunca* var. *minor*) is in error.

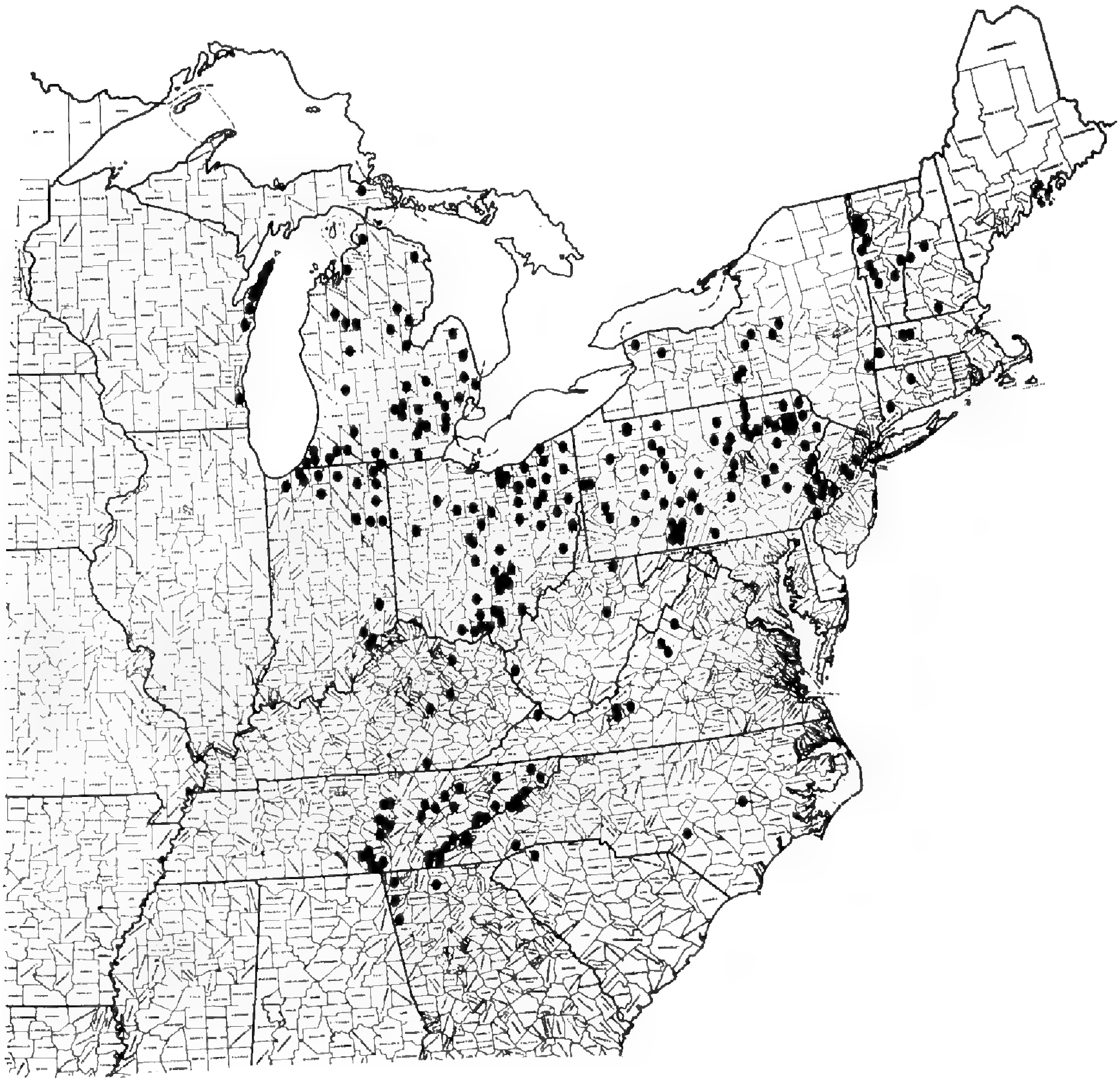
I do not agree with Fernald's disposal of this species. It is considerably more similar to *V. conspersa* than to *V. adunca,* and I believe it to represent a northern replacement of *V. conspersa. Viola labradorica* differs from *V. conspersa* mainly in its diminutive size, and its tiny, entire stipules.


WM

4. **Viola rostrata** Pursh, Fl. Am. Sept. 1: 174. 1813 ("1814").

The "long-spurred violet" truly deserves the name. The spur of the basal petal may be up to two centimeters long; it is straight or slightly curved upward. *Viola rostrata* is a member of a complex of similar species which includes *V. conspersa, V. adunca, V. walteri, V. labradorica,* and *V. howellii.* It is sympatric with *V. conspersa* and sometimes hybridizes with it. In addition Brainerd reports a case of hybridization with *V. striata* in Ohio. I have seen *V. rostrata-V. striata* hybrids from Pennsylvania and southern Ontario. Dr. Lulu Gaiser has sent me a number of find hybrid specimens collected near Guelph, Ontario.

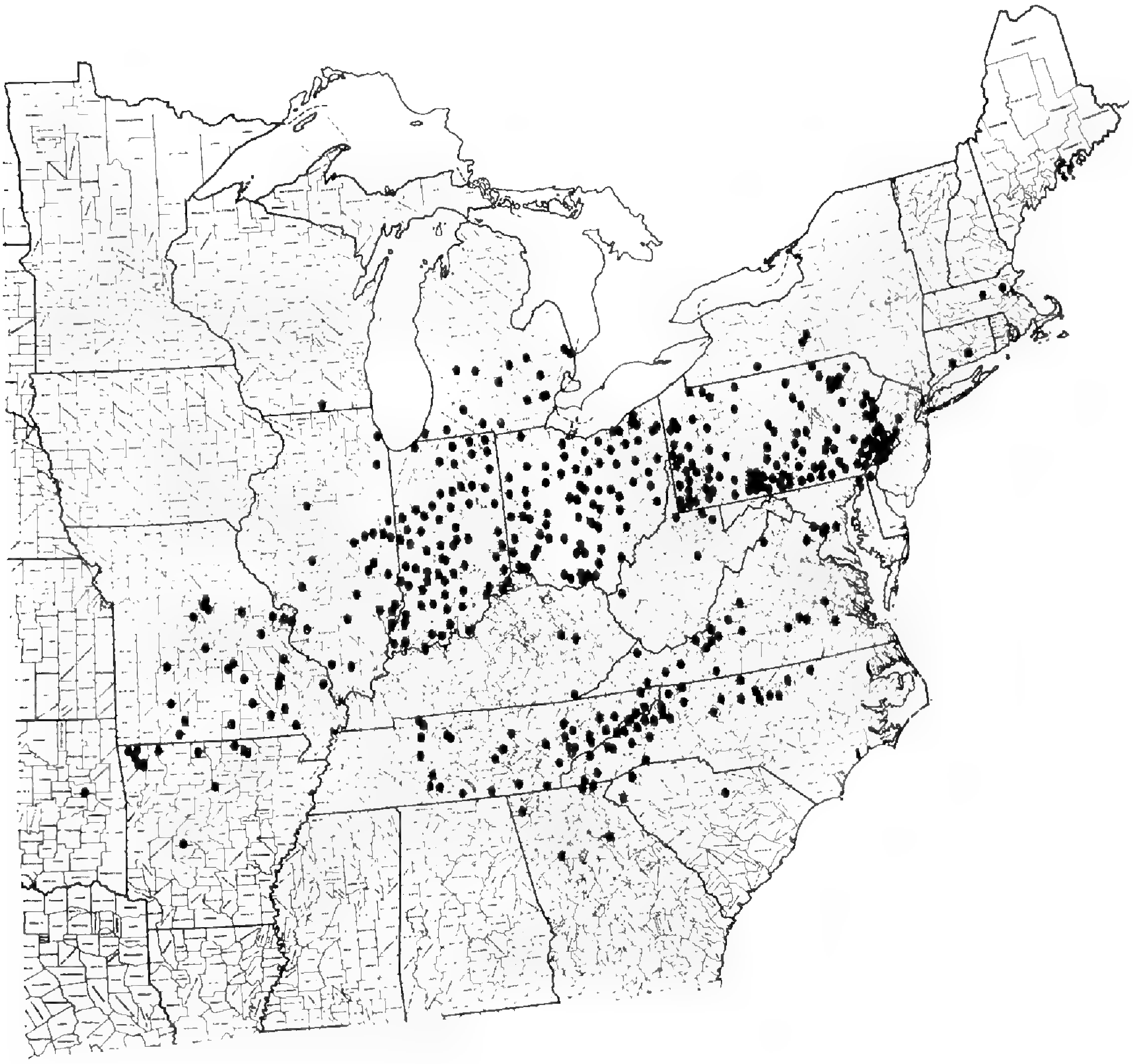
In summer, *V. rostrata* may be difficult to distinguish from large plants of *V. conspersa.* It differs in having leaves with more elongated apices; the summer leaves of *V. conspersa* tend to be more oval.



5. **Viola striata** Ait., Hort. Kew. 3: 290. 1789.

Ordinarily this stemmed, white-flowered violet is easy to distinguish. It has large, fimbriate sepals. The leaves are remarkably uniform in size and shape along the stem and have small, basal lobes, acute apices, and many small teeth. The petals are creamy white. Occasionally it may hybridize with *V. rostrata*, producing intermediate forms, discussed under that species.

Viola striata is a very weedy species, found usually in the open or in light shade beside ditches and streams, often very abundantly. Individual plants may be very bushy, with two dozen or more flowering stems. *Viola striata* is placed with the stemmed blue violets because it appears to be more closely related to them both morphologically and genetically than to the stemmed white violets, which it resembles in petal color. It has been observed to hybridize with stemmed blue violets but not with stemmed white species.

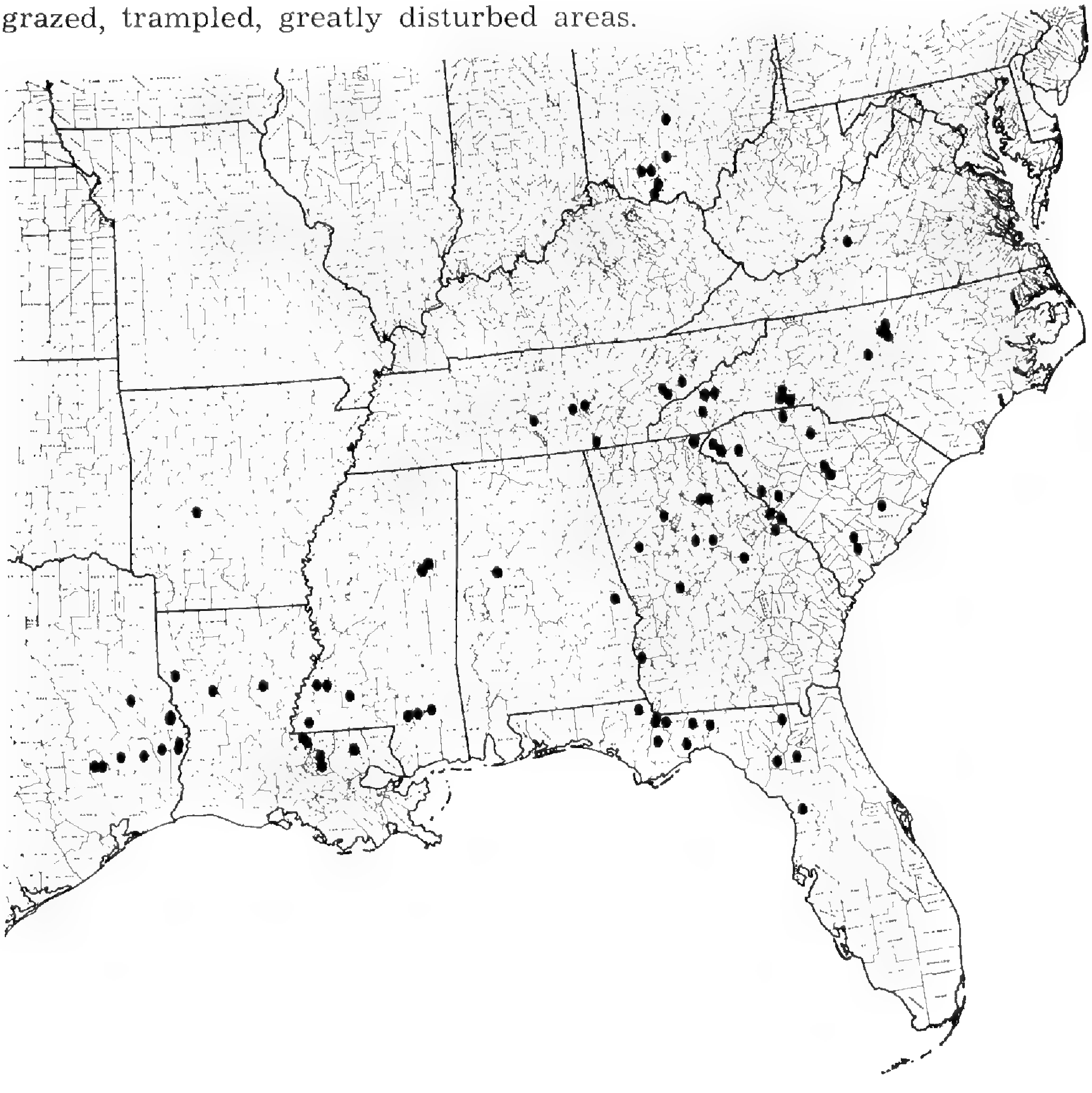


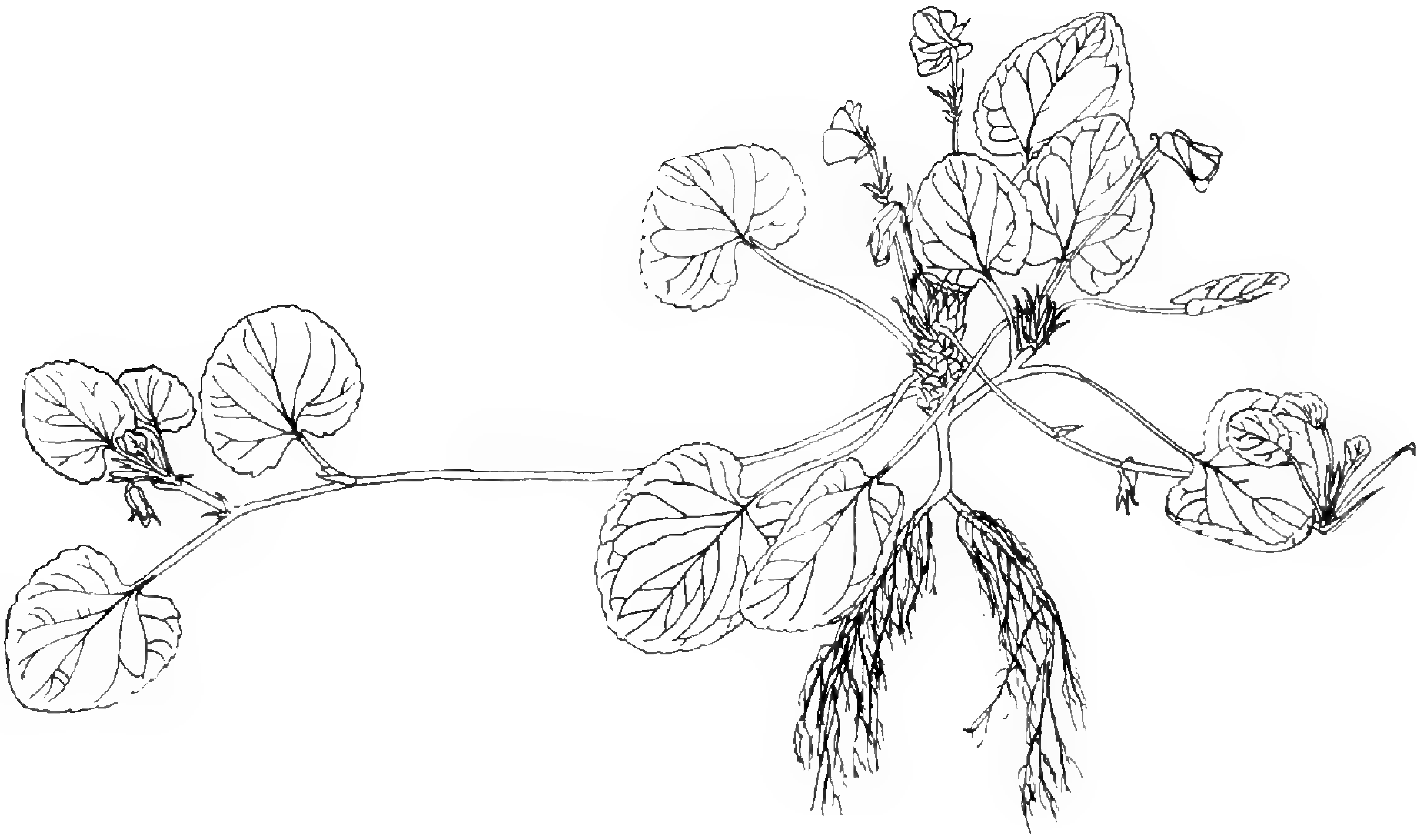
6. **Viola walteri** House, Torreya 6: 172. 1906.

I consider this to be one of the most beautiful of the violets, particularly when seen on rich wooded slopes in Georgia and northern Florida in late spring or summer. It sends out long stolons which root at the nodes and send up new crowns. Frequently the leaves, especially the veins, become suffused with purple, adding to its attractiveness.

It is probably closely related to *V. conspersa* with which it intergrades both in the mountains of southeastern Tennessee and in southern Ohio. Many specimens from these areas are difficult to assign to either species.

Several disjunct and somewhat peculiar colonies of this species occur in northern West Virginia, western Maryland, and southwestern Pennsylvania. I have visited the colonies in Monongalia County, West Virginia and made large collections. These plants have been given the names of *V. appalachiensis* and *V. allegheniensis* and were earlier thought to be *V. labradorica* (Platt, 1950). In the field the specimens appeared to me to be either depauperate plants of *V. conspersa* or *V. walteri* bordering on *V. conspersa*. The plants grew in open or partly shaded, grazed, trampled, greatly disturbed areas.



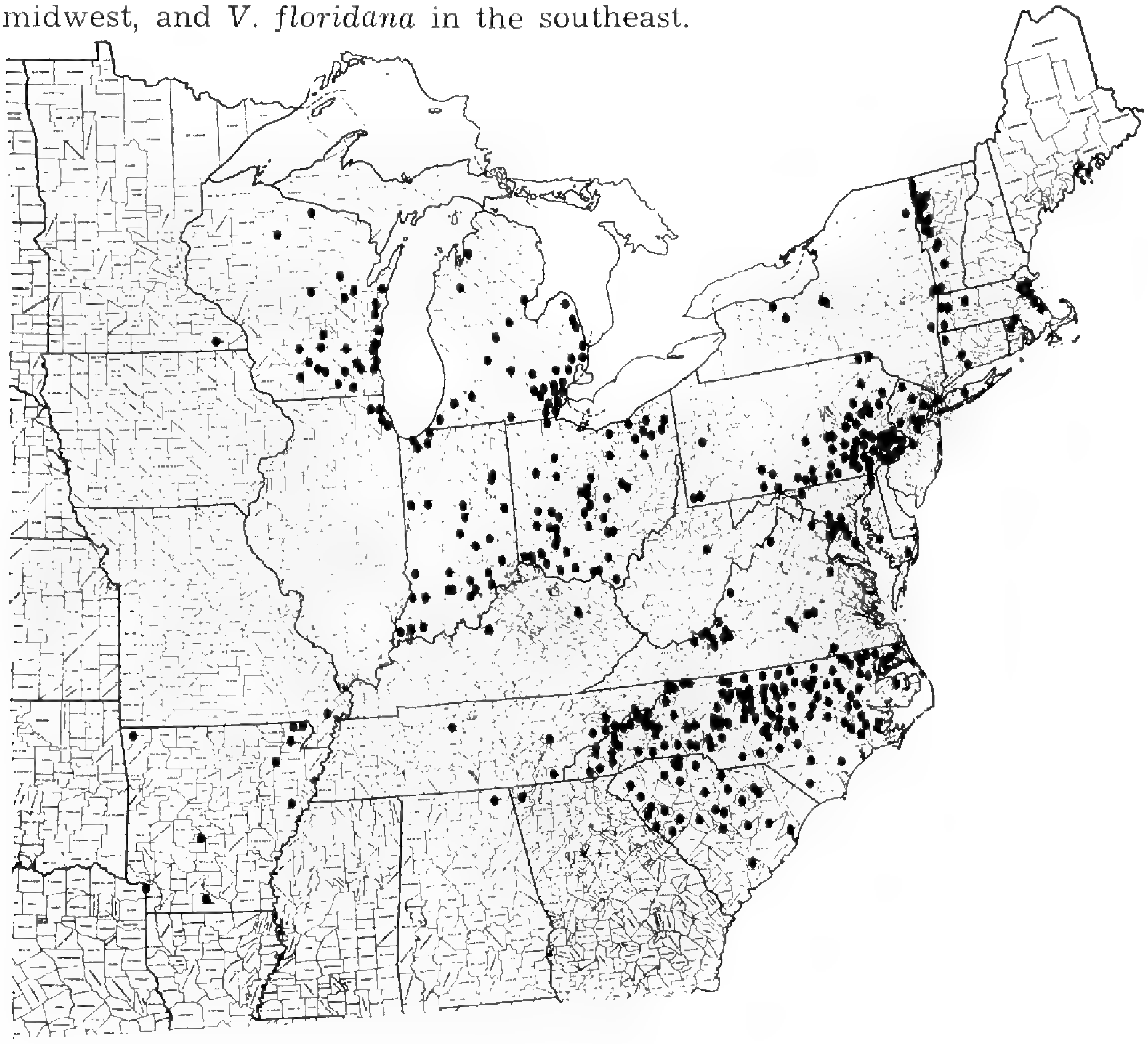


GROUP II. STEMLESS BLUE VIOLETS.

7. **Viola affinis** LeConte, Ann. Lyc. N.Y. 2: 138. 1826.

Viola affinis is one of the commonest of northeastern violets, much more so than has been supposed by most taxonomists. One reason for this is that many specimens of the mythical eastern *Viola papilionacea* (see discussion of *Viola pratincola)* actually belong to *V. affinis.* Because of its similarity to some other species, notably *V. sororia, V. nephrophylla,* and *V. cucullata,* it is often misidentified. It is found in deciduous woodlands, not in open fields or bogs as *V. nephrophylla* and *V. cucullata* often are. It also differs from both these species in having the peduncles about equalling (not exceeding) the petioles, and the cleistogamous fruits on prostrate (not erect) peduncles. It differs from *V. sororia* most markedly in pubescence. *Viola affinis* has conspicuous areas of stiff, scattered white hairs on the upper surfaces of the basal lobes of the leaf, a condition never found in *V. sororia,* in spite of the many leaf pubescence patterns of this species.

Viola affinis is a member of a complex which consists of five fairly well-marked violets. In this work I continue to treat them as species, though eventually it may be more useful to consider them subspecifically. They are: *V. affinis* in the northeast, *V. missouriensis* in the midwest, *V. viarum* in the far midwest, *V. langloisii* in the southern midwest, and *V. floridana* in the southeast.



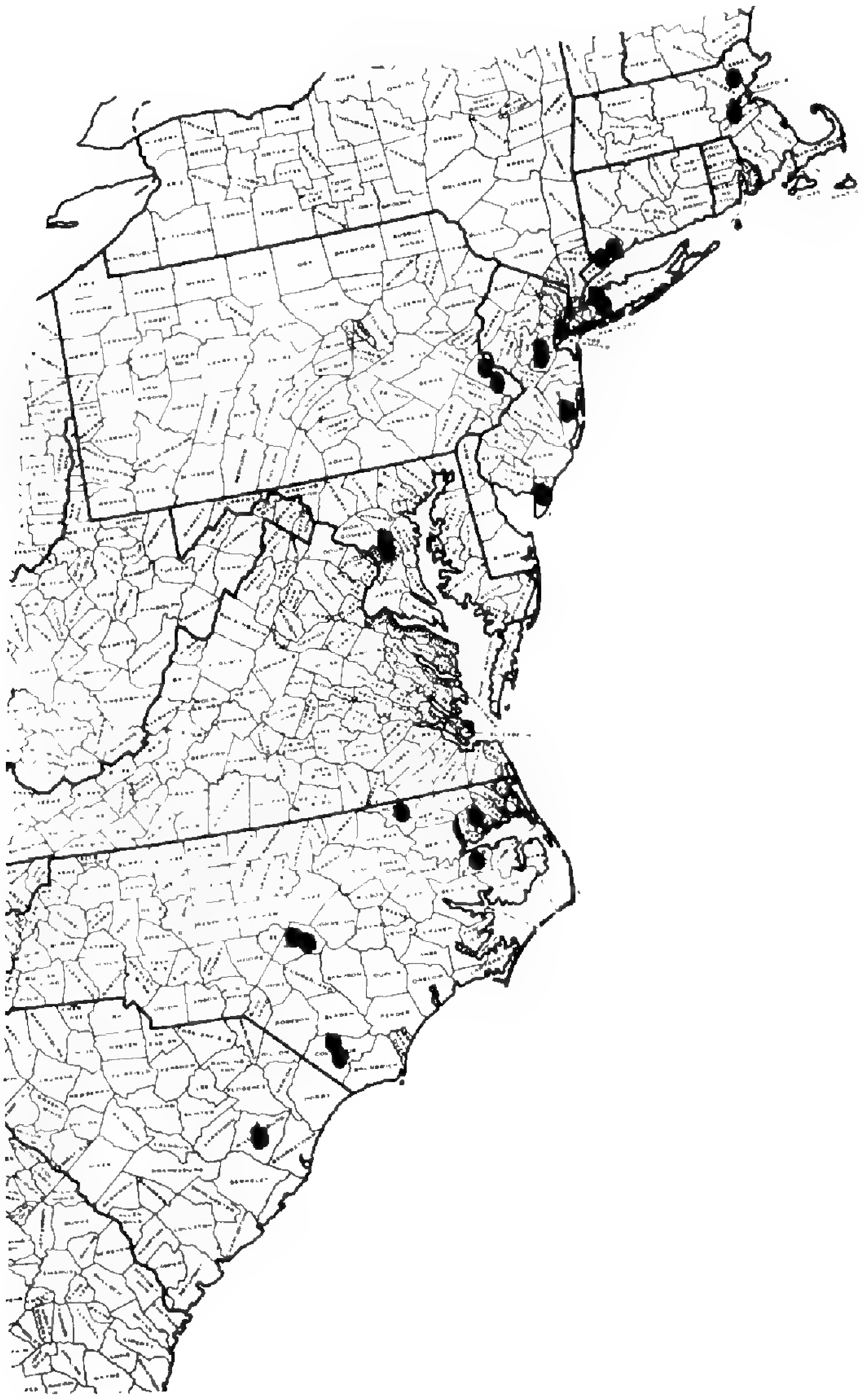
In the maps the range limits of each species are provisional and arbitrary. Where any one of these meets another, there is an insensible intergradation, and annotations of specimens are arbitrary. In western Indiana and Illinois, *V. affinis* and *V. missouriensis* grade into each other, and in southern North Carolina and South Carolina *V. affinis* and *V. floridana* are virtually indistinguishable.

Fernald (1950) lists eleven other species with which V. *affinis* has been said to hybridize. A particularly frequent hybridization with V. *sagittata* gives rise to many of the plants previously called V. *emarginata* (see excluded species).

Viola rosacea Brainerd differs from typical V. *affinis* only in petal color, a richer, reddish purple. Color forms such as this are frequent among the stemless blue violets and do not, in my opinion, deserve names unless they are accompanied by other differences. I have seen Brainerd's specimens from Mississippi and have collected, with Prof. Joseph Ewan, in the vicinity of Crowley, Louisiana, the type locality.

8. **Viola brittoniana** Pollard, Bot. Gaz. 26: 332. 1898.

This interesting violet is found occasionally on the northeastern coastal plain, where it replaces the southeastern V. *septemloba*. *Viola brittoniana* occurs as far south as Orange County, North Carolina, where I have collected it in sandy soil beside a stream.

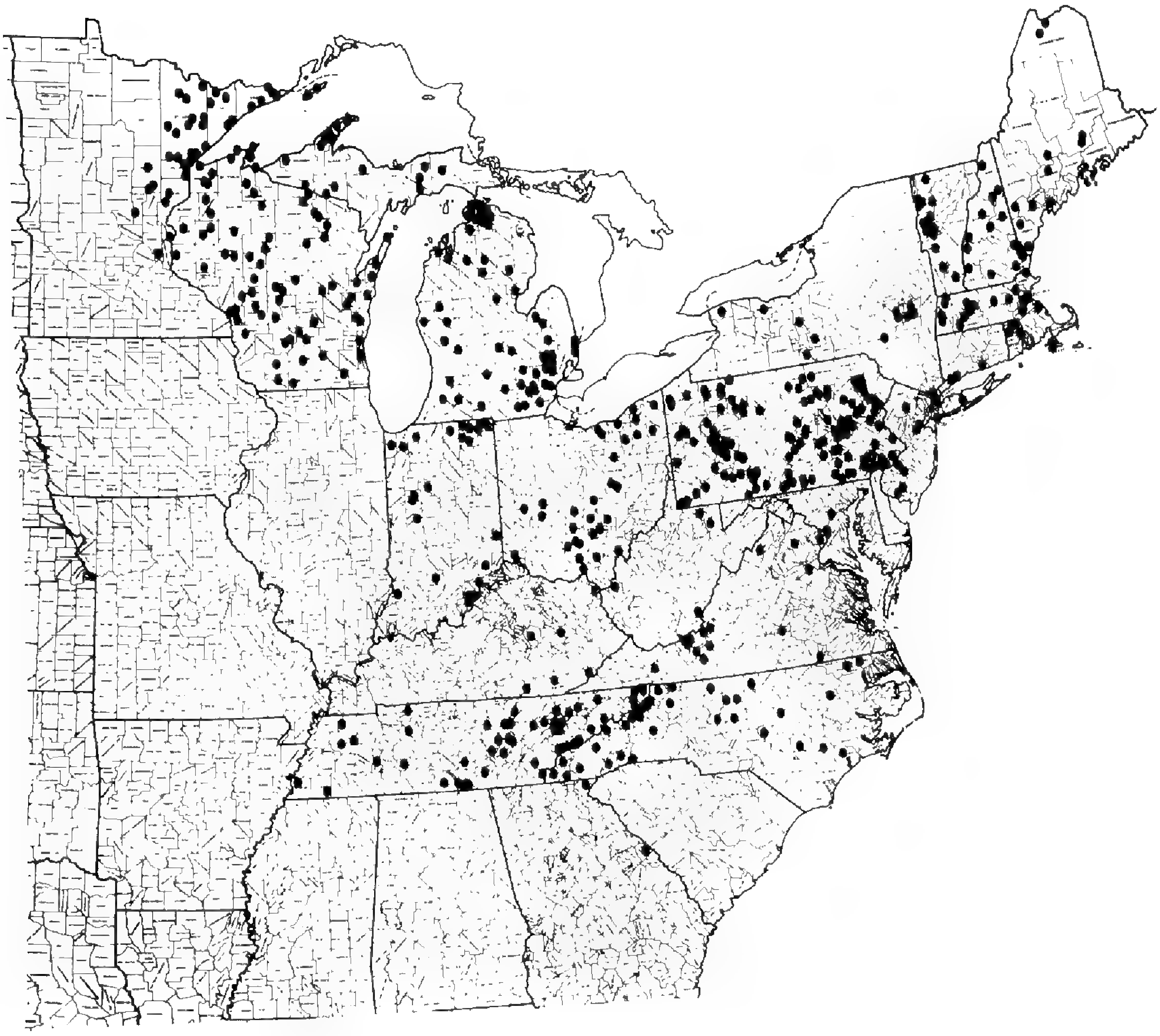


Sometimes growing with the typical plants with their deeply dissected leaves are plants with elongated, triangular leaves with especially deep crenations near the base (pectinate). They resemble some of the *V. sagittata* hybrids that have gone under the name of *V. emarginata* (see excluded species). Presumably this is not a case of hybridization but instead of genetic dimorphism.

9. **Viola cucullata** Ait., Hort. Kew. 3: 288. 1789.

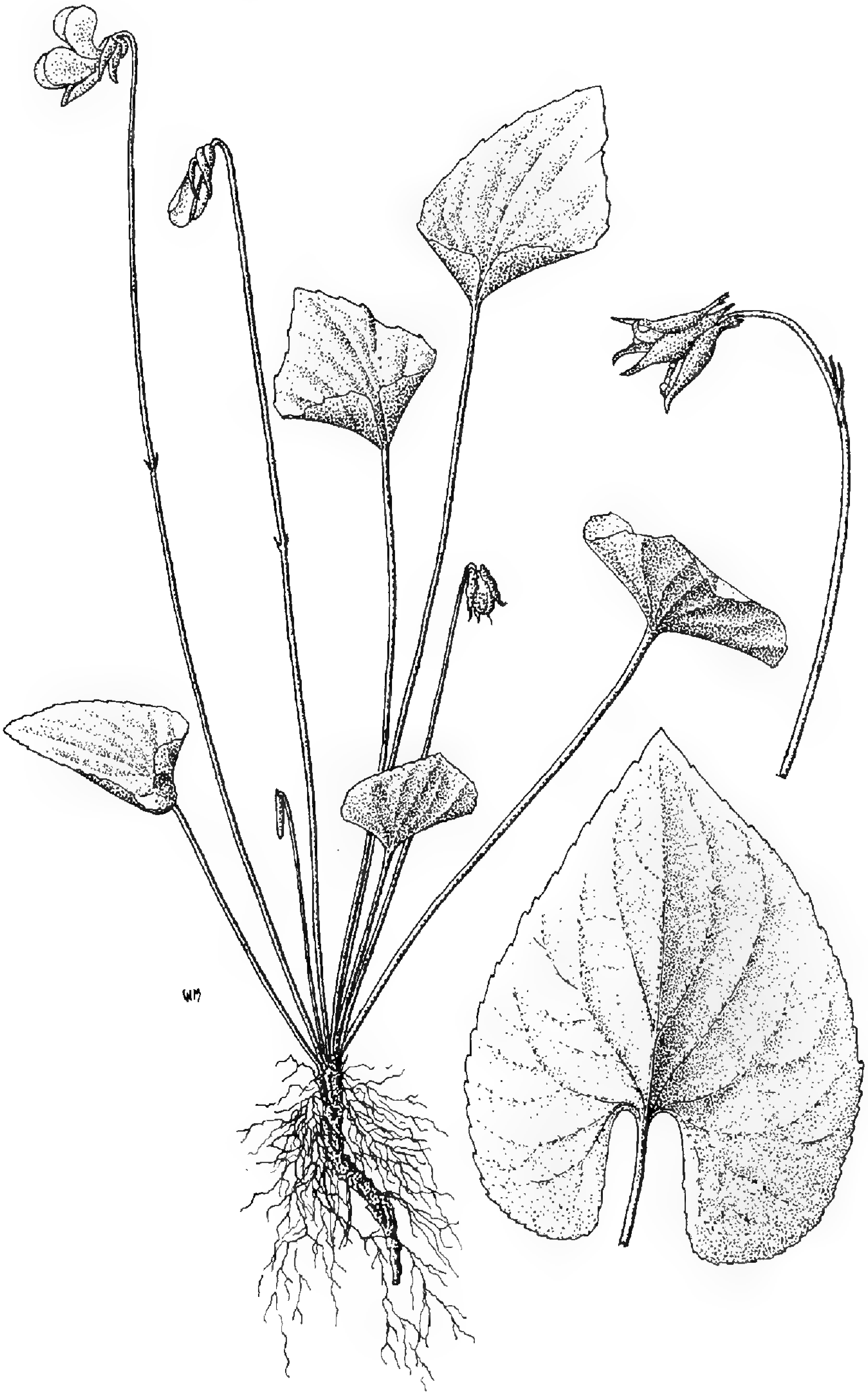
This is one of the most familiar, beautiful, and distinctive of eastern violets. It is sometimes called the bog violet. It occurs in a variety of habitats, all moist; these include true bogs, swampy areas both open and forest, and sandy soil and rock crevices beside creeks through deciduous and evergreen forests. It may be distinguished by light blue flowers on very long peduncles (in shaded areas), which somewhat surpass the petioles in spring. The lateral petals have conspicuous beards of knobbed (clavate) hairs. The cleistogenes are sagittate, and the sepals have pronounced posterior extensions or spurs. Leaf blades tend to be cordate to slightly reniform. The leaves do not grow to the large size of such species as *V. sororia* in the late summer.

Viola cucullata is known to hybridize with many other stemless blue violets when it grows near them. It is frequently strongly modified as a result of this. For example, on the Helderberg Plateau in eastern New York, it commonly hybridizes with *V. septentrionalis* and has been greatly changed as a result of much introgression (Russell, 1955c). I found no pure populations of either species in this region, though I



analyzed samples of 32 populations. Species distinctions between the two were virtually eliminated there. In addition hybrid swarms between *V. cucullata* and *V. fimbriatula* or *V. sagittata* are occasionally found in the eastern states. The purest or least genetically disturbed *V. cucullata* plants I have seen were at the summit of Roan Mountain, Carter County, Tennessee, where no other stemless blue violets grew.

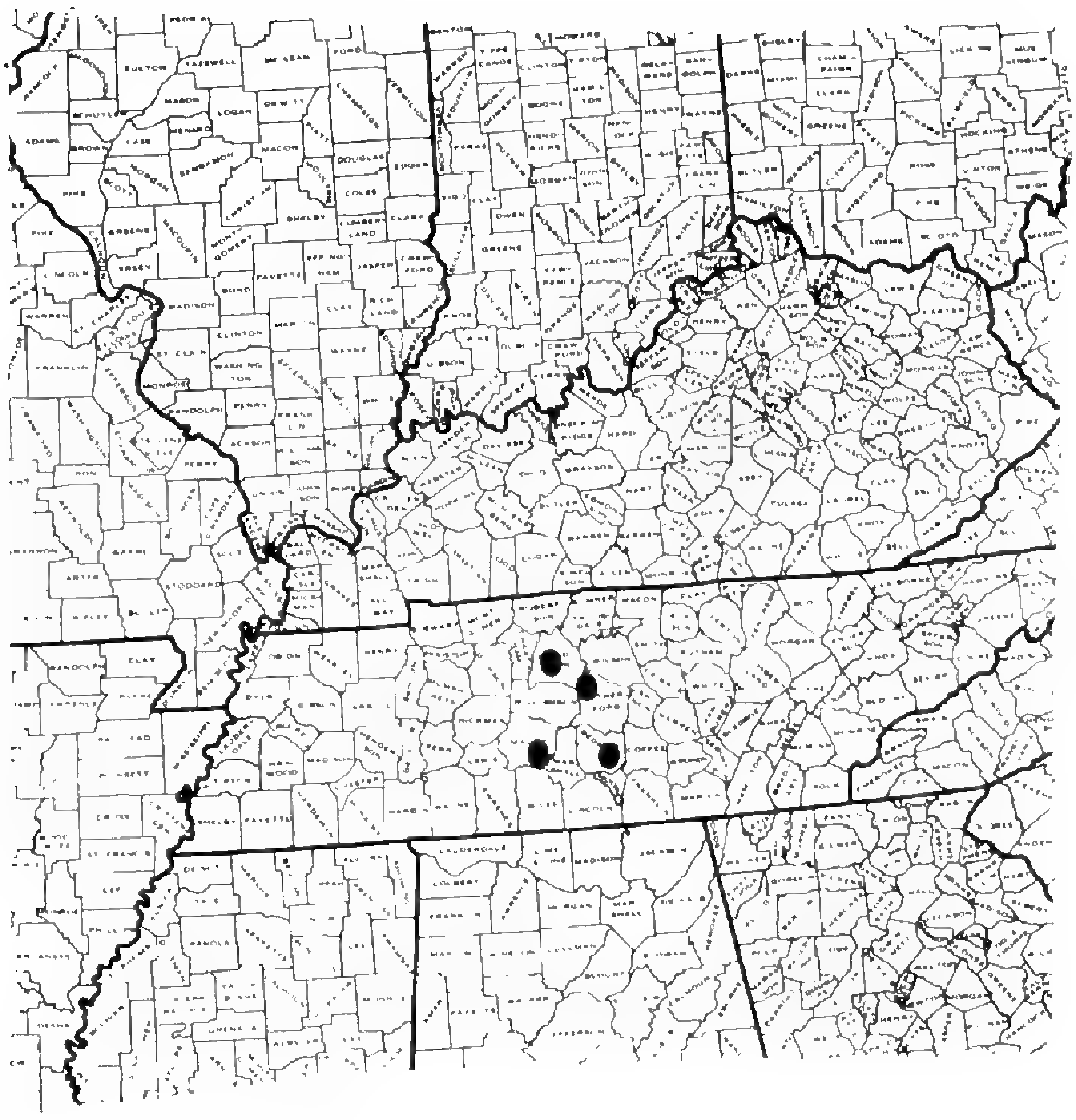
Viola cucullata is replaced in the midwest by *Viola pratincola,* with which it intergrades along the zone of contact. This will be discussed in more detail under *V. pratincola.*



10. **Viola egglestonii** Brainerd, Bull. Torr. Bot. Club 37: 526—527, pl. 34, 35. 1910.

This rare and peculiar violet has been found only in the cedar barrens of central Tennessee, where it is not at all common. I have visited this area and with the aid of Dr. Ben Channell found and sampled populations near Nashville. Brainerd (1921) cites a specimen from Bowling Green, Kentucky, which I have not seen or mapped.

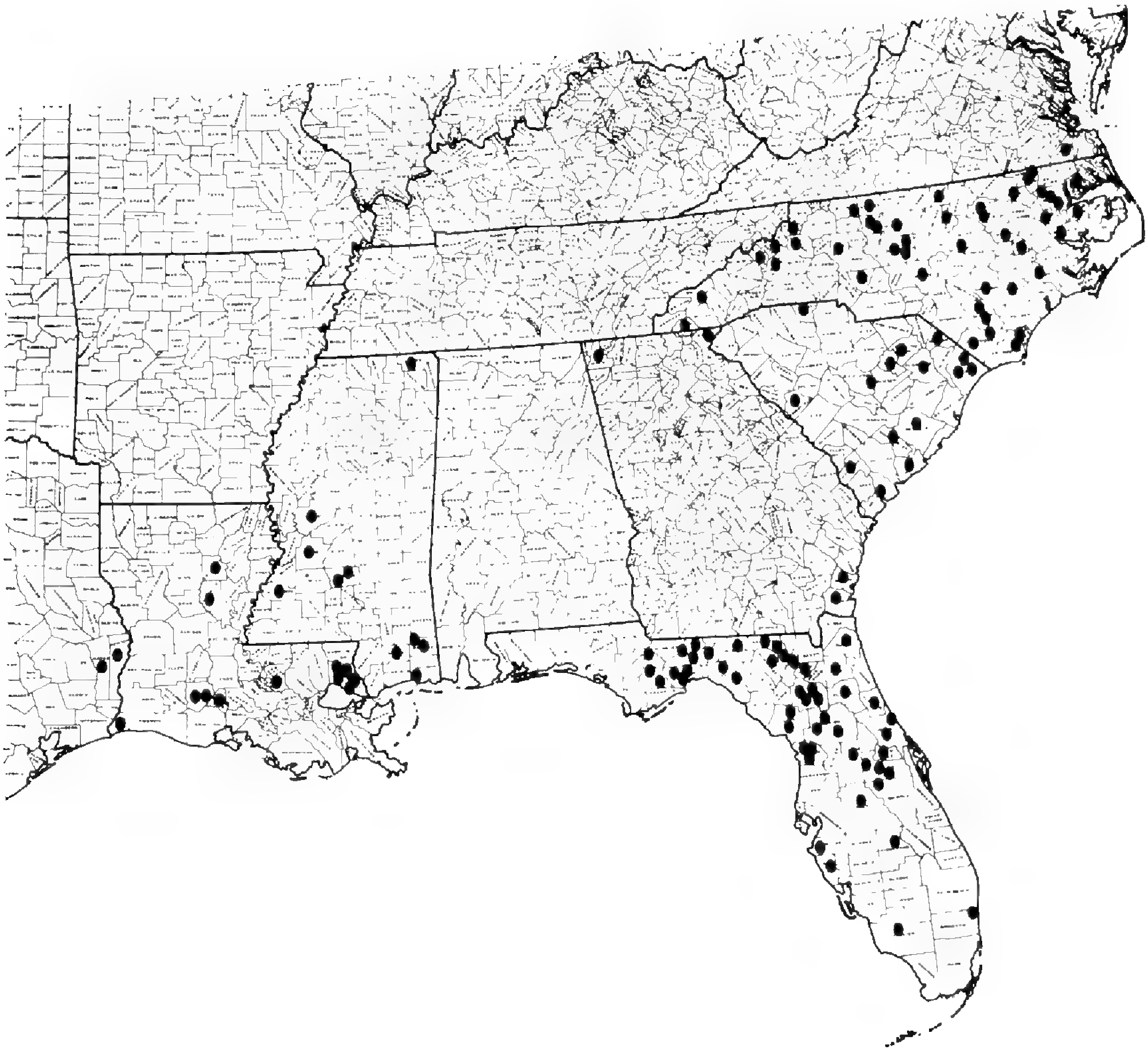
This species is not very similar to other stemless blue violets. Morphologically the leaves resemble most closely those of *V. septemloba* in their lobing pattern, but there are many differences.



11. **Viola esculenta** Ell., Sketch Bot. S.C. & Ga., 1: 300. 1817.

Viola esculenta is common on the southeastern coastal plain, where it may be confused with *V. septemloba*. It differs in the shape of the leaf lobes. The lobes of the leaves of *V. esculenta* are broadly obovate and usually only 3 or 5 in number; *V. septemloba* commonly has 7-9 slightly oblanceolate lobes. The two species often grow side by side, but I have seen no evidence of natural hybridization between them. However, I do believe that *V. esculenta* hybridizes with *V. floridana*, and that this is responsible for the many variations in leaf lobing.

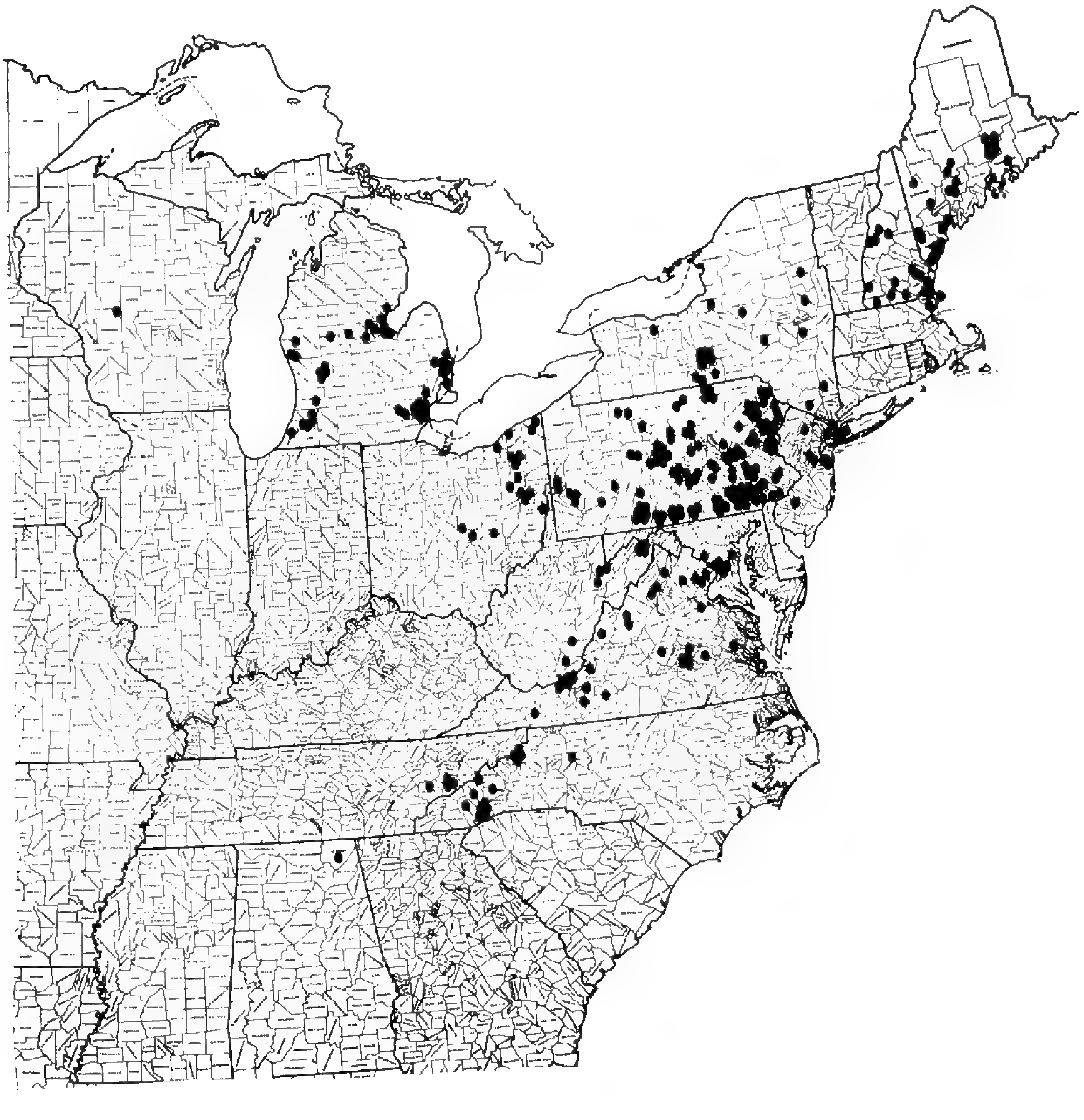
The leaves of *V. esculenta* occasionally tend to be slightly succulent and the sepals may have spurs or auricles which are long and emarginate, but I have not found either of these to be very reliable characteristics. Its closest morphological relative may be *V. floridana*.



12. **Viola fimbriatula** J. E. Smith in Rees, Cyclopaedia 37: Viola no. 16. 1817.

My observations of herbarium specimens and field populations of this species have led me to believe that it is more distinct than has been supposed. Brainerd (1921, 1924) remarked upon its "confluence" with *V. sagittata* and analyzed cases of hybridization between the two species. More frequent than hybrids in nature, I believe, are dwarfed specimens of *V. sagittata* which can be mistaken for *V. fimbriatula* or for hybrids.

The two species differ in several characters. *Viola fimbriatula* has leaves with the blades sometimes twice as long as the stunted petioles; *V. sagittata* has, at least in late spring and summer, petioles several times as long as the blades. The mature blades of *V. fimbriatula* are usually only obscurely toothed at their bases; those of *V. sagittata* are deeply toothed. The plants of *V. fimbriatula* are heavily pubescent with long hairs; those of *V. sagittata* less pubescent to glabrate, with shorter



hairs. *Viola sagittata* is usually found growing in moist, sandy fields in full sunlight. *Viola fimbriatula* is more at home in open forests or at the edges of forests. In the southern Appalachians, *V. fimbriatula* is found at higher elevations. I would suspect that *V. fimbriatula* has a mountain ancestry and *V. sagittata* a coastal plain and piedmont history.

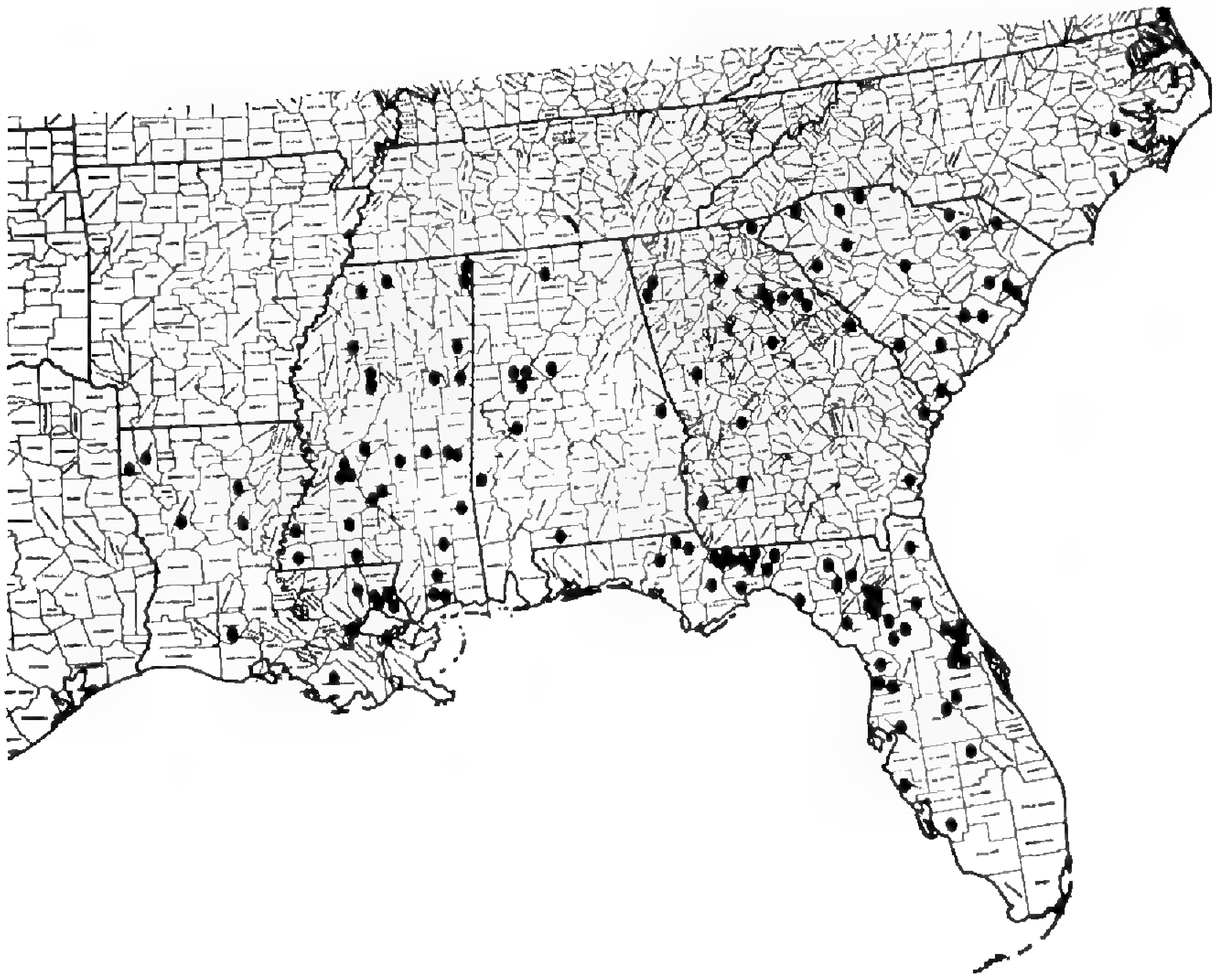
Viola fimbriatula may hybridize with several other stemless blue violets in nature, notably *V. cucullata* and *V. septentrionalis* in northeastern United States (Russell, 1955c).

13. **Viola floridana** Brainerd, Bull. Torr. Bot. Club 37: 524. 1910.

The southeastern member of the *V. affinis* group (see that species for discussion) is a beautiful violet found most abundantly in Florida. *Viola floridana* is very similar to *Viola affinis,* differing in having slightly smaller leaves, these slightly fleshy, and with flowering peduncles distinctly overtopping the leaves. To the west the plants become smaller and pass into *V. langloisii.* To the north, *V. floridana* grades into *V. affinis* in South and North Carolina.

Identification of *V. floridana* on the southeastern coastal plain is often complicated due to occasional hybridization with the cut-leaved *V. esculenta.* Both species show the effects of introgression. In addition it may occasionally hybridize with *V. sororia.*

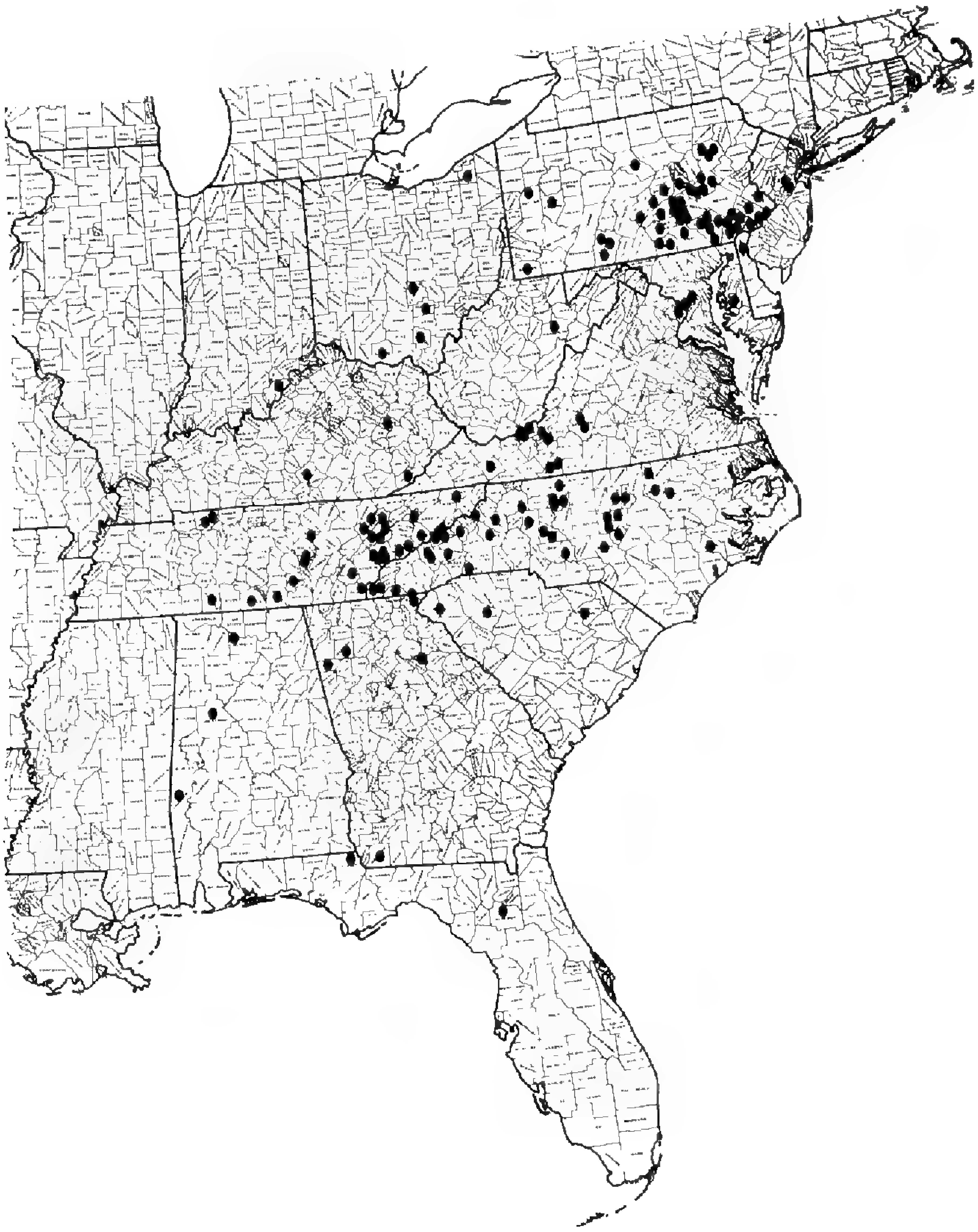
I have examined the type of *V. chalcosperma* Brainerd and other specimens from the type area, and I am unable to separate it from *V. floridana.* Some seeds do tend to a bronze color, but this is a quantitative difference and hardly sufficient to distinguish a species.



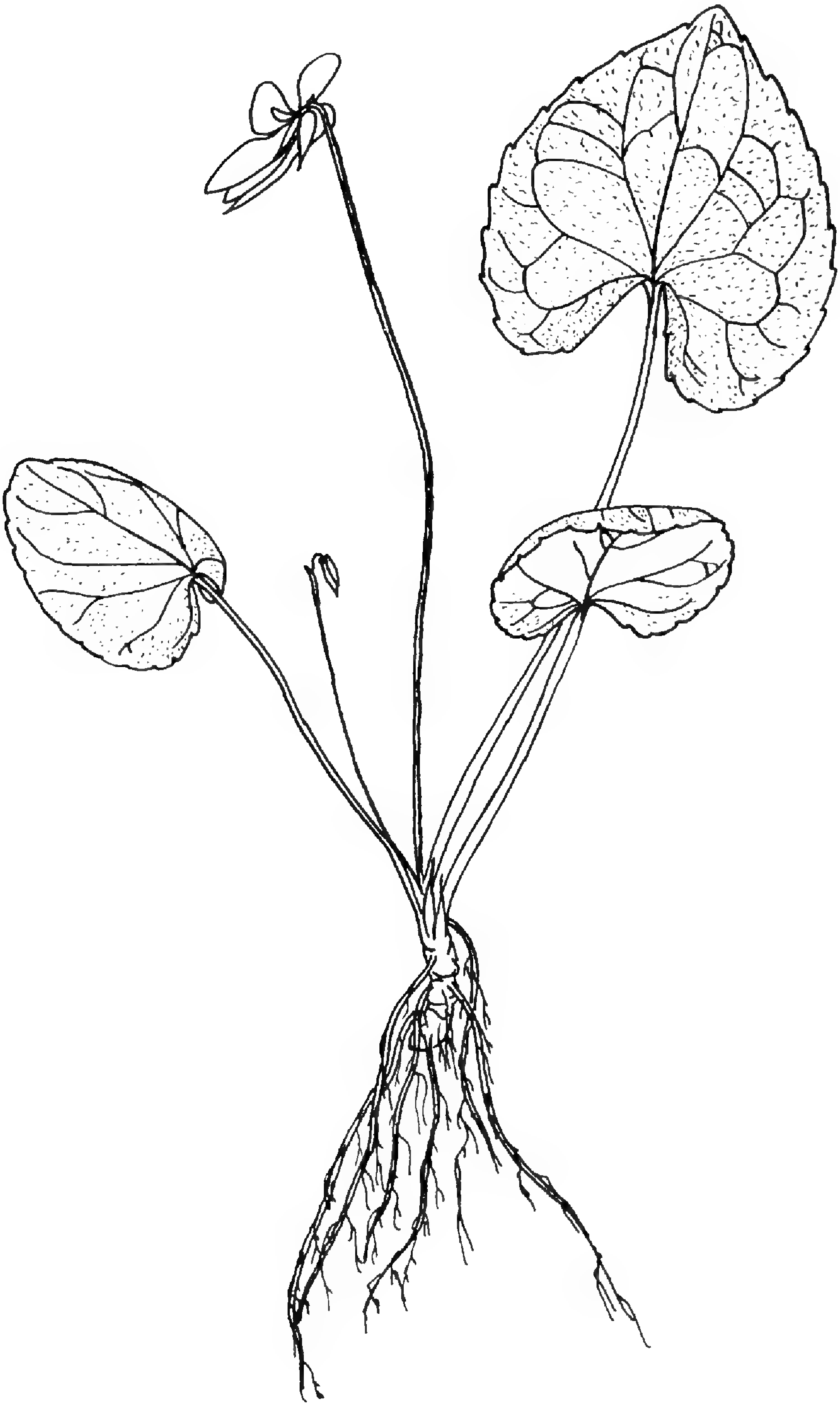
14. **Viola hirsutula** Brainerd, Rhodora 9: 98. 1907.

Viola hirsutula is one of the most attractive of the violets when it is not affected by hybridization. The oval leaves have the veins suffused with purple and are covered with a thick mat of stiff white hairs on their upper surfaces. In Tennessee and Virginia I have learned to look for it in old, relatively undisturbed pine forests. Farther northward it may occur in rich, relatively dry, deciduous forests. Usually it occurs sparingly, as scattered plants, but occasionally may form most of the carpeting of a forest. It had a long and tortuous nomenclatural history which was reviewed by Brainerd (1921). It is difficult now to understand how it could have been confused with the very different *V. villosa*, with which it sometimes grows in the southeast.

Viola hirsutula appears to be quite distinct from other stemless blue violets. It certainly does not closely resemble *V. sororia* and *V. villosa*, with which it has been confused. To me it is most similar morphologically to *Viola nephrophylla* of the north and west.



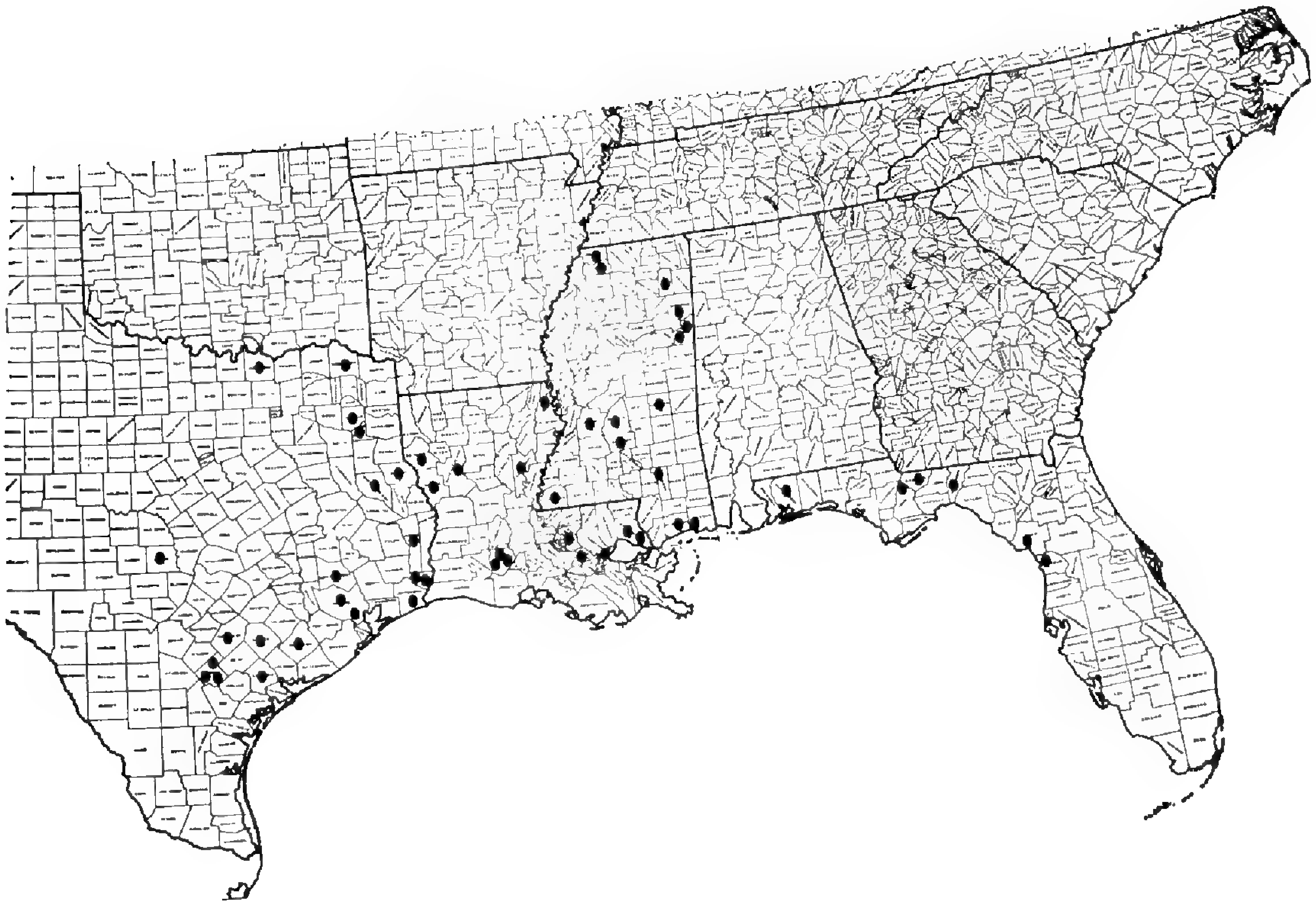
This species frequently hybridizes with other stemless blue violets (see Brainerd, 1924), producing sometimes an interesting display of backcrosses, particularly when its partner is a cut-leaved species.



15. **Viola langloisii** Greene, Pittonia 3: 87. 1896.

Brainerd (1921) remarks that V. *langloisii* is closely related to V. *affinis*. It is even more similar to V. *missouriensis*, from which it can hardly be separated in Texas and western Louisiana. Farther to the east, it grades into V. *floridana* in Mississippi and west Florida.

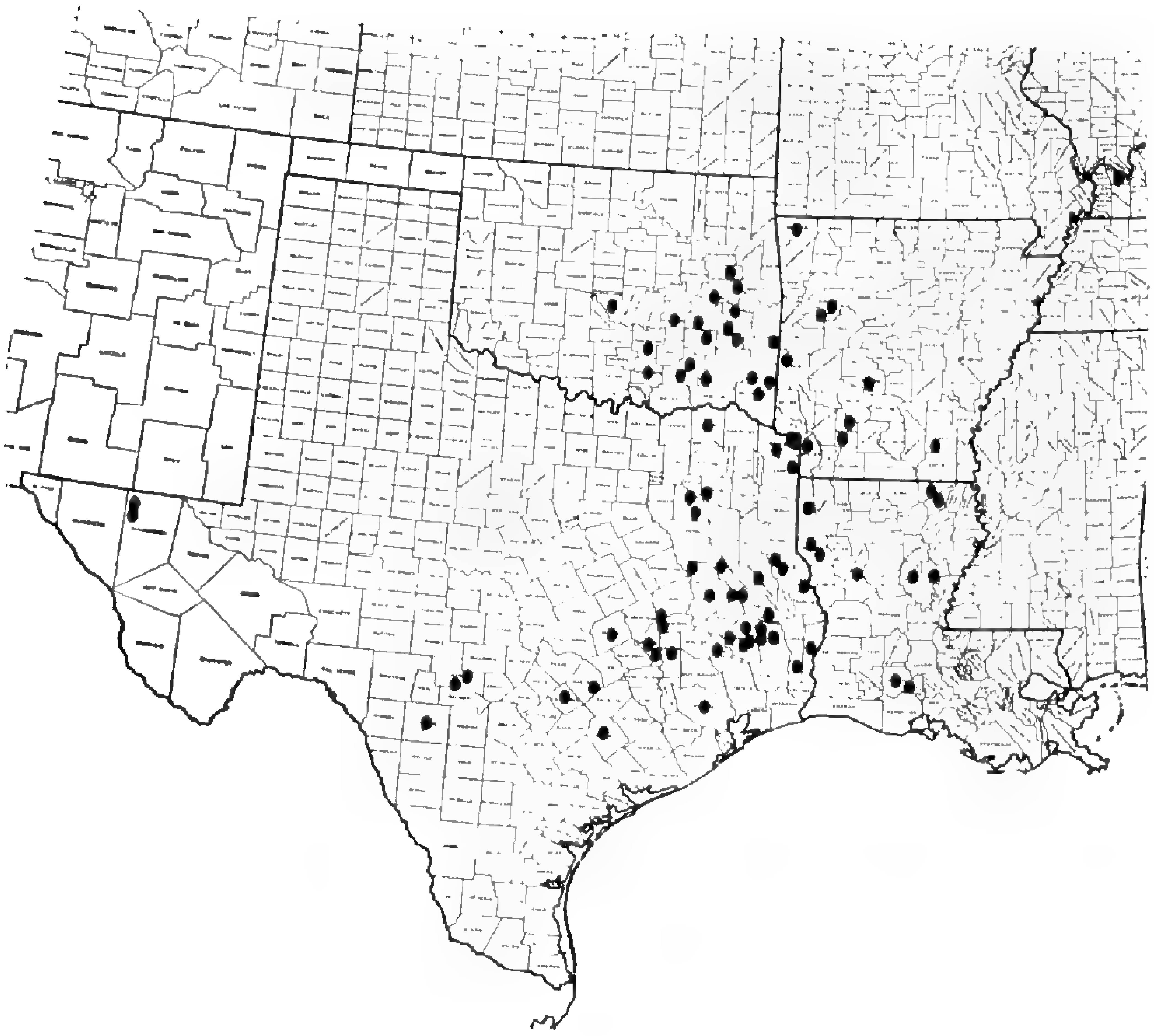
Its distinguishing features are the tiny, triangular leaves and the flowering peduncles two or three times as long as the leaf petioles. I have no drawing of it. The reader is referred to Brainerd's excellent plate (Brainerd, 1921, Species No. 18, page 50).



16. **Viola lovelliana** Brainerd, Bull. Torr. Bot. Club 37: 526. 1910.

In the southwest the *Viola sagittata* complex is represented by a small, distinctive violet first recognized and named by Ezra Brainerd. The type locality is near Crowley, Louisiana, where I have also collected it. Northward it grades into *V. sagittata*, not into *V. triloba*, as Brainerd (1921) suggested. Its leaves tend to become more triangular with a lessening of the pronounced basal lobing. It does not have the heavy, long pubescence of *V. triloba* and *V. sororia*, instead being puberulent or glabrate, as *V. sagittata* is in this area.

Viola lovelliana grows in open, disturbed forests of pine and mixed hardwoods, often with such other violets as *V. villosa*, *V. walteri*, and *V. langloisii*. I do not know whether or not it hybridizes with them. My limited observations suggest that it does not.

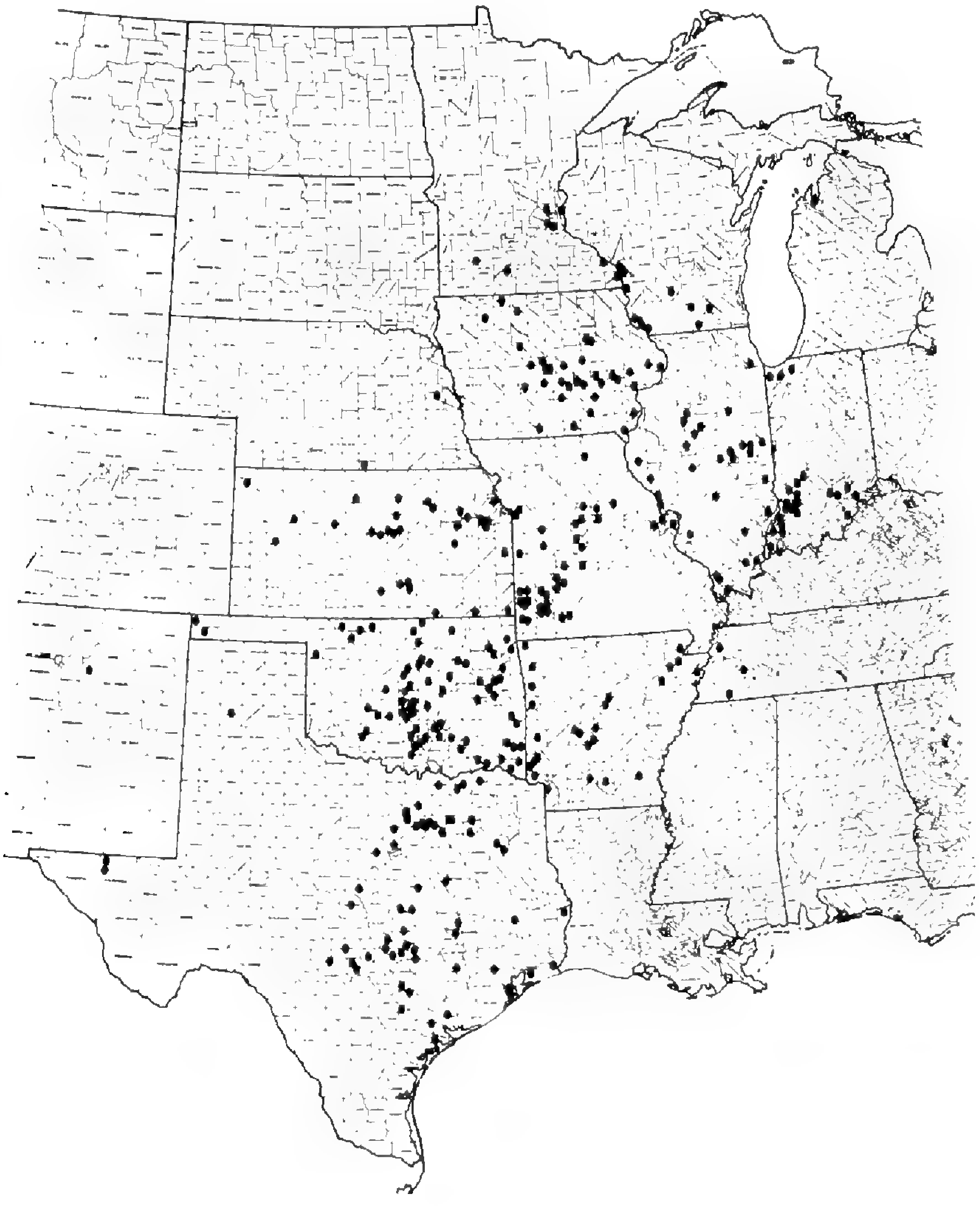


17. **Viola missouriensis** Greene, Pittonia 4: 141. 1900.

This interesting midwestern violet is found abundantly in most of its range in moist creek or river woods, where it grows on sandy or silty floodplain soils. It often forms large, dense colonies. It seems to be especially abundant in forests where cattle grazing has been heavy, perhaps because it has been released from competition with less hardy native species of plants. It is also frequently found as a weed in towns and cities.

In the midwest *V. missouriensis* may be confused with *V. sororia* and *V. pratincola*. Unlike *V. sororia*, its leaves, when not disturbed by hybridization, are entirely glabrous. In addition the leaf shape is distinctive. The apex is bluntly attenuate and the margins of the apical portion have only 1-3 teeth (crenations) on each side. In both *V. sororia* and *V. pratincola*, the number is 8, 10, or greater. *V. pratincola* differs also in having a sharply acute apex and in growing in open, dry, prairie-like habitats, never in stream forests.

In the upper midwest pure populations of *V. missouriensis* are difficult, if not impossible, to find. Growing with *V. missouriensis* in nearly



every creek forest is *V. sororia* Willd., and the two appear to require only physical proximity for hybridization and extensive introgression (Russell, 1958a). Both are markedly affected by this, and it is discussed in more detail under *V. sororia.*

In towns and cities *V. missouriensis, V. sororia,* and *V. pratincola* may grow together as weeds, and all may hybridize, producing bizarre mixtures.

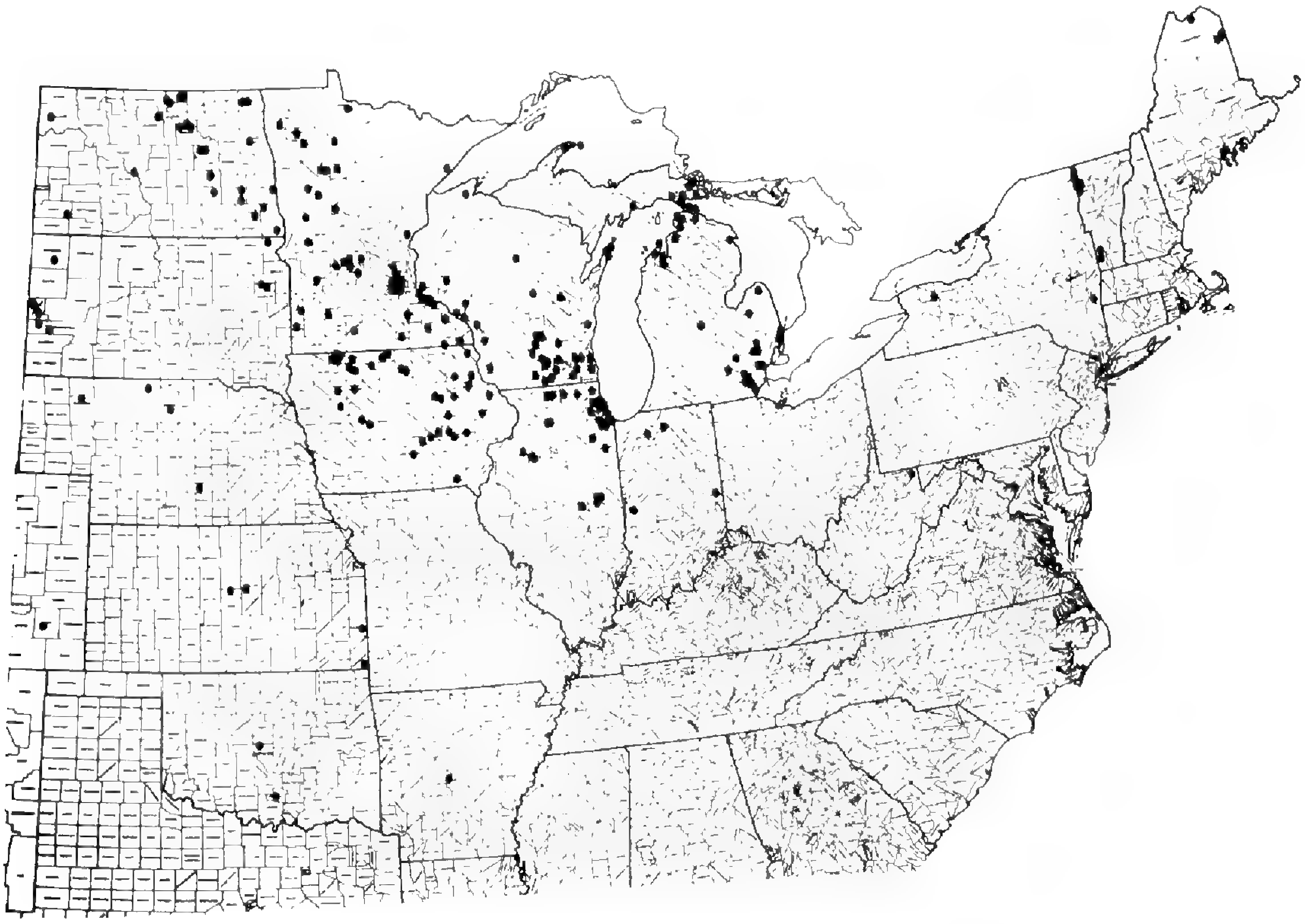
To the west *V. missouriensis* grades into *V. viarum* (se discussion under that species), and to the south it merges imperceptibly with *V. langloisii.* To the northeast, in Wisconsin, Illinois, and Indiana, it merges with *V. affinis.* Its relationships with these species and with *V. floridana* are discussed under *V. affinis.*

18. **Viola nephrophylla** Greene, Pittonia 3: 144—145. 1896.

One of the most widespread of North American violets, *V. nephrophylla* plants vary in leaf form and pubescence and other characteristics from place to place but in a rather haphazard fashion. Variation is greatest in the western mountains where several varieties or additional species were named, principally by E. L. Greene. A detailed analysis of herbarium and population sample material by Frank S. Crosswhite and myself (Russell and Crosswhite, 1963) failed to reveal any justification for the recognition of these names. In eastern and north central United States *V. nephrophylla* occurs along rocky shores and in wet, grazed meadows, always in the open.

Viola nephrophylla has several distinguishing features. In the spring the earliest leaves are oval or slightly reniform and almost invariably purplish underneath (reminiscent of *V. hirsutula*). In the summer the larger leaves are slightly reniform and about half the size of the leaves of other stemless blue violets. The flowering peduncles are about half again as long as the petioles. The spur petal is villous most of the time, but this is not always a reliable characteristic. The leaves have fine hairs on the upper surfaces of the basal lobes and are glabrous elsewhere, a characteristic shared with *V. cucullata*. Other pubescence patterns are found in Rocky Mountan *V. nephrophylla*.

Viola nephrophylla may hybridize with other species, but it does not often grow with them, so hybridization has apparently not yet modified the species. I reported upon a case of hybridization between V.

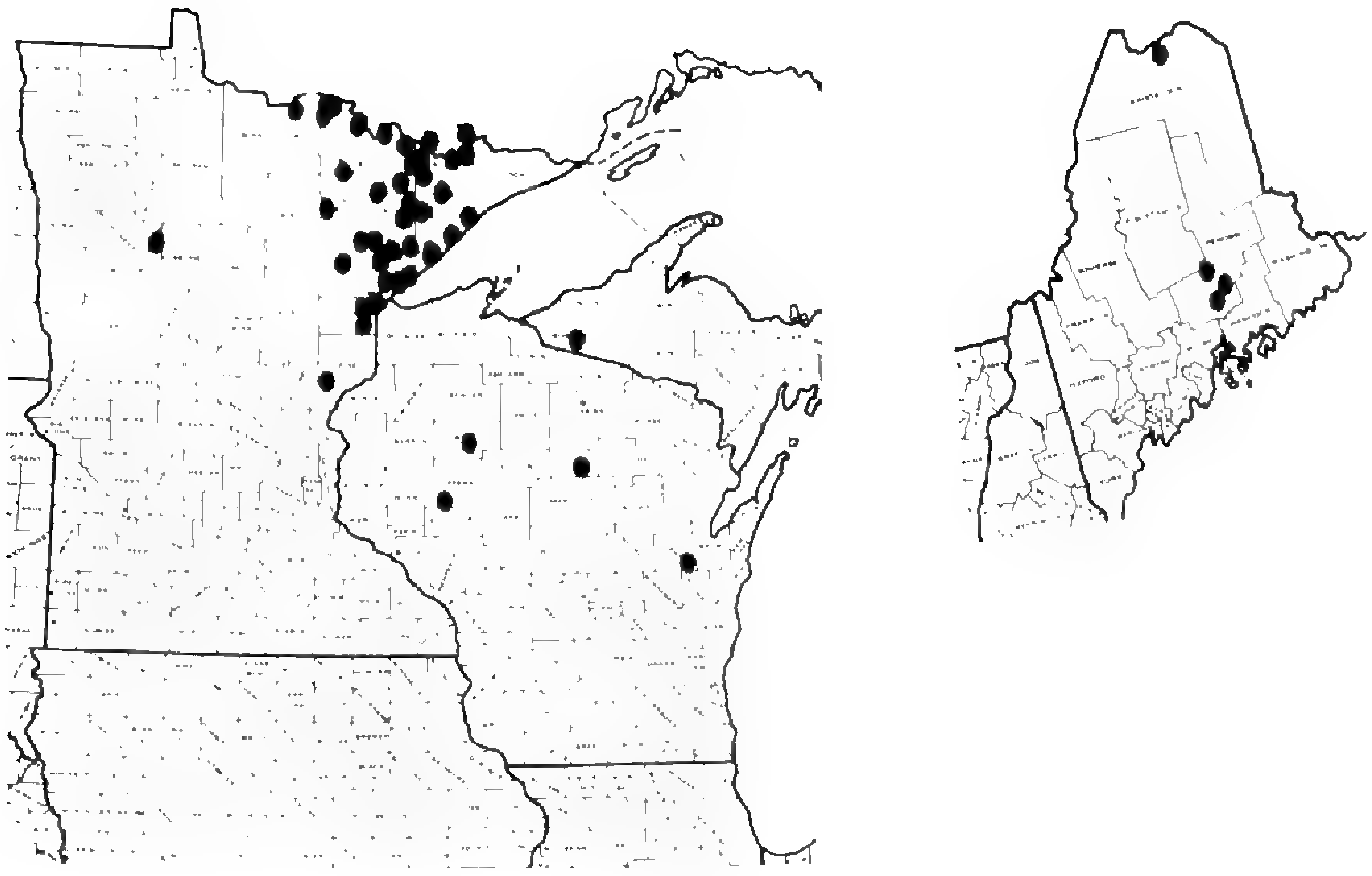


nephrophylla and *V. missouriensis* (mistaken for *V. pratincola* in the study) in southern Minnesota (Russell, 1952), and have seen hybrid swarms with *V. sagittata* in Wisconsin.

Its nearest relative may be the southeastern *V. hirsutula*. However, it is quite distinct from all the other stemless blue violets.

19. **Viola novae-angliae** House, Rhodora 6: 226, pl. 59. 1904.

This species, originally collected in northern Maine, grows best along the north shores of the Great Lakes, in rock crevices along shore, or beside cold, rapidly flowing streams. In northern Wisconsin and Minnesota, where I am most familiar with it, it grades into *V. sagittata*, and the two species are hard to separate. Characteristically its leaf blades are not toothed but small, and somewhat triangular.

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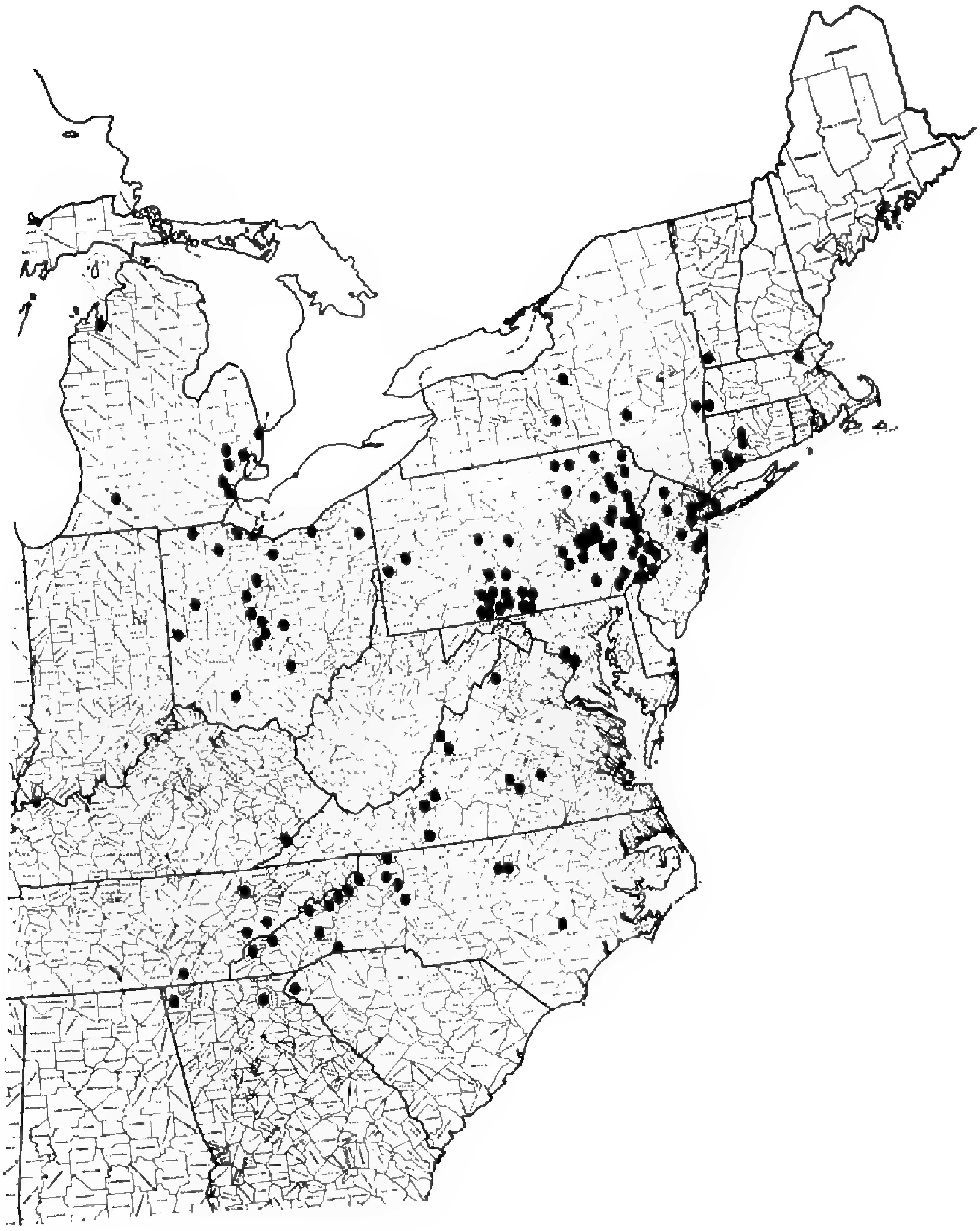
20. **Viola palmata** L., Sp. Pl. 933. 1753.

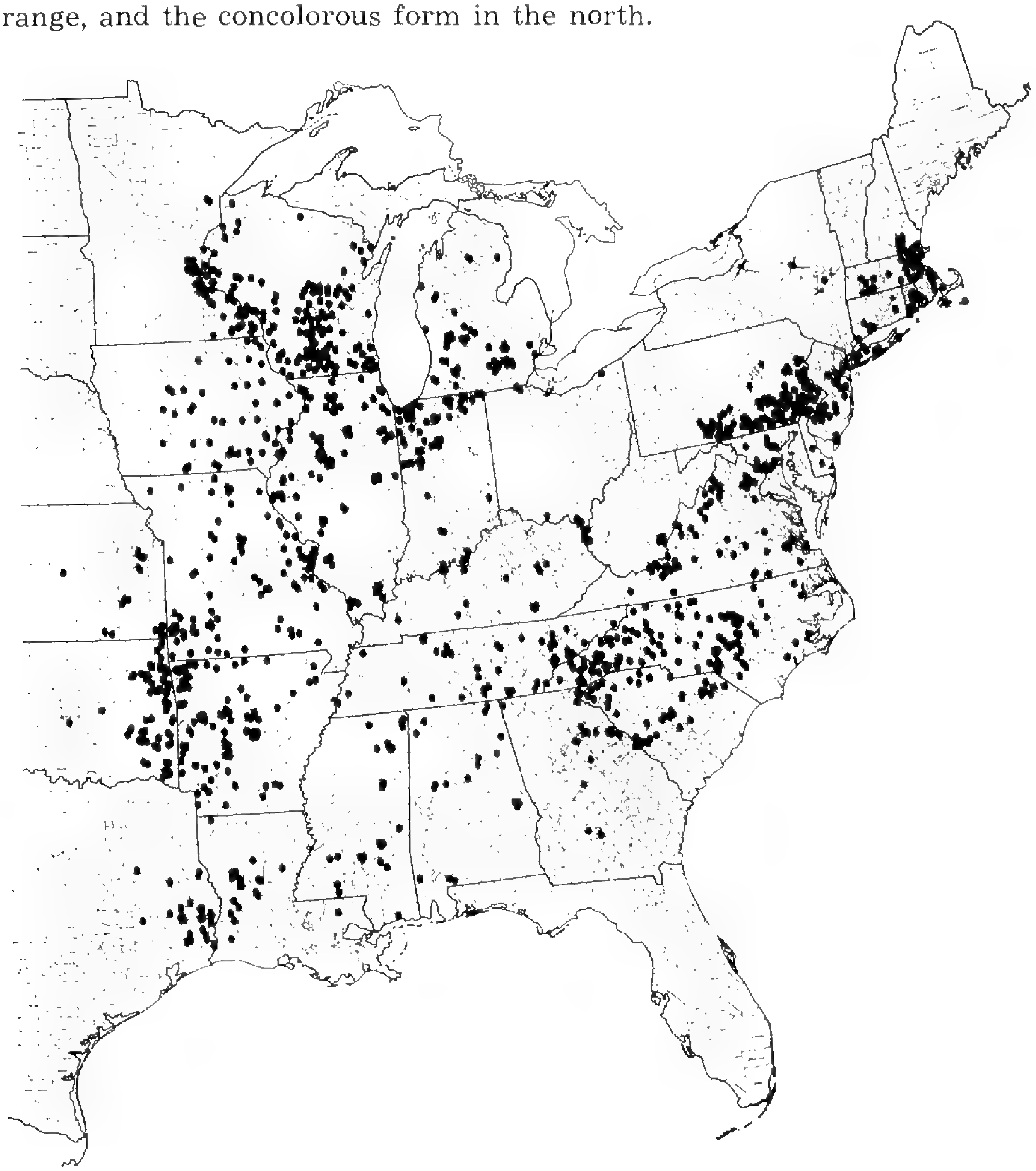
This essentially Appalachian violet is relatively uncommon, occurring occasionally in relatively dry, open, deciduous forests. It may be confused with *V. triloba,* but differs in its deeper, somewhat pinnate lobing. Its similarities to *V. pedatifida,* which replaces it in the midwestern prairies, are discussed under that species. *Viola palmata* may hybridize with other species of stemless blue violets, rendering it difficult to determine. In Brainerd's monograph one of his plates of *V. palmata* (Brainerd, 1921, p. 17, Species 2b) actually portrays a plant of *V. esculenta,* perhaps with some introgression from a pubescent violet.



21. **Viola pedata** L., Sp. Pl. 933. 1753.

The bird-foot violet is the most frequently collected of all eastern violets, as its distribution map illustrates. It is actually less frequently seen in the field than such species as *Viola sororia* and *V. pubescens* var. *eriocarpa* however. It is usually found in open, sandy areas.

Morphologically, it can be distinguished by a short, thick, vertical rootstock, deeply pedately cut leaves, and the absence of cleistogamous flowers during the summer. The petaliferous flowers are exceptionally distinctive. The large, beardless petals assume a flattened aspect, seen elsewhere only in the cultivated pansies. There are two principal types of coloration. At one extreme the top two petals are dark purple, the three lower light blue. At the other extreme all five petals are light blue. The bicolorous form is more frequent in the southern part of the range, and the concolorous form in the north.



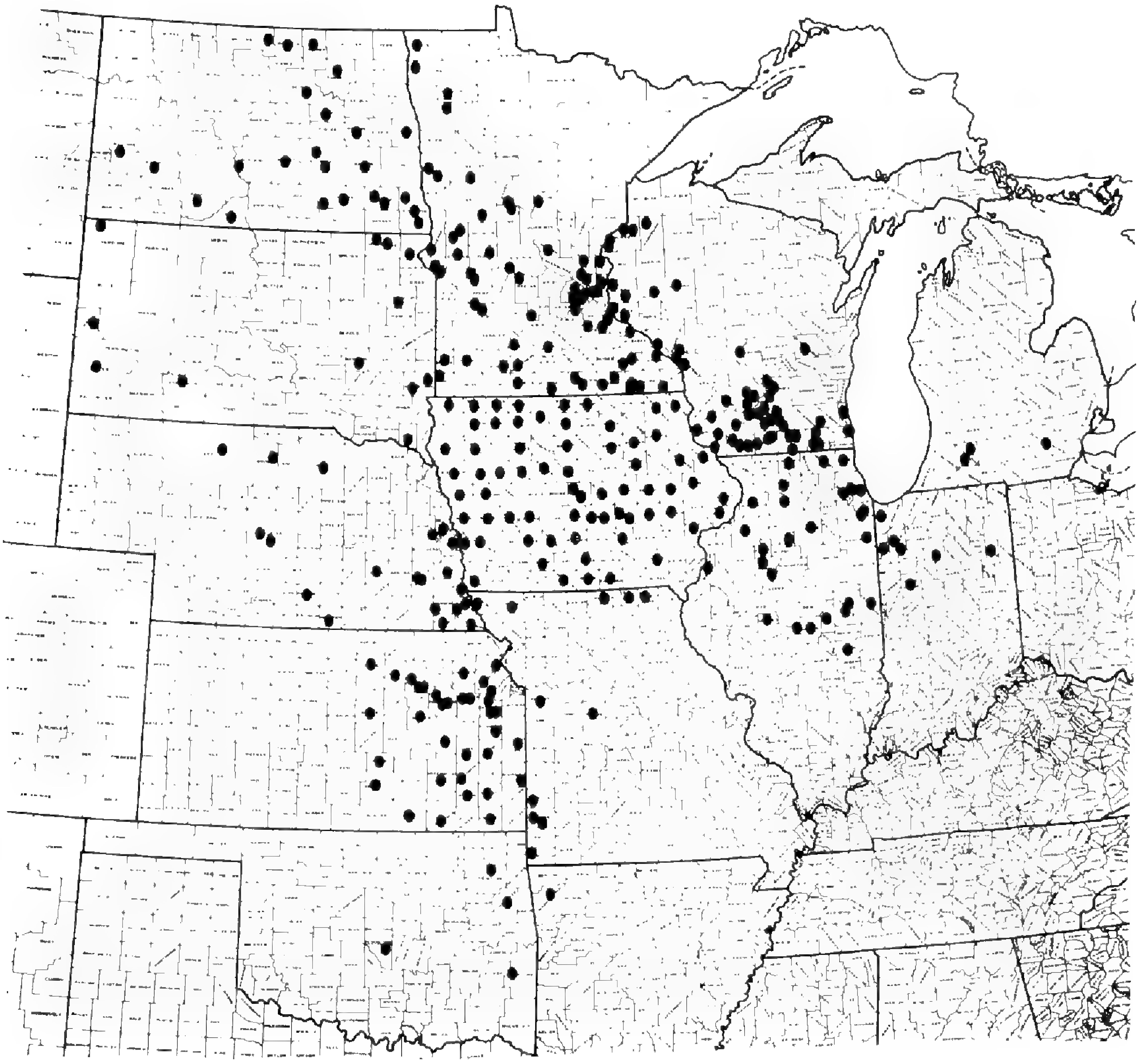
Most taxonomists have considered *V. pedata* to consist of two varieties, *pedata* and *lineariloba*. I have elsewhere discussed the status of these (Russell, 1959). The variety *lineariloba* supposedly designates a northern form with deeply lobed leaves and concolorous corollas. The growth of this type of leaf appears to be a response to the longer daylengths of summer. They are produced by *V. pedata* plants throughout the range of the species during the summer.

Many names have been proposed for several unusual flower and leaf forms found particularly in the southeastern United States (e. g., *V. Reidiae* Cory). These unusual forms sometimes occur in profusion in populations. In 1959 Mr. William Bowen and myself collected specimens from one such variable population seven miles east of Rockingham, North Carolina. As a result of our analysis we suggested (Russell and Bowen, 1960) that the peculiar variation was due to introgressive hybridization from *V. primulifolia*, with which it grew at this locality.

Viola pedata has long been considered to be very distinct from other violets and to have no close relatives. However, on morphological grounds, there are two other violets which resemble it: *V. septemloba* and *V. brittoniana*. Their similarities and ranges suggest that they form a small species complex, perhaps derived from a single ancestral forms.

22. **Viola pedatifida** G. Don, General System 1: 320. 1831.

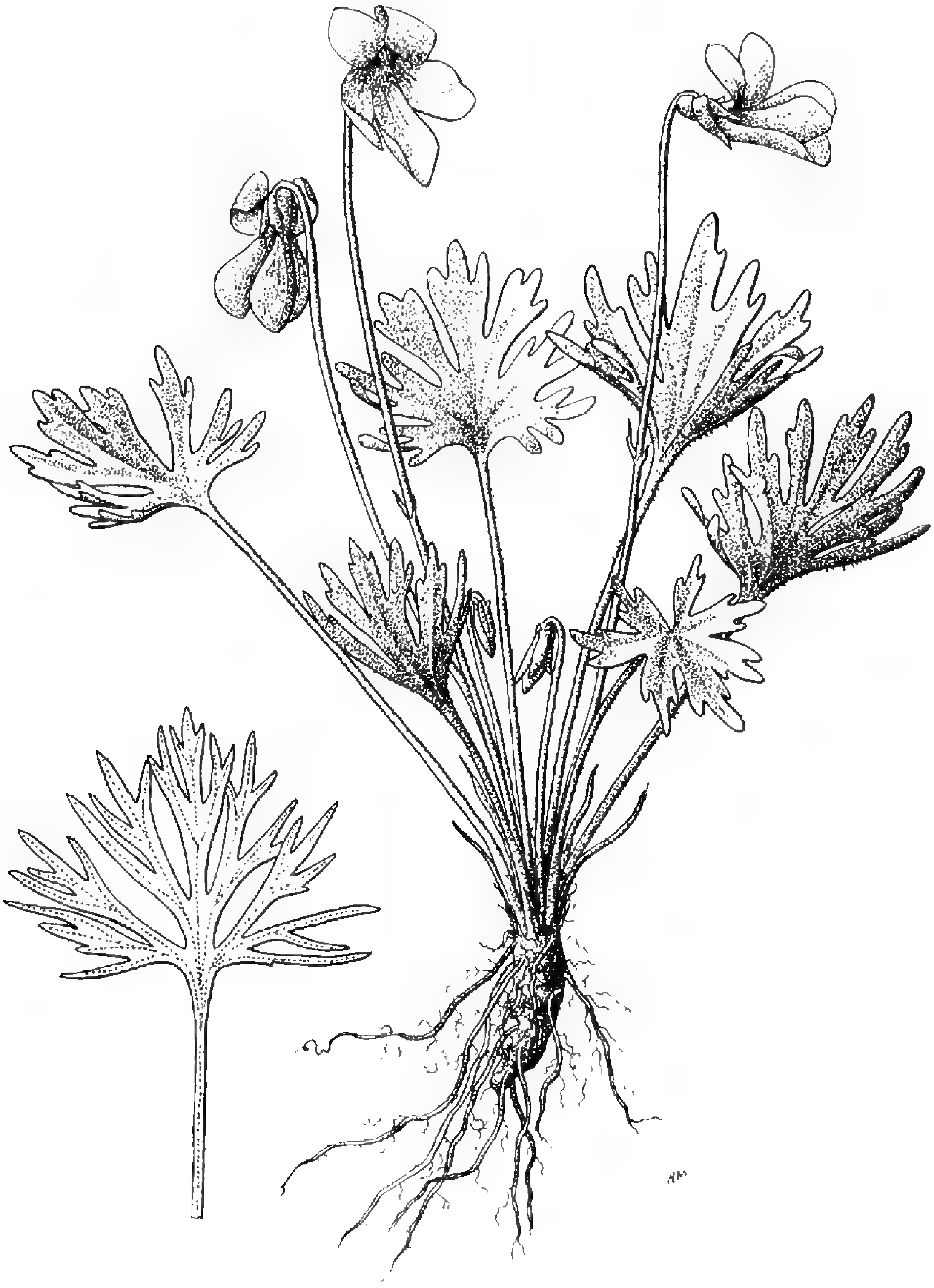
This violet is likely to be confused only with *Viola pedata*, with which it sometimes grows in the upper midwest. It differs in having the usual papilionaceous (pea-like) corolla, with the lateral and spur petals heav-



ily bearded. The leaves are not truly pedate, according to Brainerd (1921), having the middle segment divided in a somewhat pinnate fashion. In addition *V. pedatifida* produces cleistogenes during the summer.

Viola pedatifida is found in the true prairie, most often in grazed, burned, or otherwise disturbed open fields. It seems to grow most frequently on sandy soil.

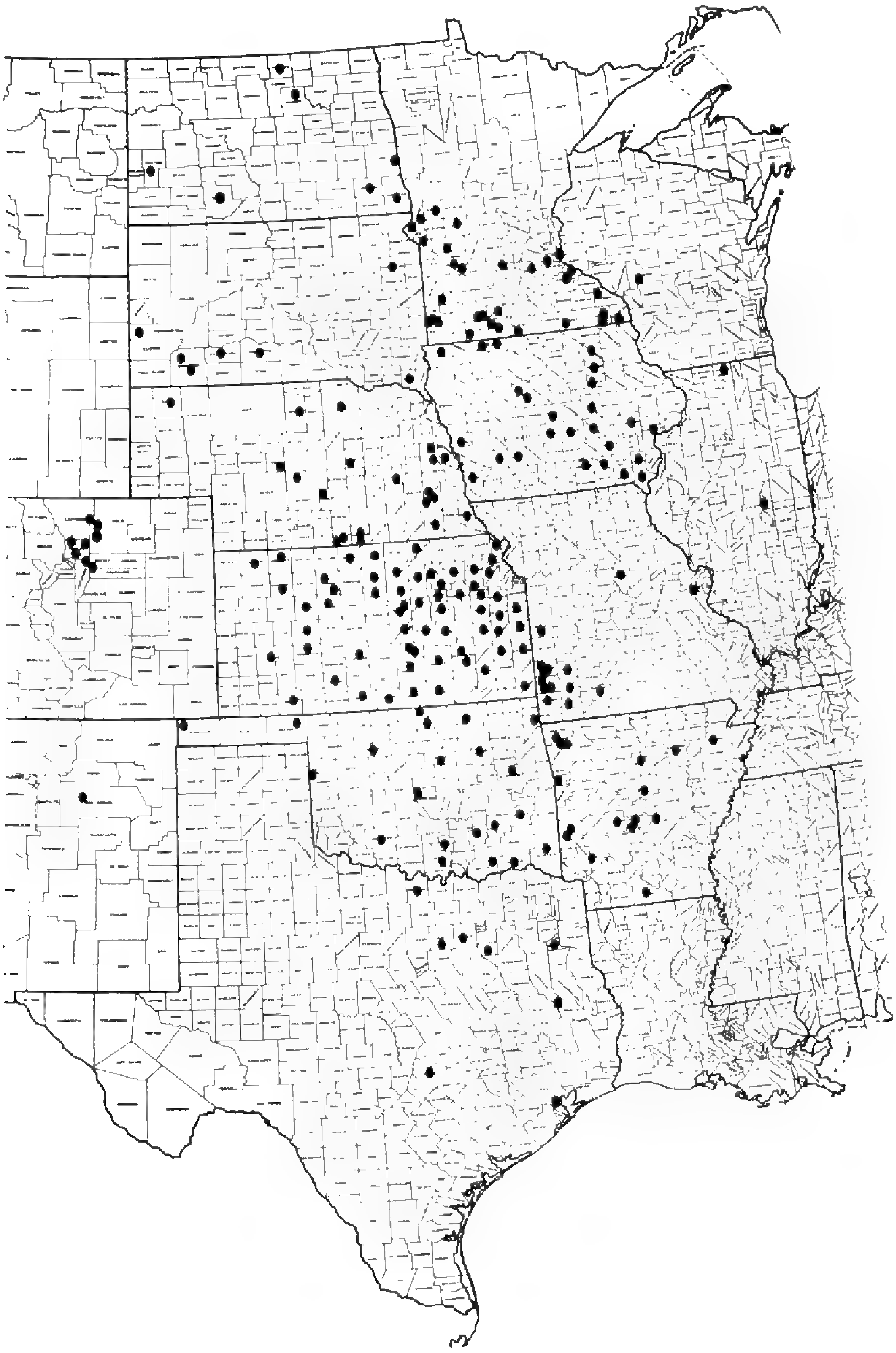
Brainerd (1921) spoke of the similarity of *V. pedatifida* to *V. palmata* and mentioned Asa Gray's cognizance of this. I have observed it also. In southern Michigan, where the ranges of the two come together, they intergrade, and it is almost impossible to separate them. In the southeastern Appalachians, *V. palmata* is sometimes so similar to *V. pedatifida* that it is mistaken for it. The two species might easily be considered as varieties of a single species.



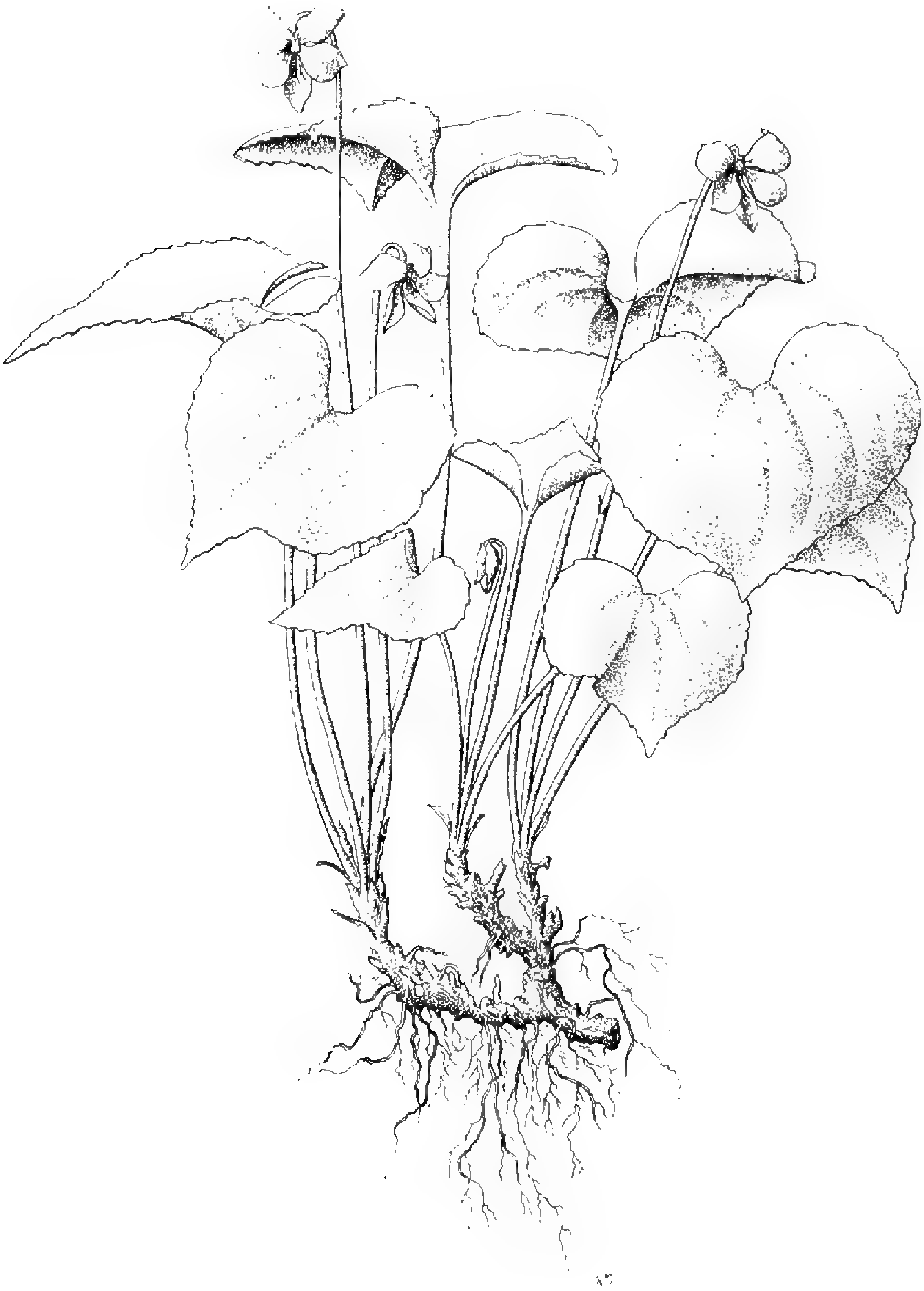
23. **Viola pratincola** Greene, Pittonia 4: 64. 1899.

The name *Viola pratincola* was proposed by Greene for a midwestern violet thought to be a close relative of the well-known and common *Viola papilionacea* Pursh of the eastern and central United States. Subsequently most taxonomists concerned with wild violets have considered *V. pratincola* to be either a variety of *V. papilionacea* or, more often, not deserving of nomenclatorial status of any sort.

Fifteen years ago in Minnesota I found *V. pratincola* (or *V. papilionacea*, as I then thought it to be) quite distinct—a prairie margin violet, growing most frequently as a weed beside or in disturbed prairie tracts (especially on railroad banks in prairies) or frequently as a common lawn or sidewalk weed in towns and cities. I was able to trace this violet into Illinois and from there eastward my search for a species of violet



to fit Pursh's name of *V. papilionacea* has been futile. I have concluded that there simply is no such violet. All herbarium material so annotated is easily referable to other species, especially *V. affinis* and *V. sororia. Viola papilionacea* has been a myth, a catch-all for almost any glabrous or near-glabrous stemless blue violet with uncut leaves. *Viola sororia,* as discussed under that species, often has glabrous or near glabrous plants in the eastern states, either due to normal variation or as the result of introgression. Pursh described one of these variants for his new species.

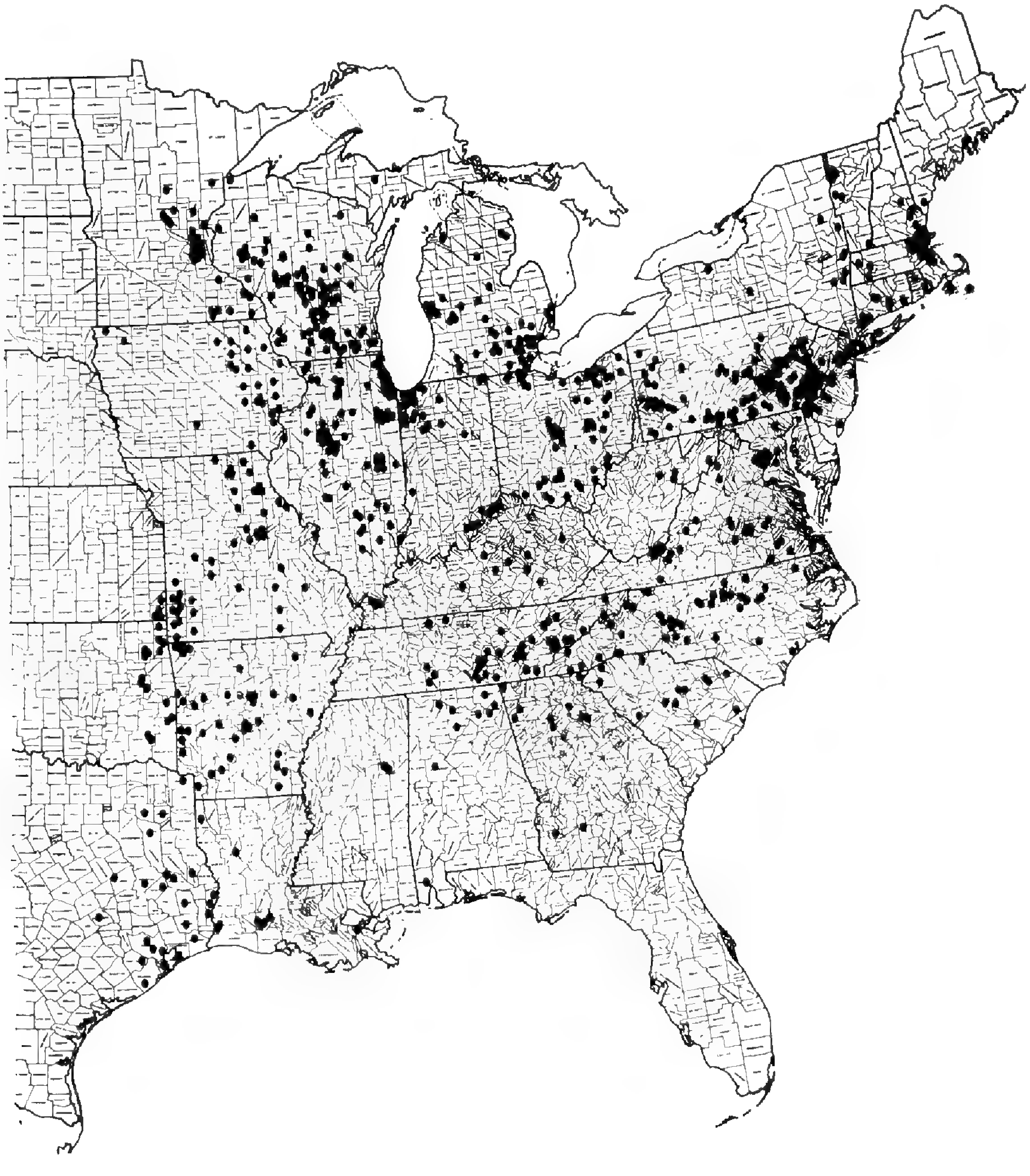


Viola pratincola bears close resemblance to *V. cucullata* of the east, when not affected by hybridization. The cleistogenes may be borne on erect peduncles and have sagittate shapes and marked sepal auricles. The lateral petals also often have clusters of clavate hairs. Where the two species come in contact, they grade together.

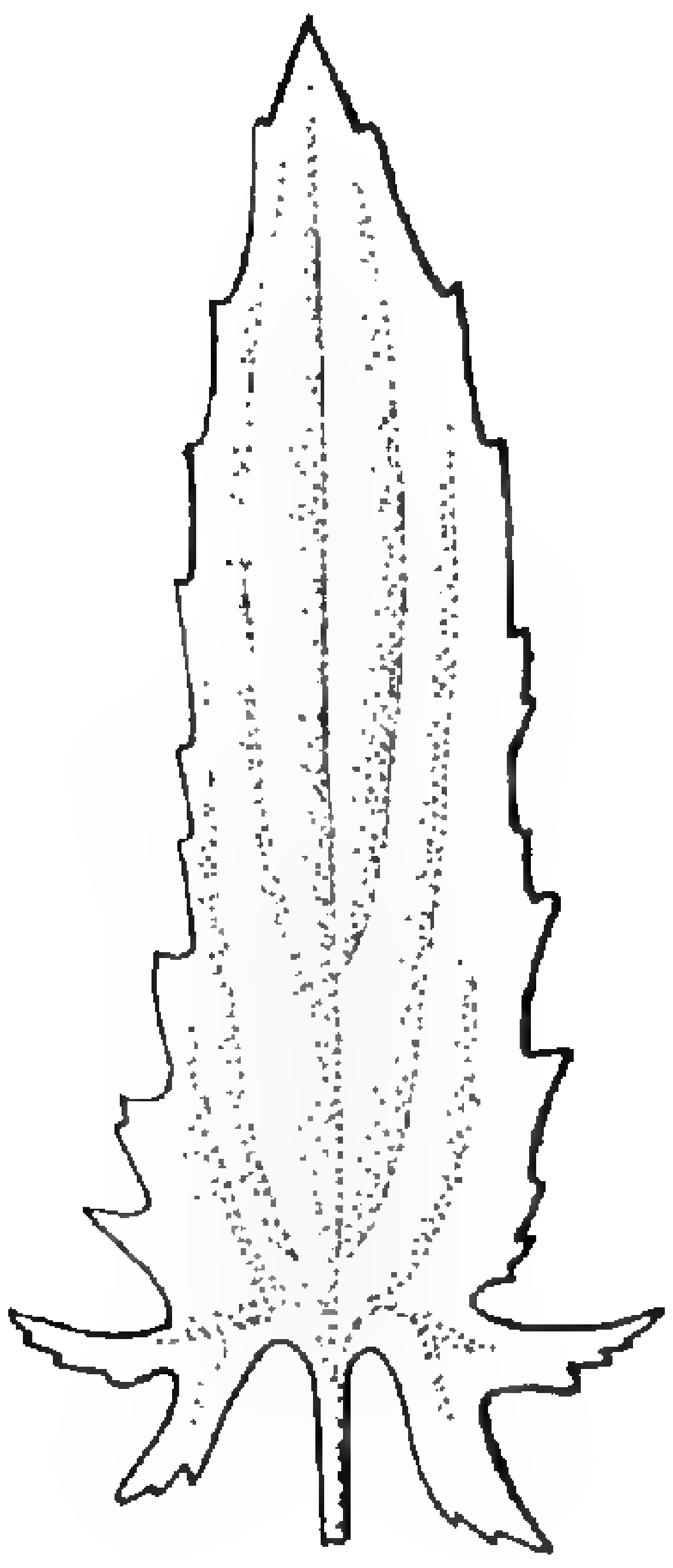
In the midwest *V. pratincola* may be confused with another glabrous violet, *V. missouriensis*. Differences are pointed out in the discussion of *V. missouriensis*.

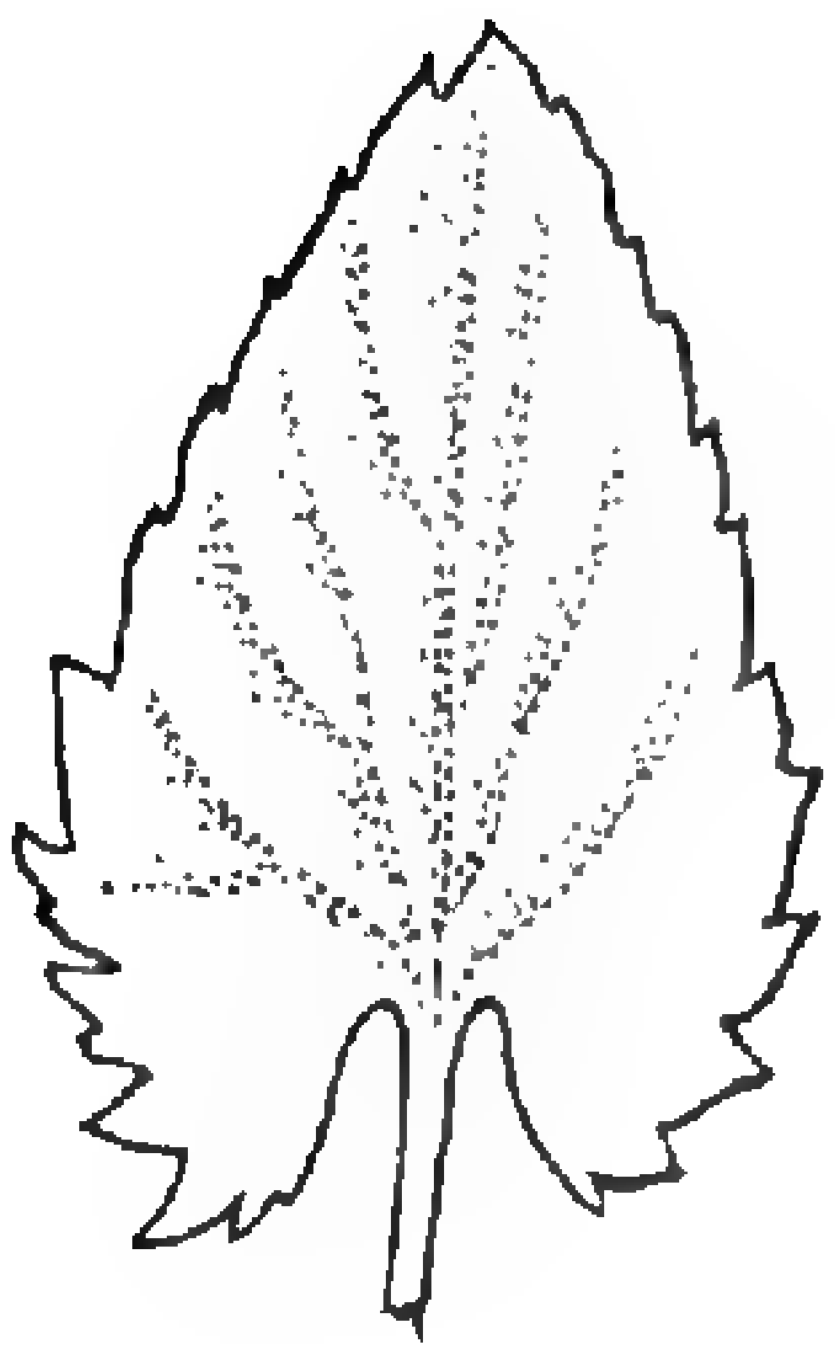
24. **Viola sagittata** Ait., Hort. Kew. 3: 287. 1789.

The differences between *V. sagittata* and its close relative, *V. fimbriatula*, are discussed under the latter species. Its hybridizations with *V. affinis*, producing plants known as *V. emarginata*, are discussed under *V. affinis*.



Viola sagittata is a widespread stemless blue violet in central and eastern United States and is quite variable in size and pubescence. However the sagittate leaf form remains constant, except where modified by hybridization. It frequently hybridizes with other species in nature. Fernald (1950) lists ten known natural hybrids. Locally it may be considerably modified by natural hybridization, most frequently by crosses with *V. sororia* and *V. affinis.* I have analyzed two such cases of hybridization (Russell and Cooperrider, 1955; Russell and Risser, 1960).



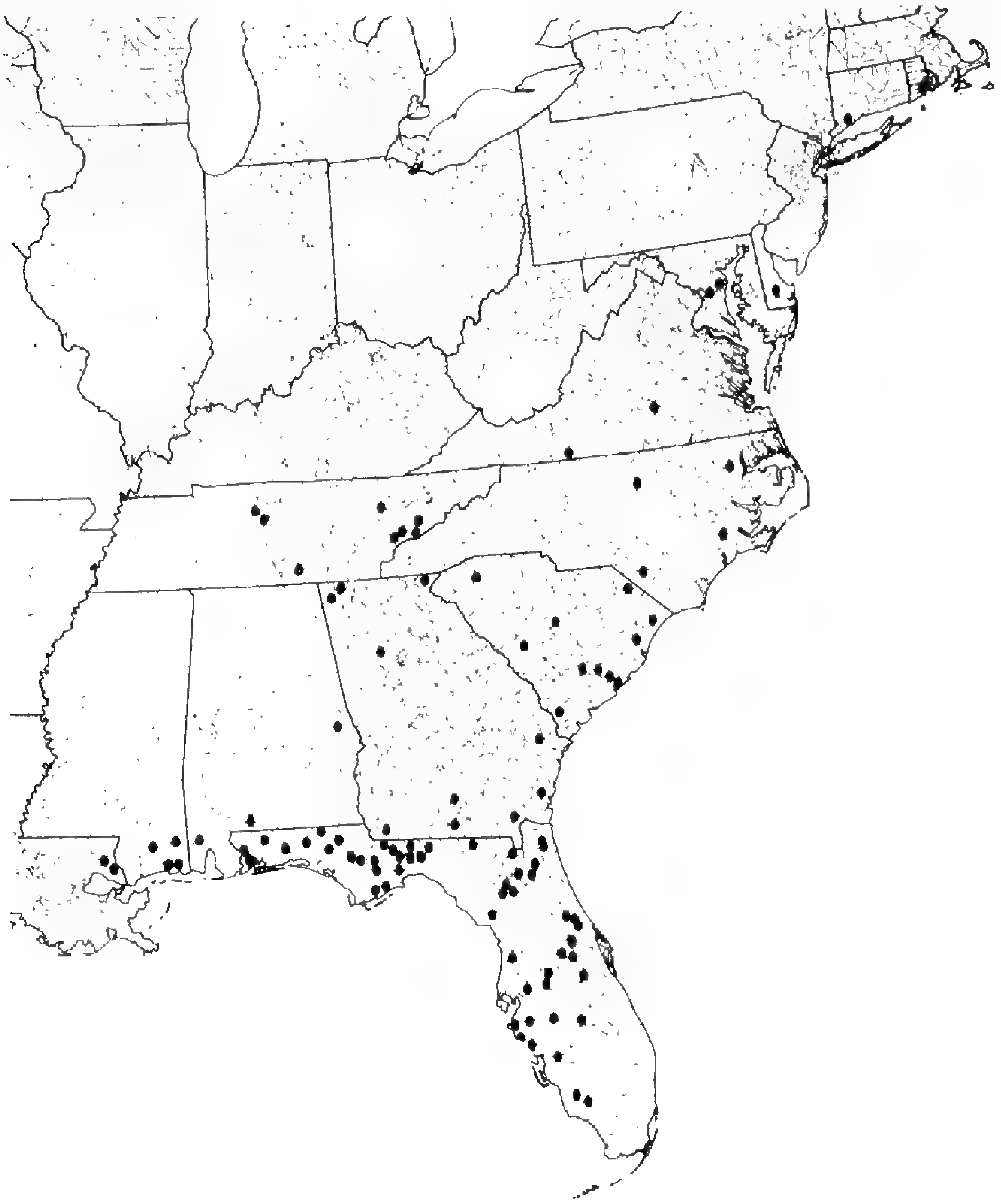


25. **Viola septemloba** LeConte, Ann. Lyceum N.Y. 2: 141. 1826.

This pretty little violet may produce one or two entire leaves in early spring, but the typical leaf form is pedate, with 7 to 9 slightly oblanceolate lobes. It grows in moist places in pine forests in the southeast. It rarely forms dense clones or mats; instead the plants occur singly, often widely separated from each other.

In the discussion of *Viola pedata,* its similarities to that species and to *V. brittoniana,* which replaces it in the northeast, were mentioned. I have seen some specimens with leaves almost identical to those of *V. pedata.* Both Gray and Brainerd (Brainerd, 1921) considered it to be most closely related to *V. palmata.* It does not appear so to me.

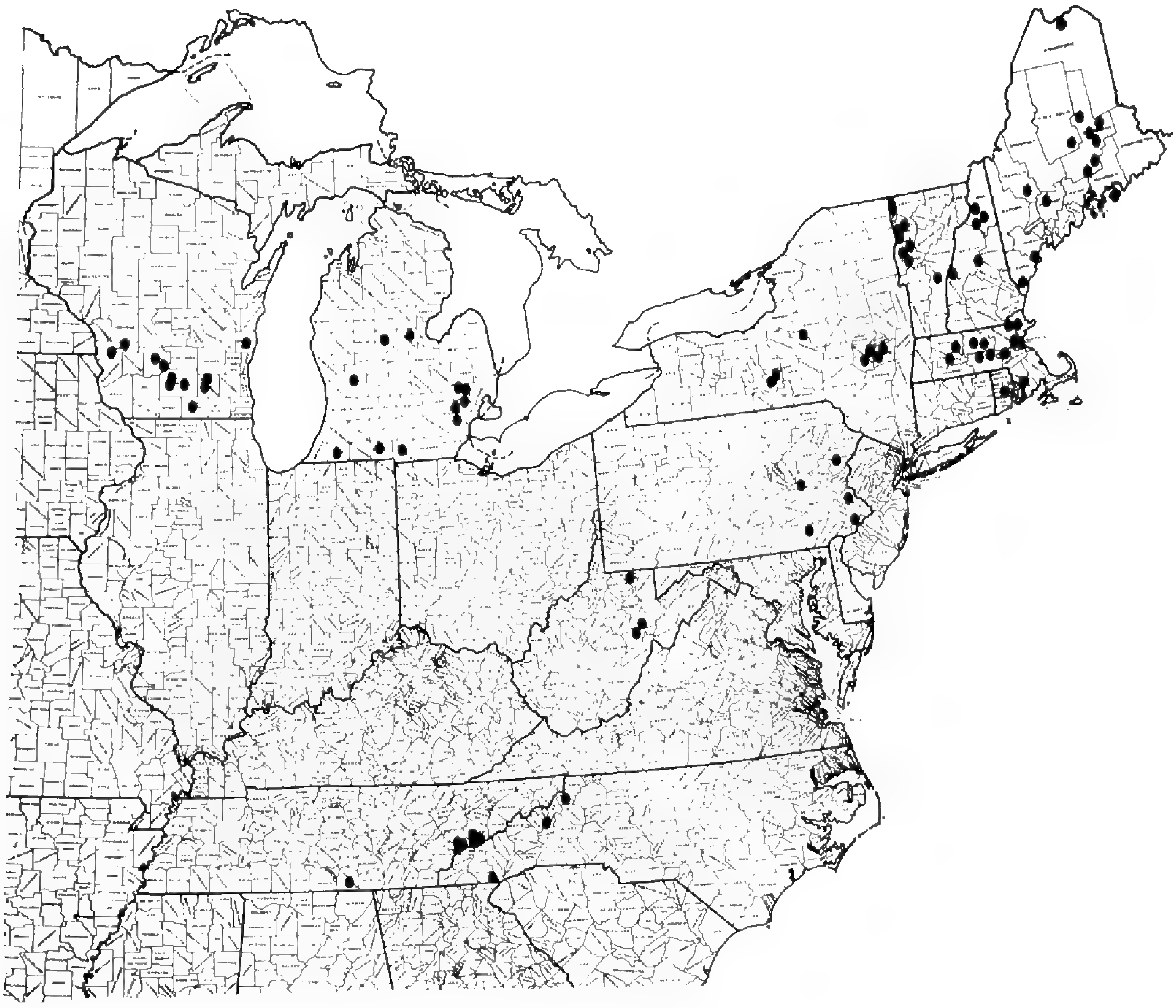
In the southeast, it is most easily confused with *V. esculenta,* and can sometimes be distinguished only with difficulty. I have found the shape of the leaf lobes the best feature. *V. esculenta* has broader, more obovate lobes, more similar to those of *V. triloba* var. *triloba.*

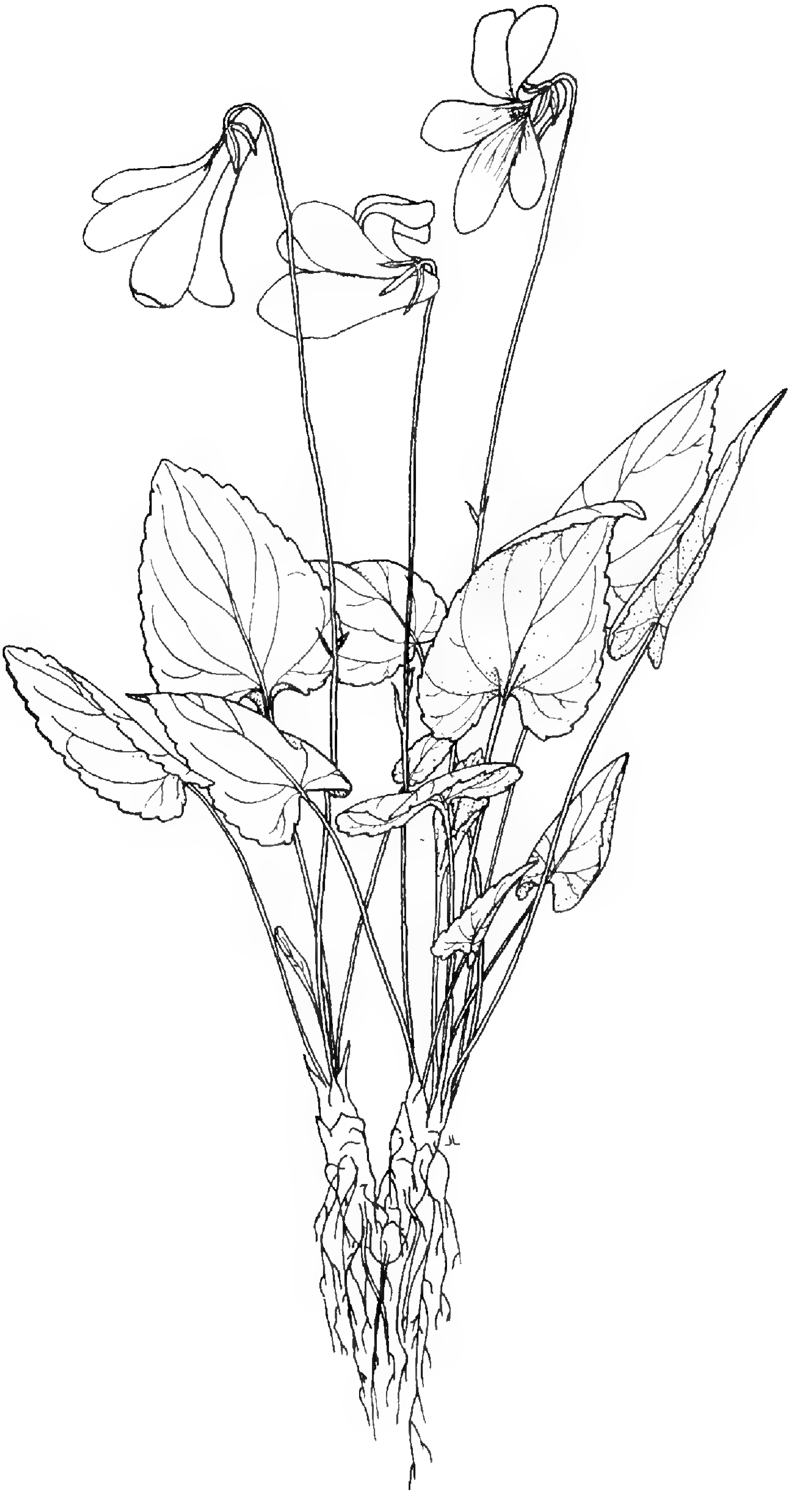


26. **Viola septentrionalis** Greene, Pittonia 3: 334. 1898.

Viola septentrionalis is locally abundant in parts of New England and in the southern Appalachians, where it may fill high elevation (about 5000') beech forests. In New England it is more abundant under conifers. In general aspect it most closely resembles *V. sororia*. It differs from *V. sororia* in its larger, thinner, more heart-shaped leaves, in the nature of its pubescence which is sparser and concentrated on the lower lamina surface, in having a distinct fringe of hairs around the lamina margin, in the sepals being closely ciliated around their total margins, and in having smaller, globose capsules borne on thin peduncles.

Viola septentrionalis is known to hybridize with several other stemless blue violets, especially *V. fimbriatula* and *V. cucullata* (see discussion under *V. cucullata*).

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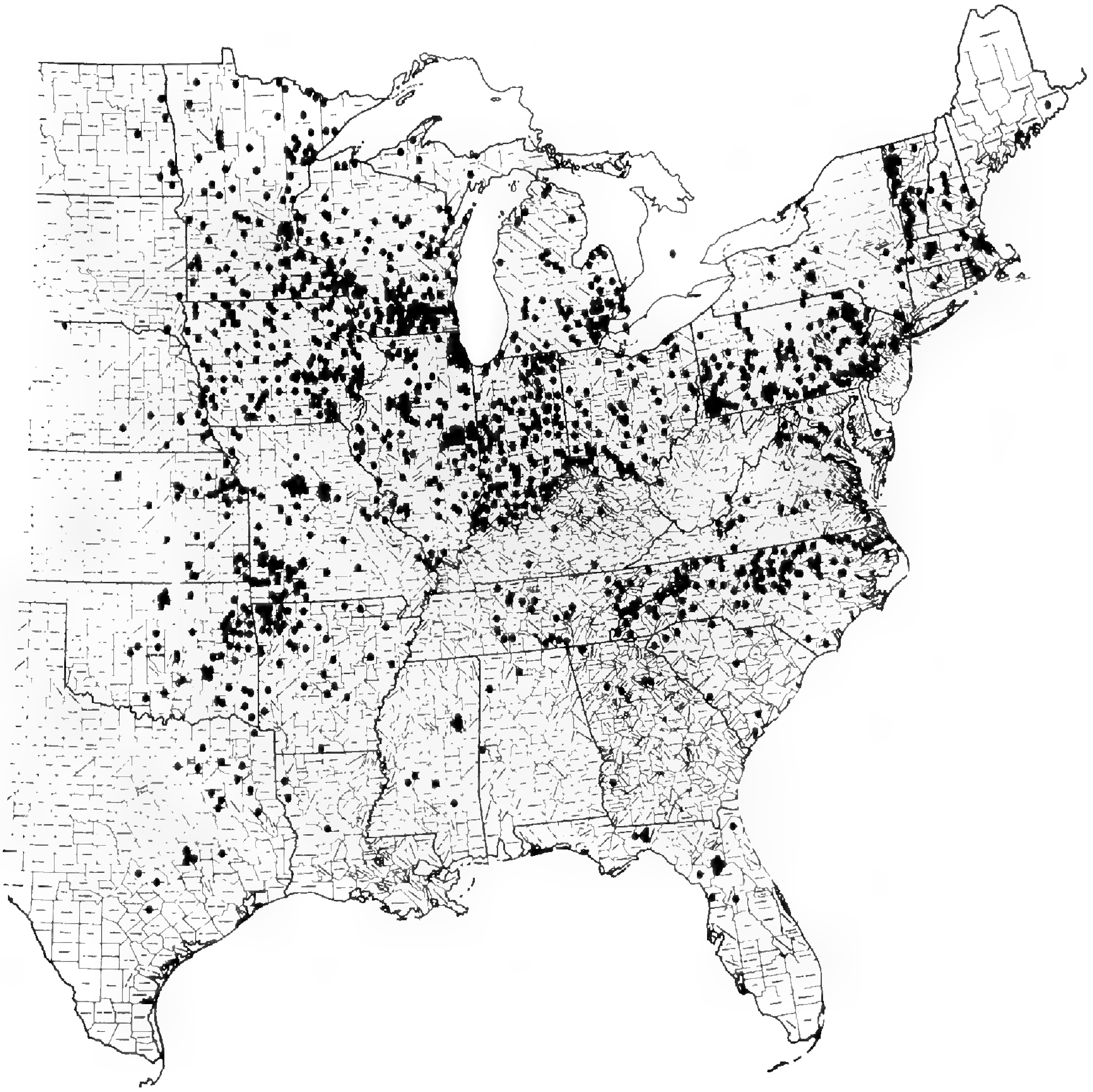
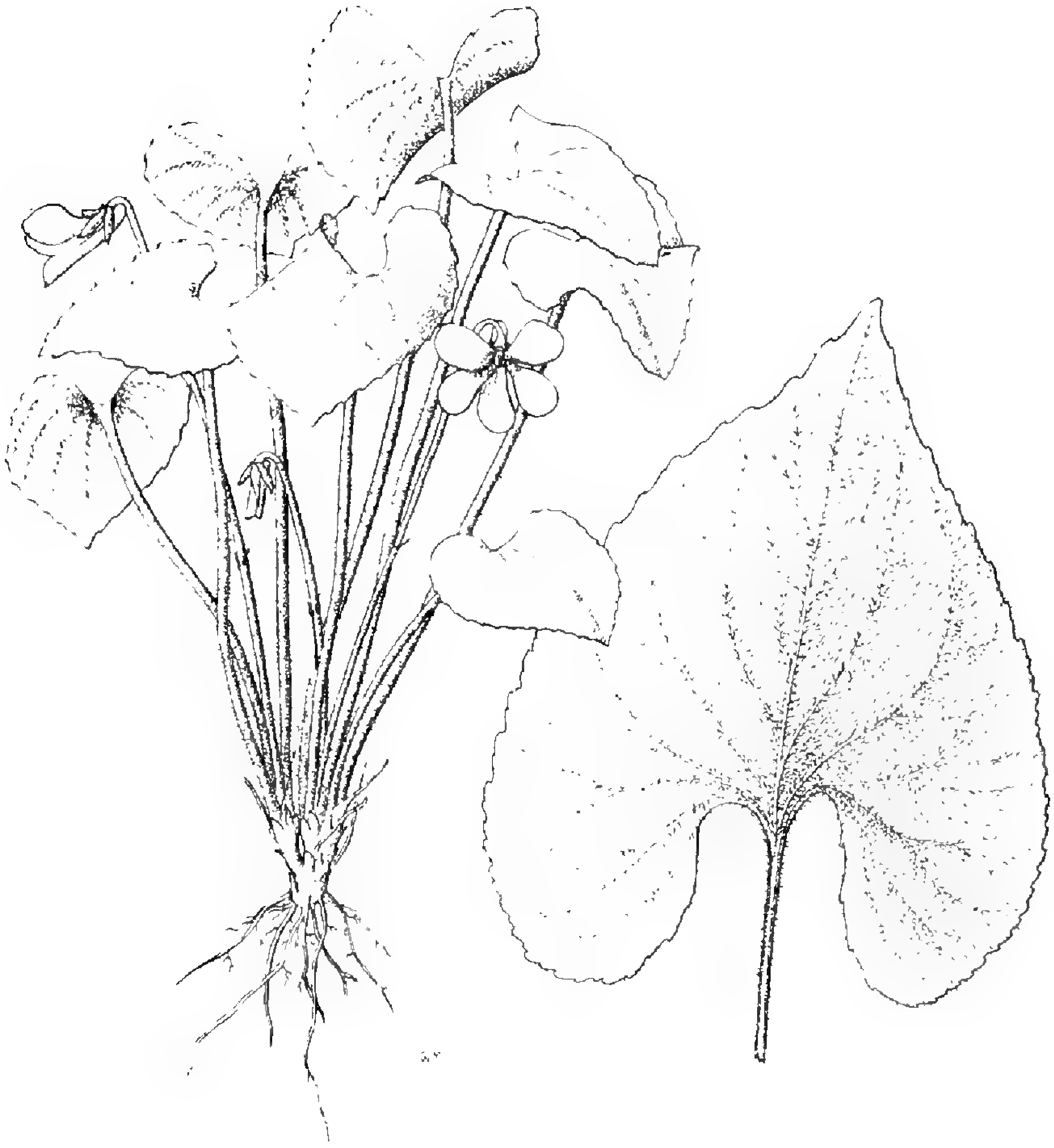
27. **Viola sororia** Willd., Enum. Hort. Berol. 1: 72. 1809.

This is the commonest species of violet in the eastern United States, being most abundant in the upper and central midwest, where it occurs in almost every deciduous woodland, as well as in every town and city as a common weed. It is the most variable of all the stemless blue violets in such features as petal color, size, and lamina pubescence. Petal color, normally dark blue or purple, may be bright red, light blue, pure white, or the peculiar gray-blue of the so-called "Confederate violet," a sometimes cultivated variant (*V. priceana* Pollard). In size it varies from the tiny plants sometimes found in oak woodlands in Minnesota to huge plants in Missouri and warmer climates. In pubescence it is supposed to be densely villous. This villous condition is most frequently found in the upper midwest; elsewhere it varies to an almost completely glabrous condition. As explained in the discussion of *V. pratincola*, most plants formerly assigned to *V. papilionacea* prove to be glabrate forms of *V. sororia*.





As might be expected, V. *sororia* can be difficult to characterize at times. Its more distinguishing characteristics are: the presence of some degree of pubescence, always uniformly distributed over the petiole and lamina surfaces; flowers usually dark purple, on peduncles shorter than the petioles; cleistogamous fruits large, ovoid, purplish, and borne on short, prostrate peduncles; lateral and spur petals heavily bearded with cylindrical hairs.

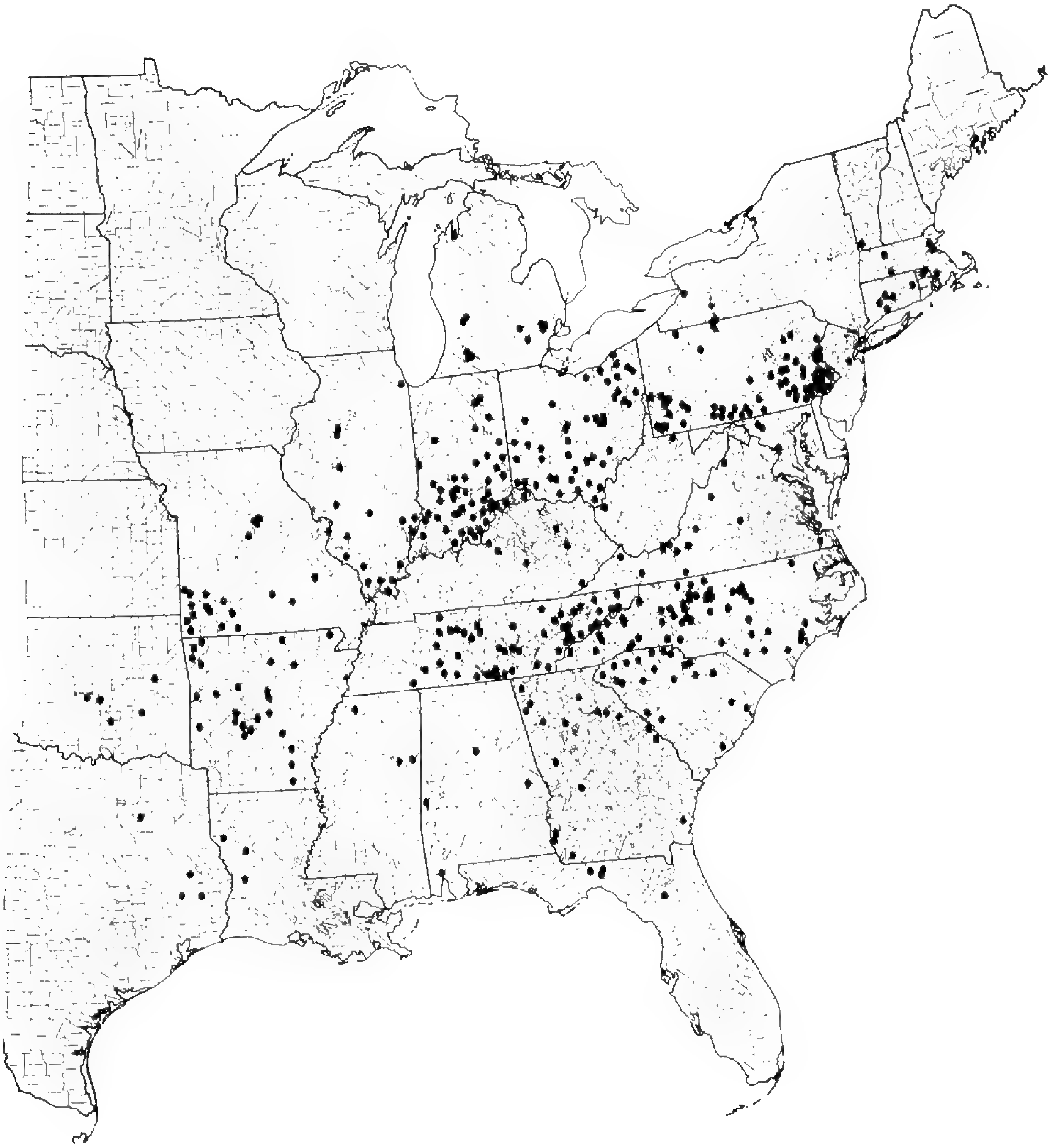
One might wonder about the source of this considerable variation and also about the vigor that makes this species the most successful of all violets in disturbed areas. On close examination of specimens of *V. sororia* from over its range, something remarkable is seen. In New England specimens tend to resemble *V. cucullata* and especially *V. affinis;* in Minnesota they have characteristics of *V. sagittata* and *pedatifida;* in the lower midwest they resemble *V. missouriensis;* and in the southeast, *V. floridana.* In local situations it may resemble still other stemless blue violets. Indeed Fernald (1950) cites its name as meaning "sisterly, resembling other species." Fernald reported it as hybridizing with 14 other stemless blue violet. Indeed it seems to hybridize with any stemless blue violet with which it comes in contact. A reasonable, though hard to test, presumption is that it has profited by these hybridizations and has a relatively very large gene pool. Because of this (presumed) introgression, it has been able to spread outward from its original home in dry, midwestern oak forests, into the territories of other violets, where it is becoming increasingly important.

It is most similar to *V. triloba* var. *triloba,* with which it frequently occurs and intergrades. About the only discernible difference between the two species is in the lobing or non-lobing of the leaves. However, in spite of their apparent morphological intergradation, they were found to have distinctly different flowering periods in another study (Russell, 1960), indicating important physiological differences and supporting the maintenance of them as separate species.

28. **Viola triloba** Schwein., Aner. J. Sci. 5: 57. 1822.

28a. **Viola triloba** var. **triloba**.

This violet, which closely resembles *V. sororia* except in the lobing of its leaves, occurs occasionally in dry woods throughout its range, which is extensive. As remarked in the discussion of *V. sororia*, it intergrades with that species. In addition, Fernald (1950) cites natural hybrids with eleven other species of stemless blue violets. These, however, are not frequent, and *V. triloba* does not appear greatly affected by introgression, as is almost certainly the case with *V. sororia*.



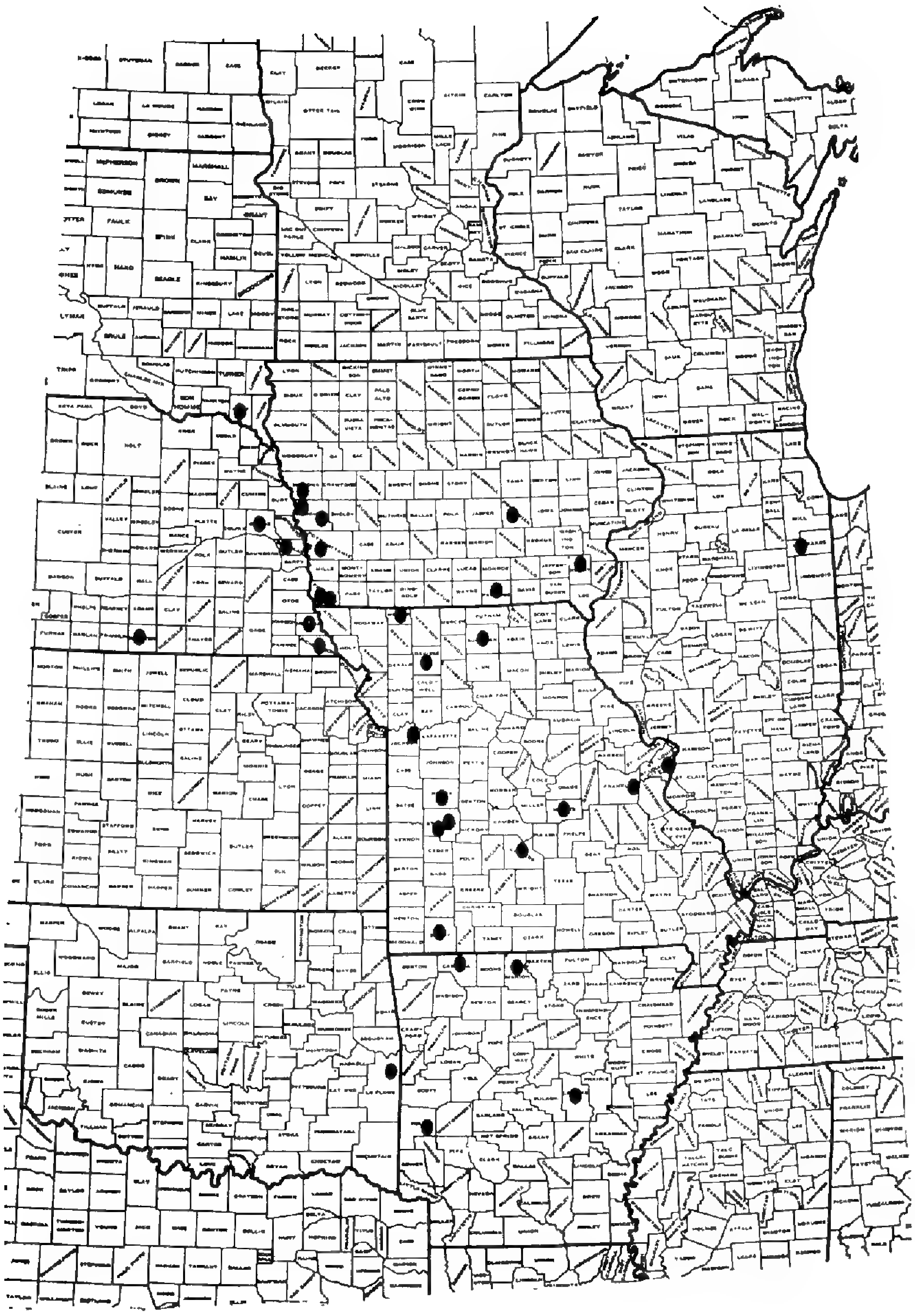
28b. **Viola triloba** var. **dilatata** (Ell.) Brainerd, Bull. Torr. Bot. Club 37: 586—588, pl. 36. 1910.

This variety of *V. triloba* is characterized by leaves with 5-7 very deep, sometimes almost linear, lobes. Although specimens intermediate between the two varieties are sometimes seen, I have never found populations of both together in the same forest. Though their ranges overlap broadly, *V. triloba triloba* is more characteristic of the Appalachians, and *V. triloba dilatata* occurs at and beyond the fringes of the range of *V. triloba triloba* most abundantly.

Physiologically the two varieties seem to be distinct as indicated by a study of their flowering periods at different latitudes (Russell, 1960).

29. **Viola viarum** Pollard in Britton, Man. p. 635. 1901.

This strange little violet puzzled me for several years. At first I thought it may have been a hybrid. Many specimens so labeled proved to be *V. sagittata* hybrids, but others did not. Then one day in my front yard in Grinnell, Iowa, I discovered its nature. I had many spontaneously occurring plants of *V. missouriensis* and with them I found a few plants of *V. viarum*. There were also intermediates between the two. Subsequent observations have convinced me that *V. viarum* is a cut-leaved "species" of the *V. affinis*-*V. missouriensis* complex. It is found sporadically and may be, indeed, an occasional simple genetic form, instead of a species. I have observed many specimens of *V. missouriensis* with shallow basal incisions in the summer leaves. These are simply deepened in *V. viarum*. It, like *V. missouriensis*, is found on river banks or in floodplain forests.

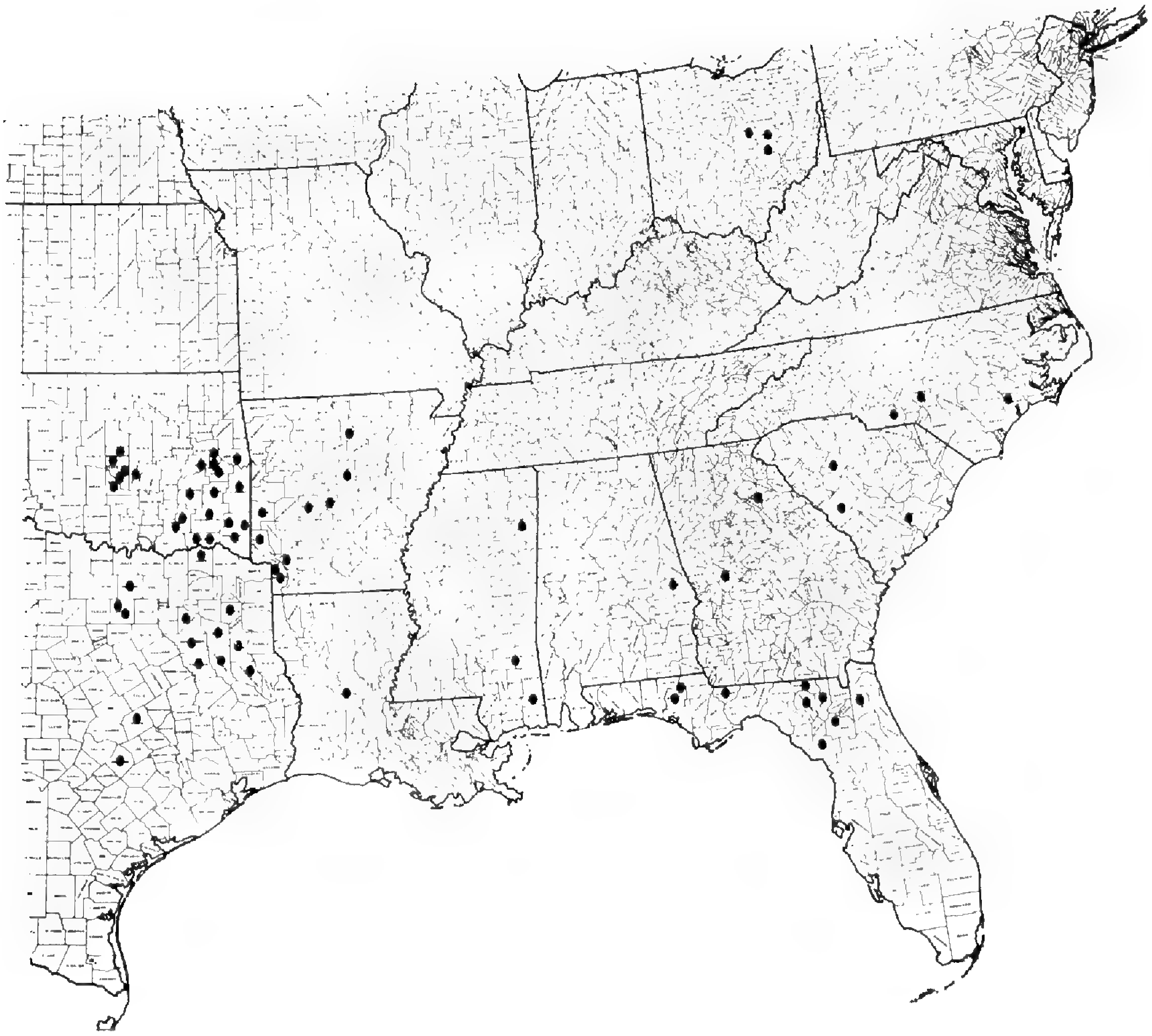


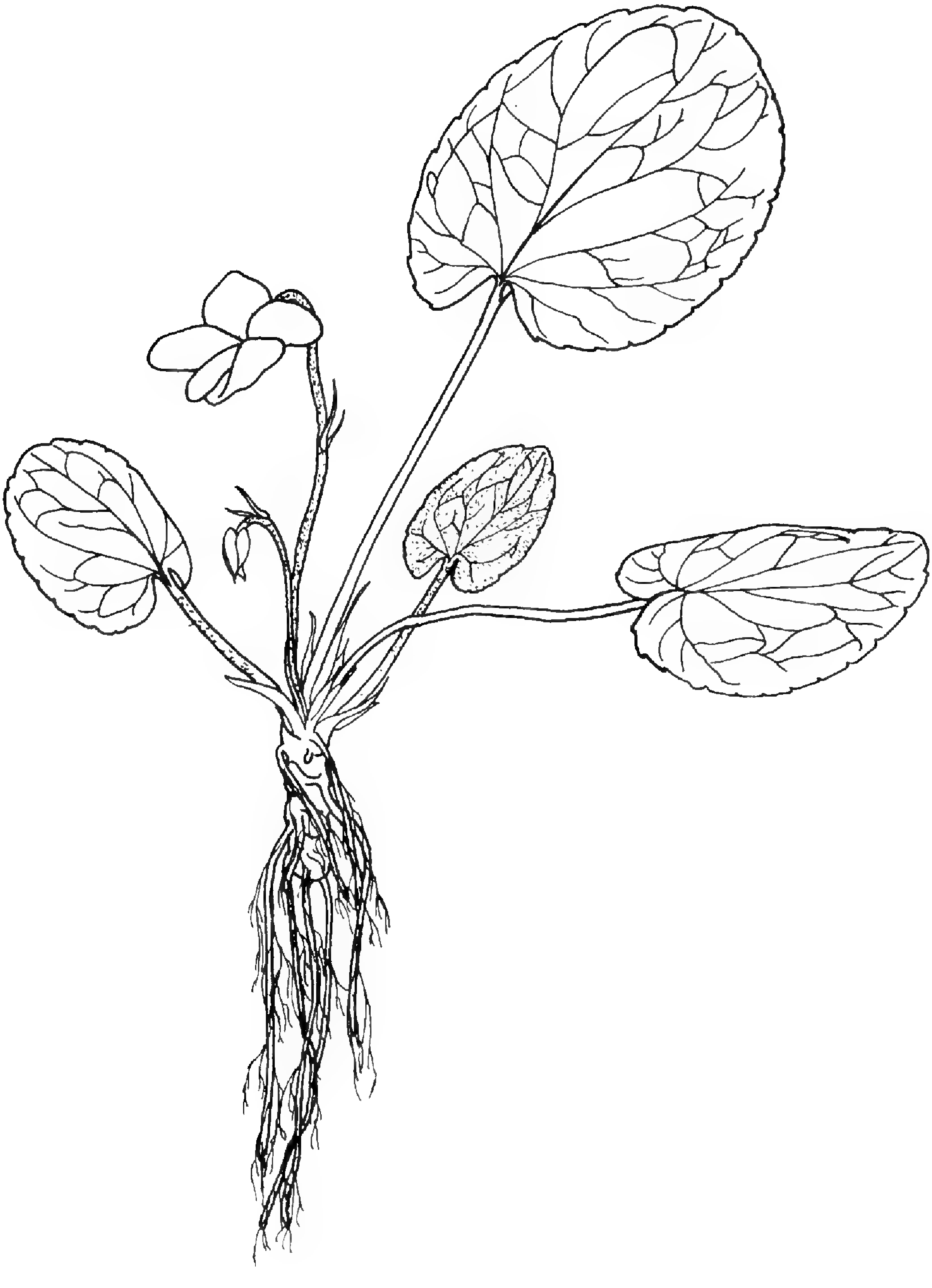
30. **Viola villosa** Walt., Fl. Car. p. 219. 1788.

This small, inconspicuous violet is found occasionally in moderately rich southern deciduous forests, in relatively sandy areas. Sometimes it grows with *V. lovelliana* (in the west) or *V. walteri* (in the east). It somewhat suggests a miniature *V. sororia* in superficial aspect, but is quite distinct from that species, resembling it mainly in its dense pubescence. I do not see any strong resemblance between *V. villosa* and any of the other stemless blue violets, nor have I seen evidences of hybridization with other species in the field. Fernald (1950) reported no natural hybrids.

My only suggestion for a possible relative is *V. sororia,* though if the two had a common ancestor, they have diverged considerably since their separation.

The nomenclatural history of this species was reviewed by Brainerd (1921), who clarified its confusion with both *V. sororia* and *V. hirsutula.*



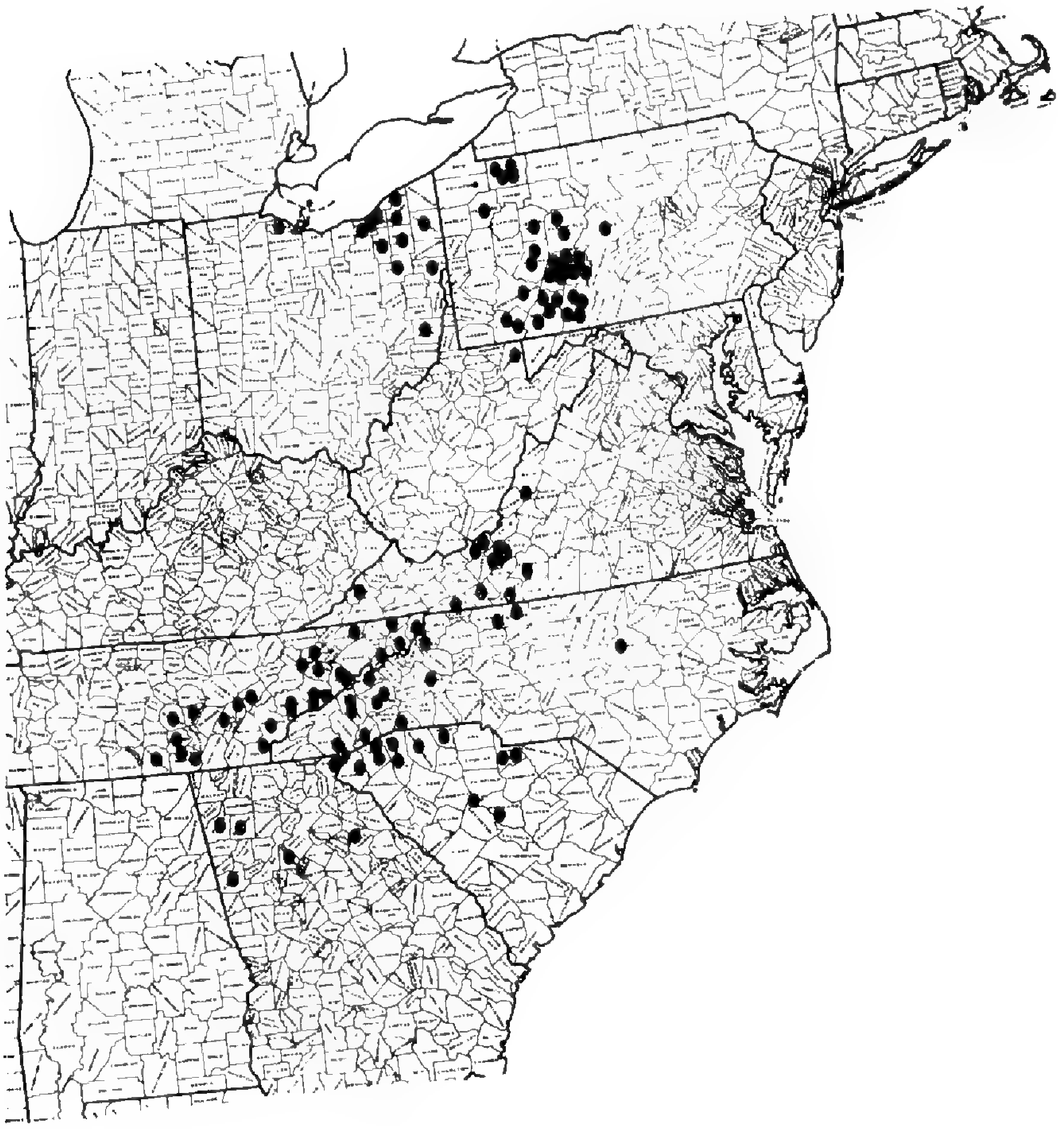


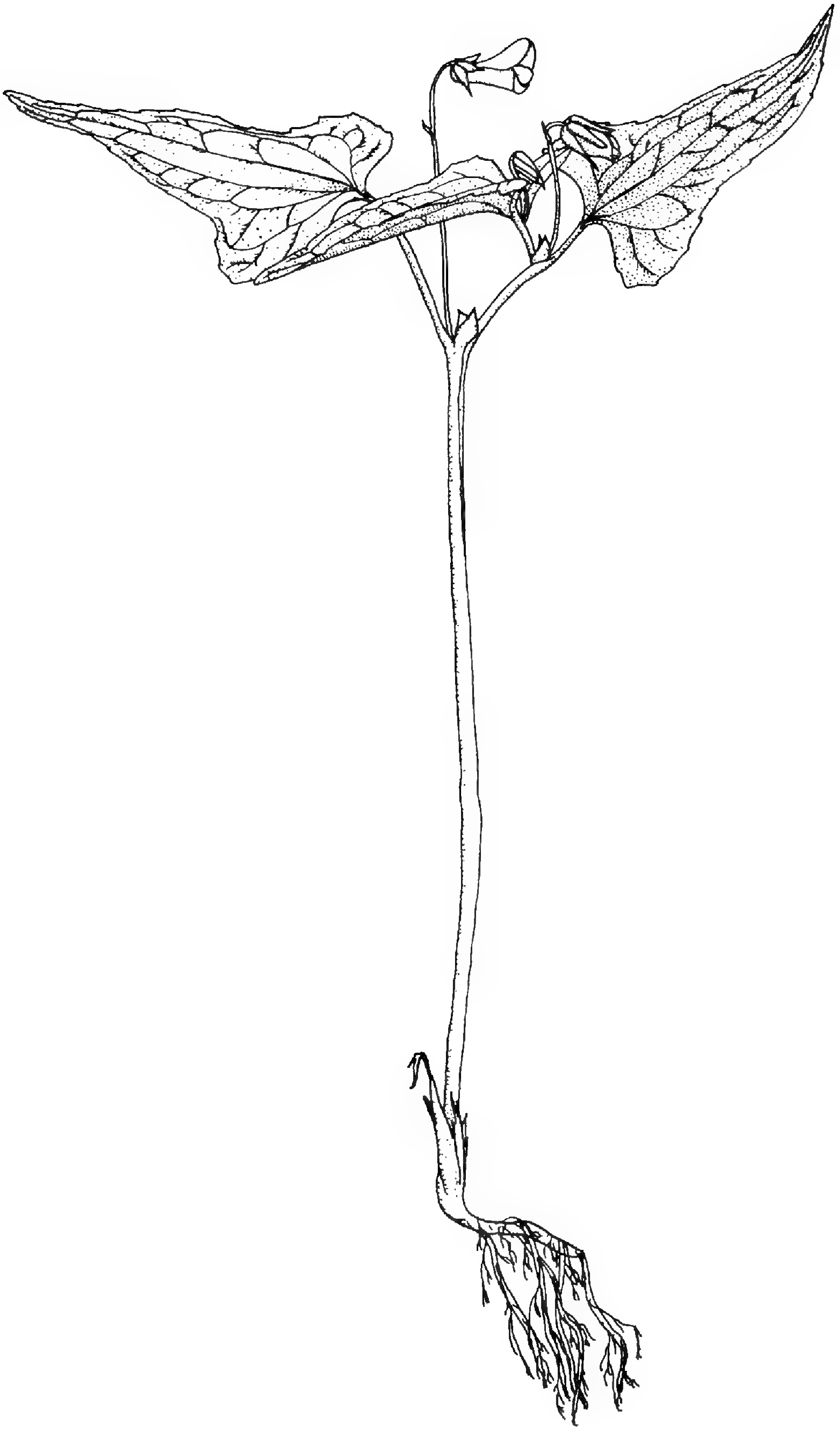
GROUP III. STEMMED YELLOW VIOLETS.

31. **Viola hastata** Michx., Fl. Bor.-Am. 2: 149. 1803.

Viola hastata is a distinctive and beautiful violet, hardly to be mistaken for any other. Its elongate, triangular, green or purplish stem and root leaves are conspicuous in the dark, rich deciduous forests where it usually grows. Often the whitish, fragile rootstocks produce only single root leaves.

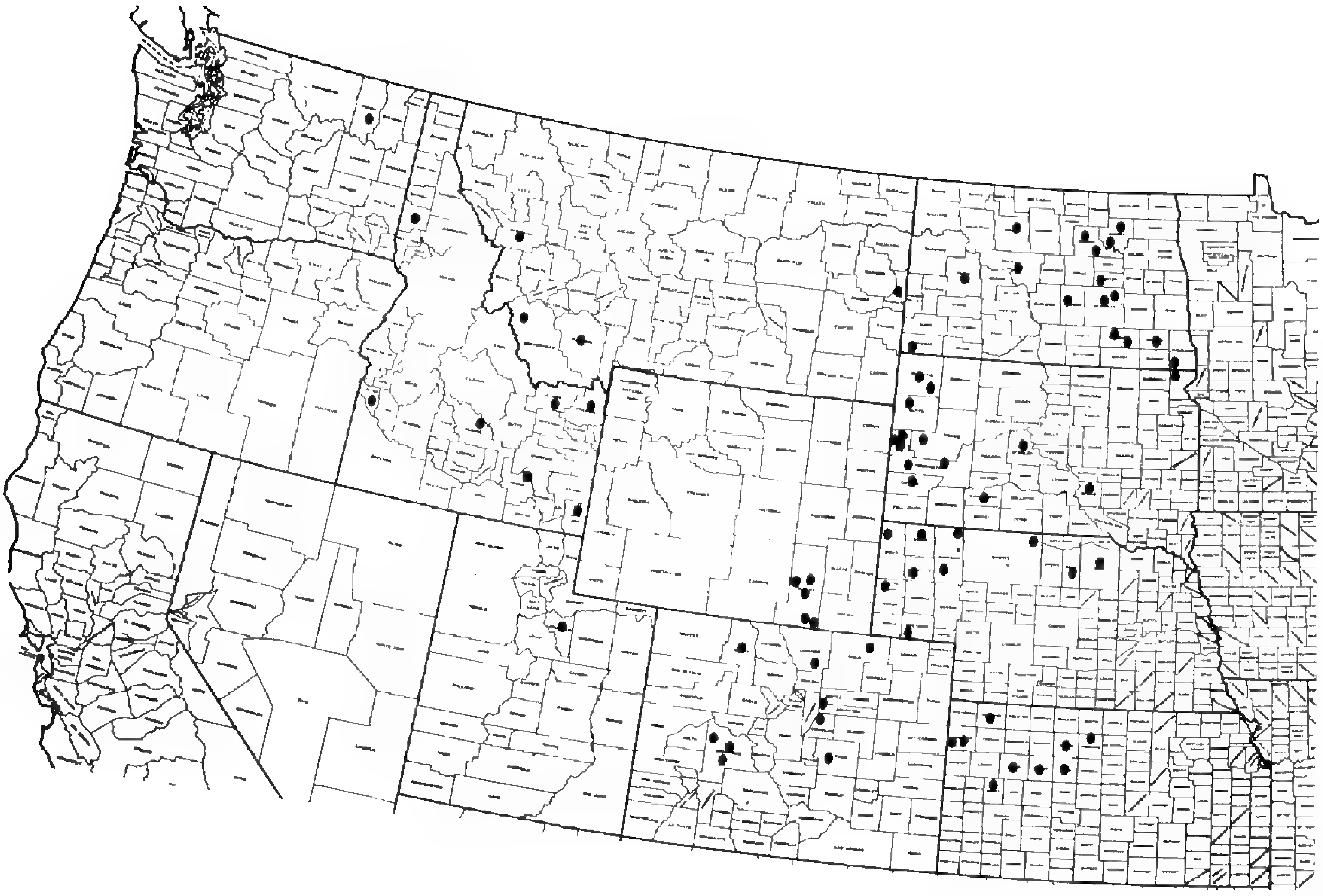
Viola hastata is related to the other stemmed yellow violets (*V. pubescens* var. *pubescens*, *V. pubescens* var. *eriocarpa*, *V. tripartita*, and *V. glabella*) by its growth form, petal color, and chromosome number (2n=12). I have seen no instances of its hybridizing with them; it rarely occurs with them, being found in much richer forests.





32. **Viola nuttallii** Pursh, Fl. Am. Sept. 1: 174. 1813 ("1814").

Viola nuttallii is essentially a western violet, occurring in central United States in the prairies and plains. It is quite different from other central and eastern violets, but is closely related to such western violets as *V. praemorsa* Dougl., *V. purpurea* Kellogg, and *V. chrysantha* Hooker. There is considerable variation in plant size and leaf form, and some taxonomists have divided it into additional species, namely *V. linguaefolia* Nutt. and *V. vallicola* Nelson. I have been unable to distinguish these in the field. An extensive population analysis in the central Rockies by Miss Millicent Kalil (ms.) also did not separate these additional forms.

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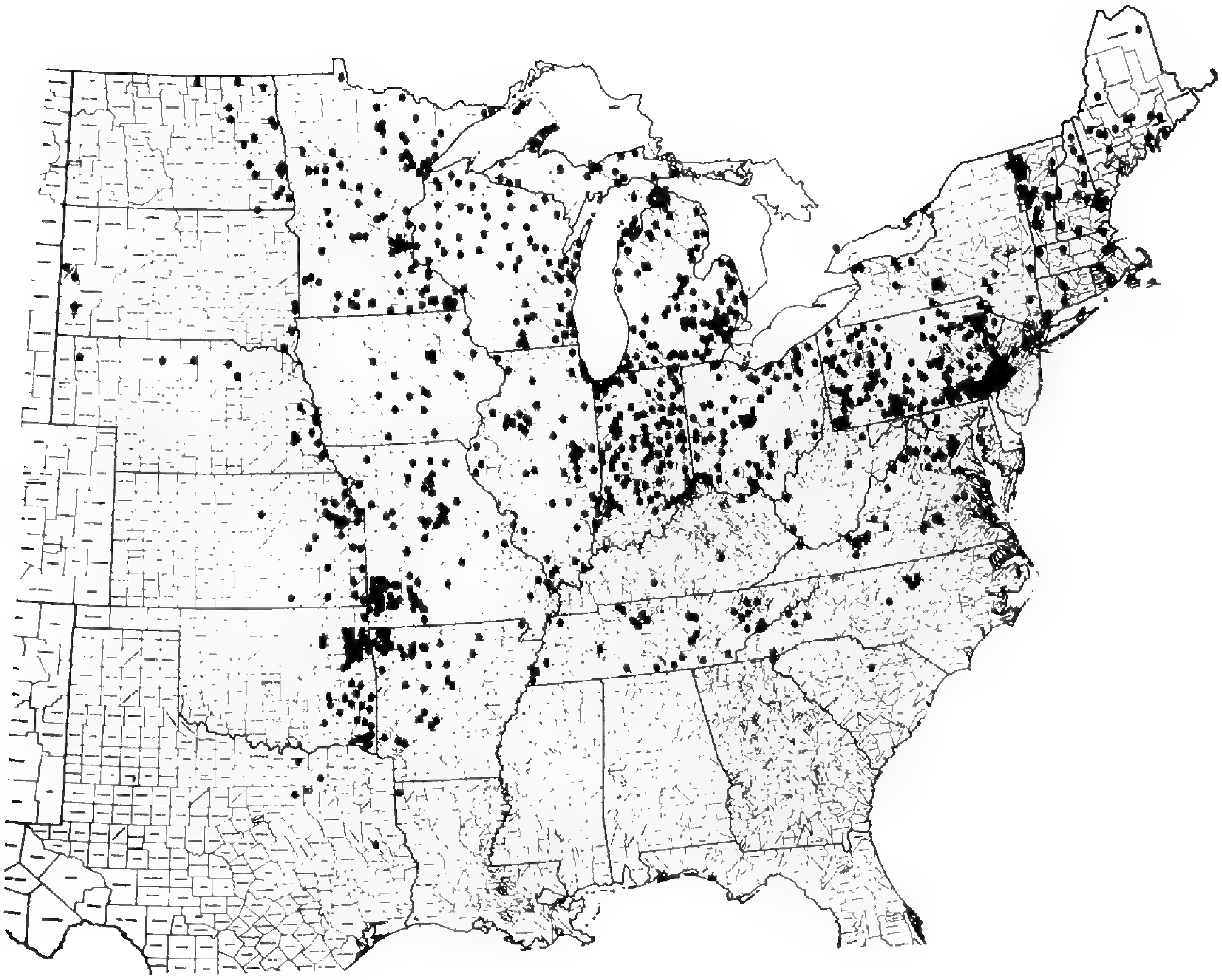
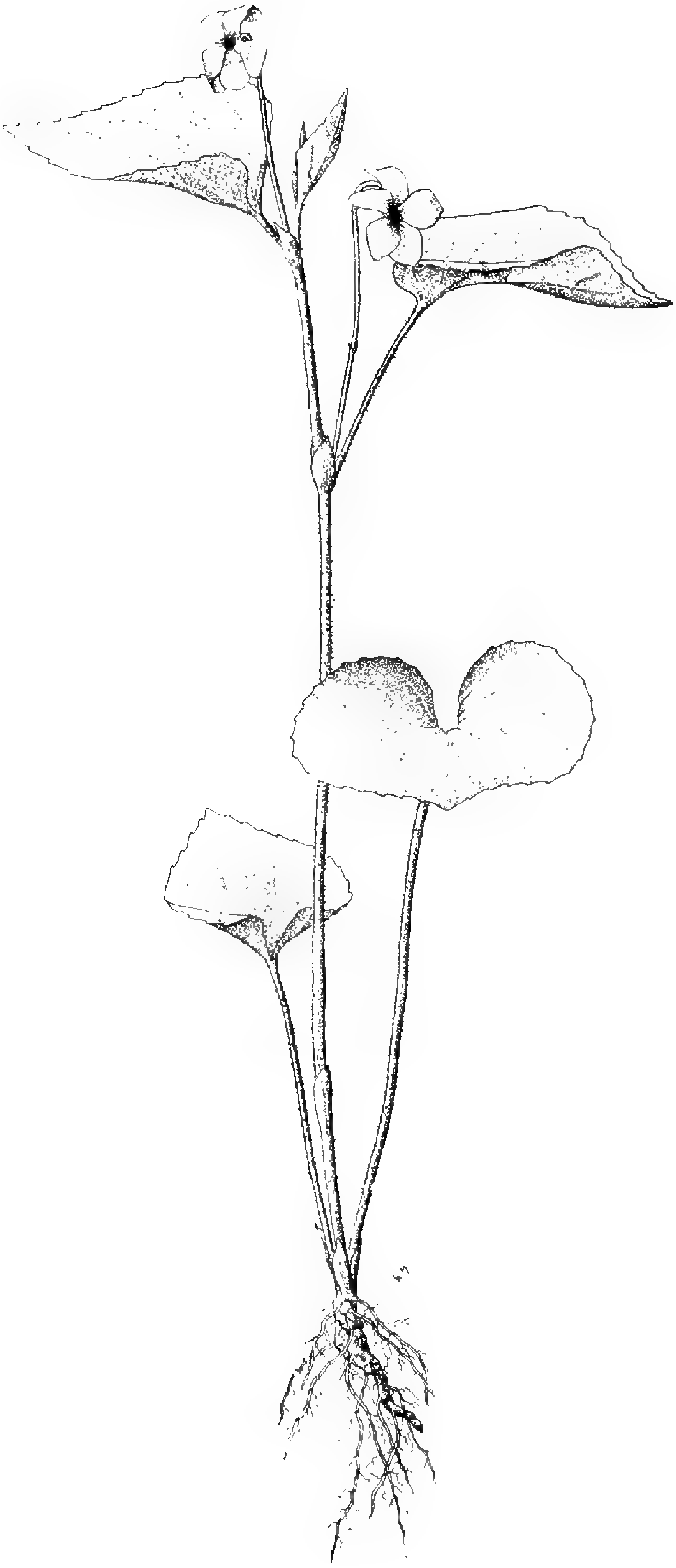
33. **Viola pubescens** Ait., Hort. Kew. 3: 290. 1789.

33a. **Viola pubescens** var. **pubescens.** The morphological nature and nomenclatural status of this violet are discussed under the next variety.





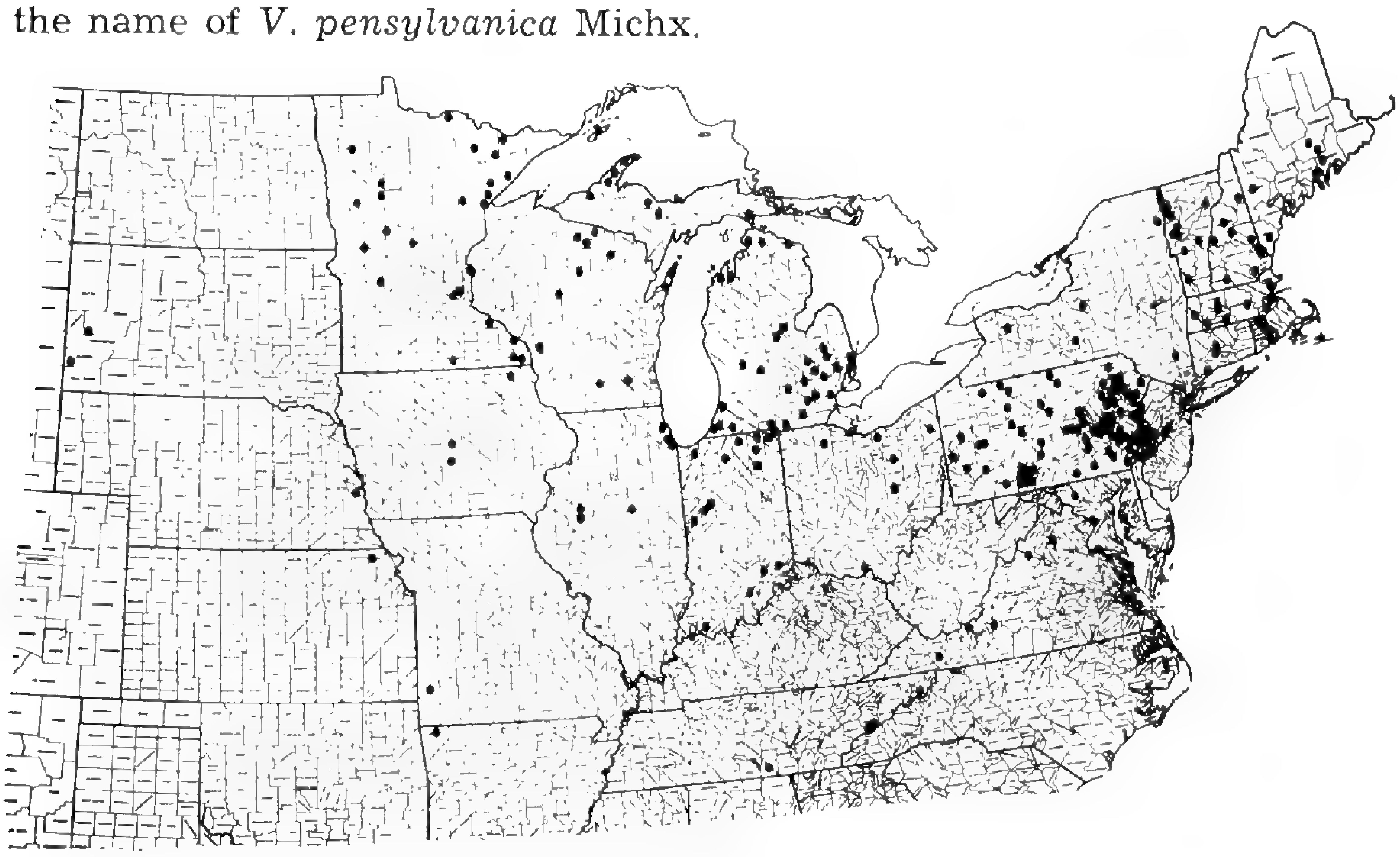
33b. **Viola pubescens** var. **eriocarpa** (Schwein.) Russell, comb. nov. *V. eriocarpa* Schwein., Amer. J. Sci. 5: 75. 1822.

The two varieties of *Viola pubescens* (as treated here) have long been considered separate, though sympatric, species by taxonomists. However such students of the violets as Ezra Brainerd (1921) have noted their intergradation in nature and remarked upon the difficulty of distinguishing them. After studying several thousand specimens, including many population samples, I believe that only a single species exists and that the two forms represent morphological and ecological extremes, most separate in the eastern part of their ranges.

Brainerd listed a number of differences between the extreme forms, and my observations support them. *Viola pubescens* var. *pubescens* usually has only a single flowering stem, one or two root-leaves, is densely hairy with long hairs, has 30 to 45 coarse teeth on the stem leaves, large broad stipules, and grows erect and tall (up to a foot or more) in shaded, dry forests on sandy soil. *Viola pubescens* var. *eriocarpa* extremes have several flowering stems, five or more root leaves, are finely pubescent to glabrate, have 25-30 teeth on stem leaves, smaller, narrower stipules, and grow spreading and partially prostrate (often six inches or less tall) in moist, open meadows.

The nearest relative (morphologically) of these two varieties seems to be *Viola glabella* Nutt. of the Black Hills (where it is indistinguishable from *V. pubescens* var. *eriocarpa)* and the western mountains. Further study may well indicate that it is also best considered a variety of *V. pubescens.* In the Appalachian Mountains, two other members of the group of stemmed yellow violets are *V. hastata* and *V. tripartita.* See the discussions of them for remarks upon their affinities.

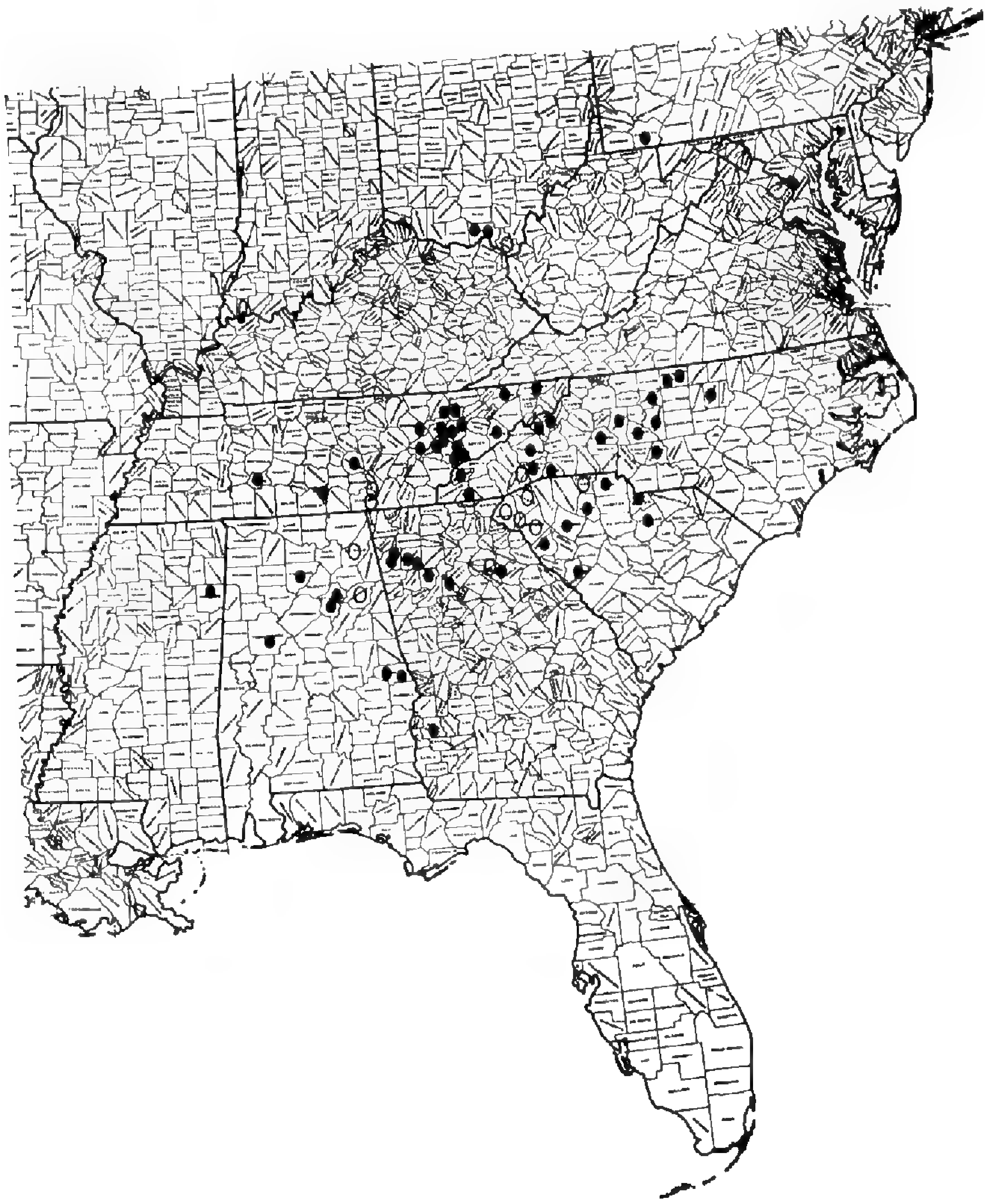
For many years recently *V. pubescens* var. *eriocarpa* has gone under the name of *V. pensylvanica* Michx.

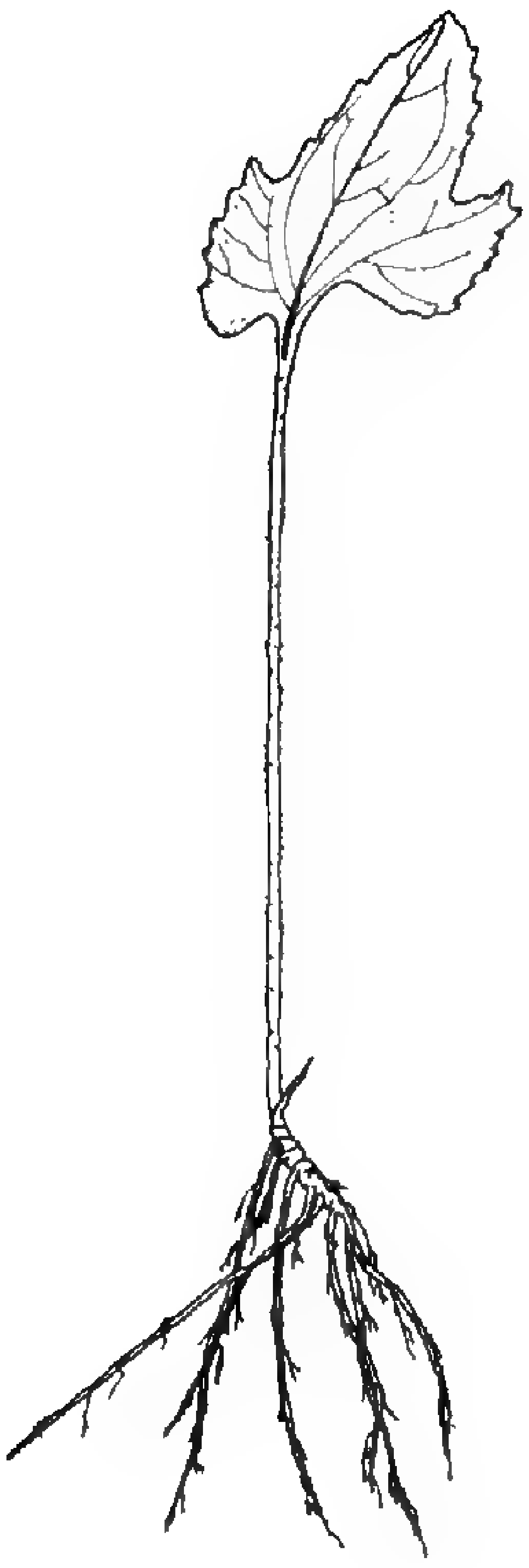


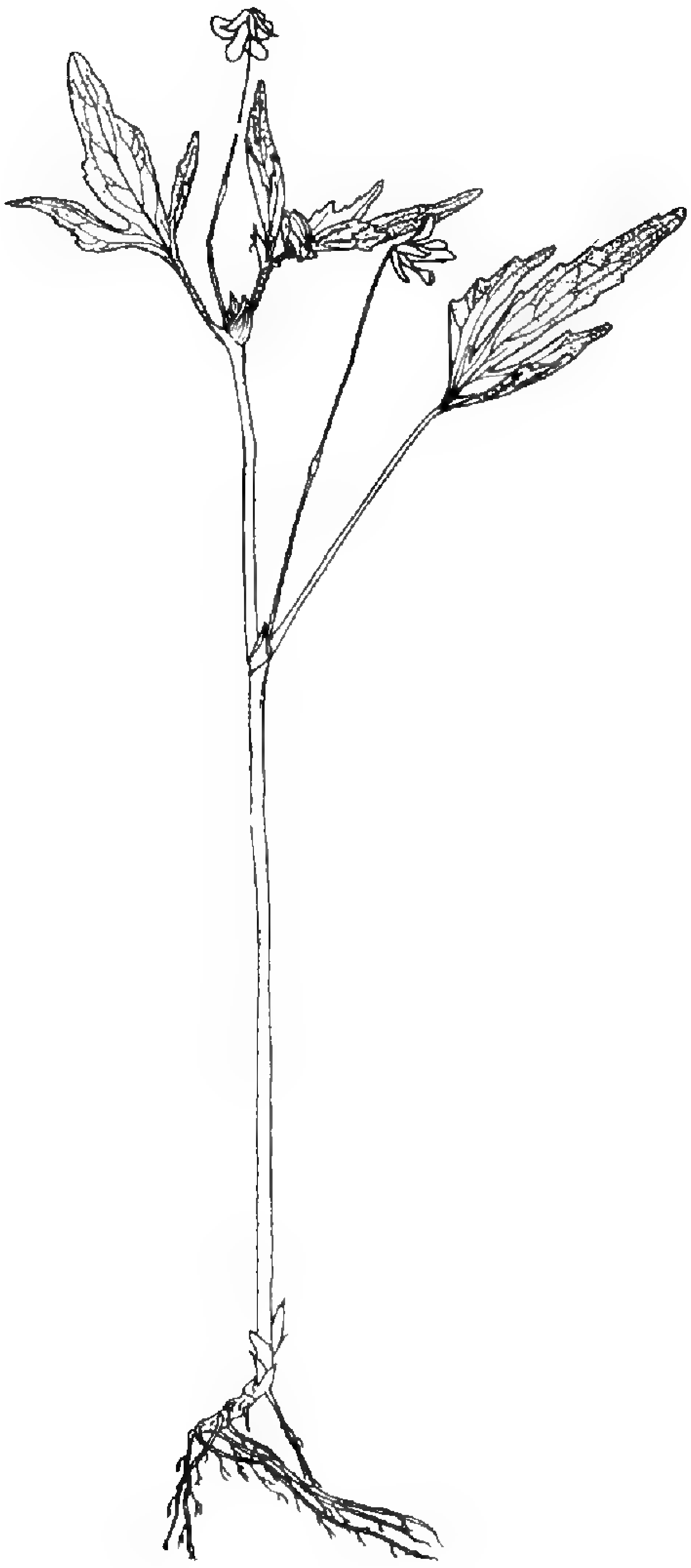
34. **Viola tripartita** Ell., Sketch Bot. S.C. & Ga. 1: 302. 1818.

This species, often very similar to *V. pubescens* var. *pubescens* in general form, is noted for the dimorphism of its few leaves, which vary from entire to deeply three-lobed. The name above was originally applied to the form with parted leaves and the names *V. tripartita* var. *glaberrima* (Ging.) Harper and *V. tripartita* forma *glaberrima* (DC.) Fern. to plants with uncut leaves. I do not recognize the two forms as nomenclaturally distinct here. They are sympatric and frequently grow together and intergrade. I have mapped them separately, using open circles for the *glaberrima* form.

Viola tripartita is infrequently encountered in southern Appalachian forests. I have found it in relatively dry ravines in older, mixed deciduous woods, often under oaks and hickories. Though very similar in general aspect to *V. pubescens* var. *pubescens,* its cut or triangular leaves usually render it quite distinct. I know of no instance of its hybridizing with other violets in nature.



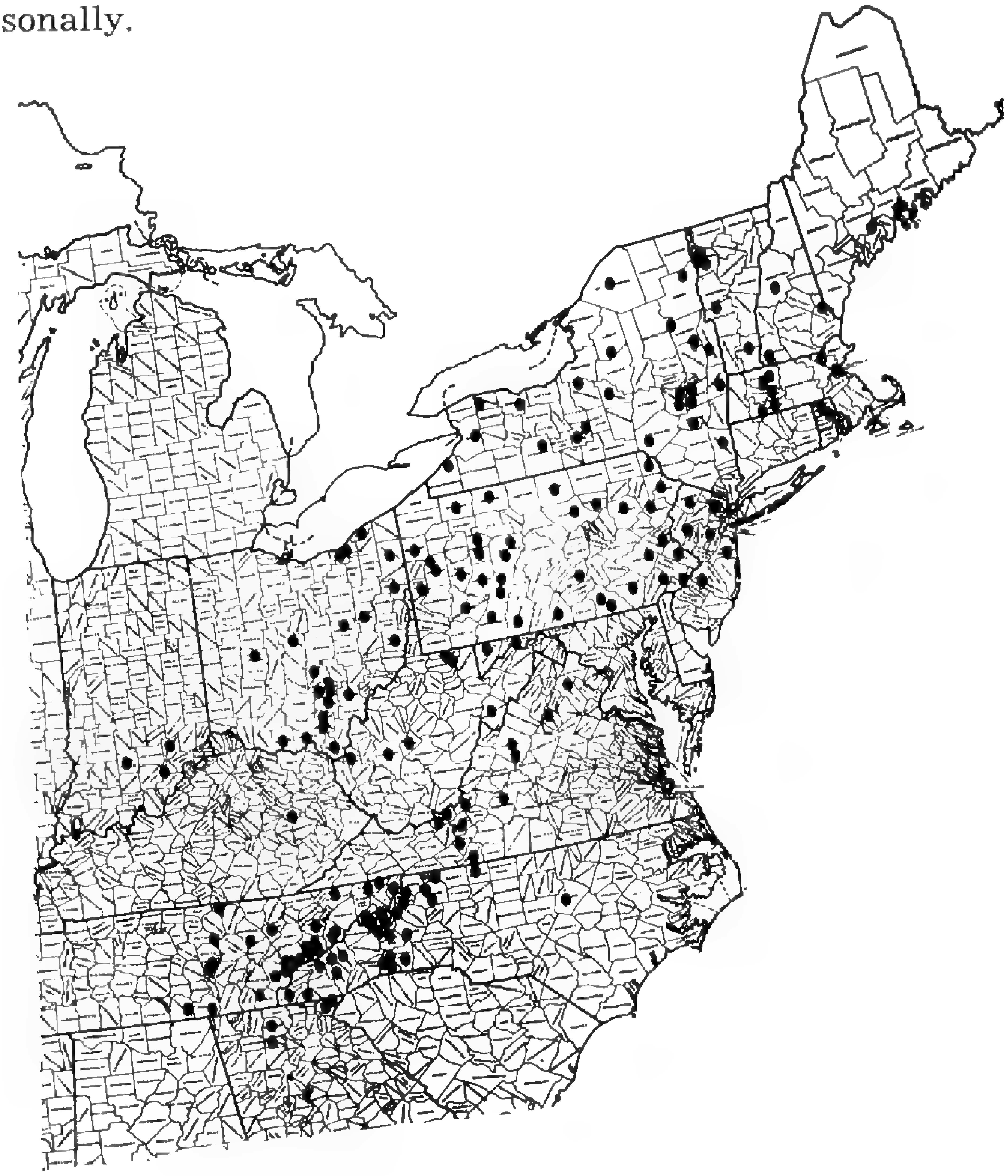




GROUP IV. STEMLESS WHITE VIOLETS.

35. **Viola blanda** Willd., Hort. Berol. t. 24. 1816.

Viola blanda, the "sweet white violet," is primarily an Appalachian species, found westward as far as southern Indiana. It has been confused with *V. incognita, V. macloskeyi* subsp. *pallens,* and *V. macloskeyi* subsp. *macloskeyi* and thus has occasionally been erroneously reported as occurring in such distant states as Minnesota and California. It may be distinguished from the other cordate- or reniform-leaved stemless white violets by the following combination of characteristics. *Viola blanda* has leaves which are always pubescent with short, stiff, white hairs on the upper surfaces of the basal lobes; the shape of the leaf is distinctly cordate or heart-like and very symmetrical. The basal lobes are short and frequently overlap, a good characteristic to use on summer, fruiting specimens. The spex of the leaf is acute or sometimes slightly acuminate. The petals of the open flowers are beardless. Usually, long leafy vegetative stolons are produced; sometimes these may be up to a foot in length. It occurs in moist, shaded, relatively undisturbed forests, most frequently under hemlock, though it may be found occasionally in rich beech-maple forests. It is said that the flowers of *V. blanda* have a faint, sweet odor, but I have been unable to detect this personally.



Morphological variation in *V. blanda* follows an interesting pattern. In the southern Appalachian Mountains of western North Carolina and eastern Tennessee, the plants are at one extreme of variation in many morphological characters, and gradually change from this outward in every direction, particularly to the north, also becoming more variable away from this "center" (Russell, 1956c).

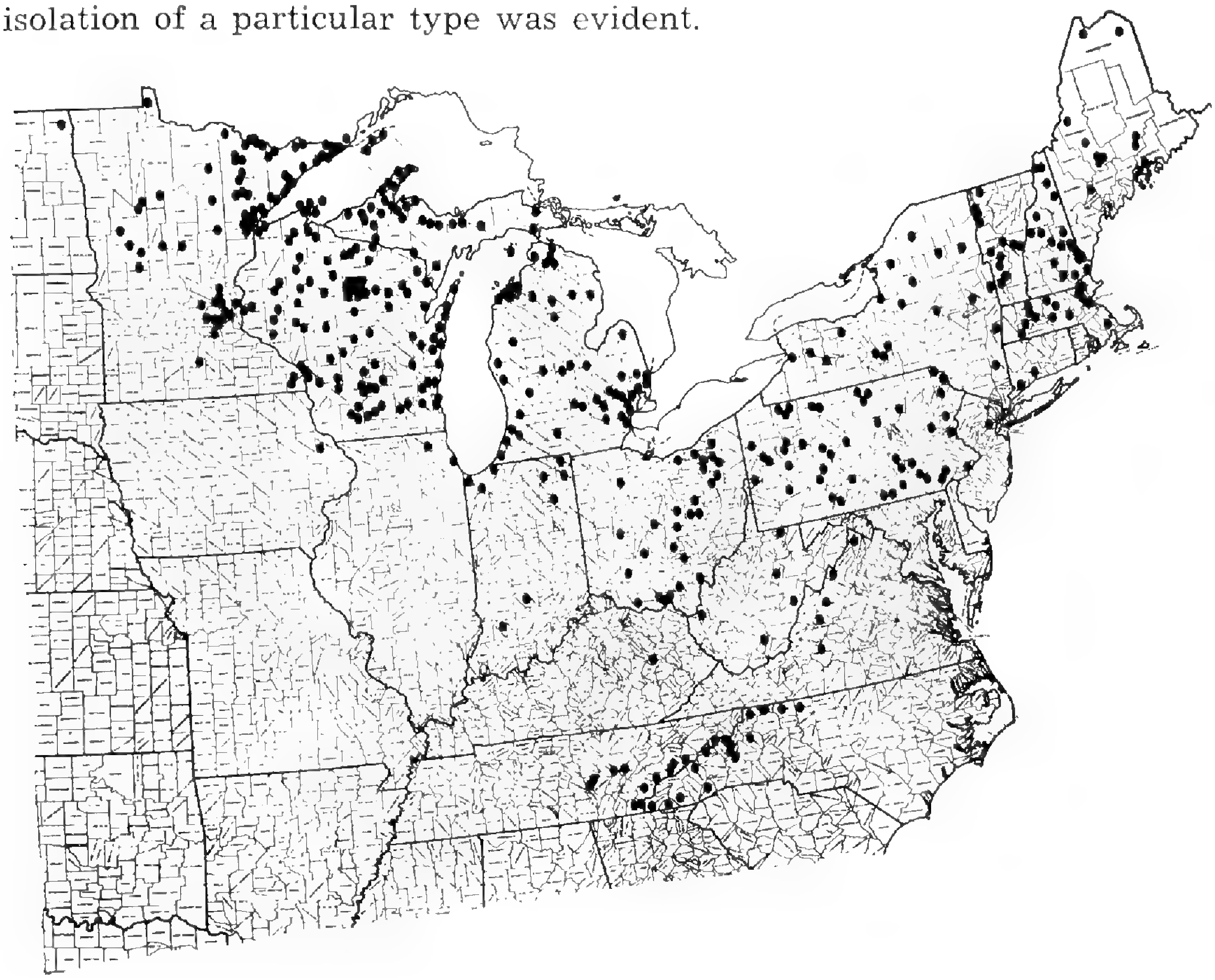
Where *V. blanda* and *V. incognita,* a species very similar to it, grow together there is frequently morphological intergradation between them, and a rather strong case for hybridization and introgression may be made. I have published an analysis of one such case (Russell, 1954b) in western Pennsylvania and have observed other similar situations elsewhere, particularly in the Southern Appalachians. The chromosome number of the two species has been said to be the same (2n=48) (Gershoy, 1934), and in the paper cited above I discussed the possibility of a close evolutionary and genetic relationship between them. *V. incognita* is principally found in glaciated territory and *V. blanda* in non-glaciated.

36. **Viola incognita** Brainerd, Rhodora 7: 248. 1905.

Brainerd (1921) reviewed the interesting and sometimes confusing history of the recognition of this common, tiny, white-flowered violet. It continues to be confused by taxonomists, particularly with *V. blanda* and *V. macloskeyi* subsp. *pallens*—as evidenced by the many errors in annotation I have come across in various herbaria. A typical plant of *V. incognita* has even recently been named as a new variety of *V. blanda*.

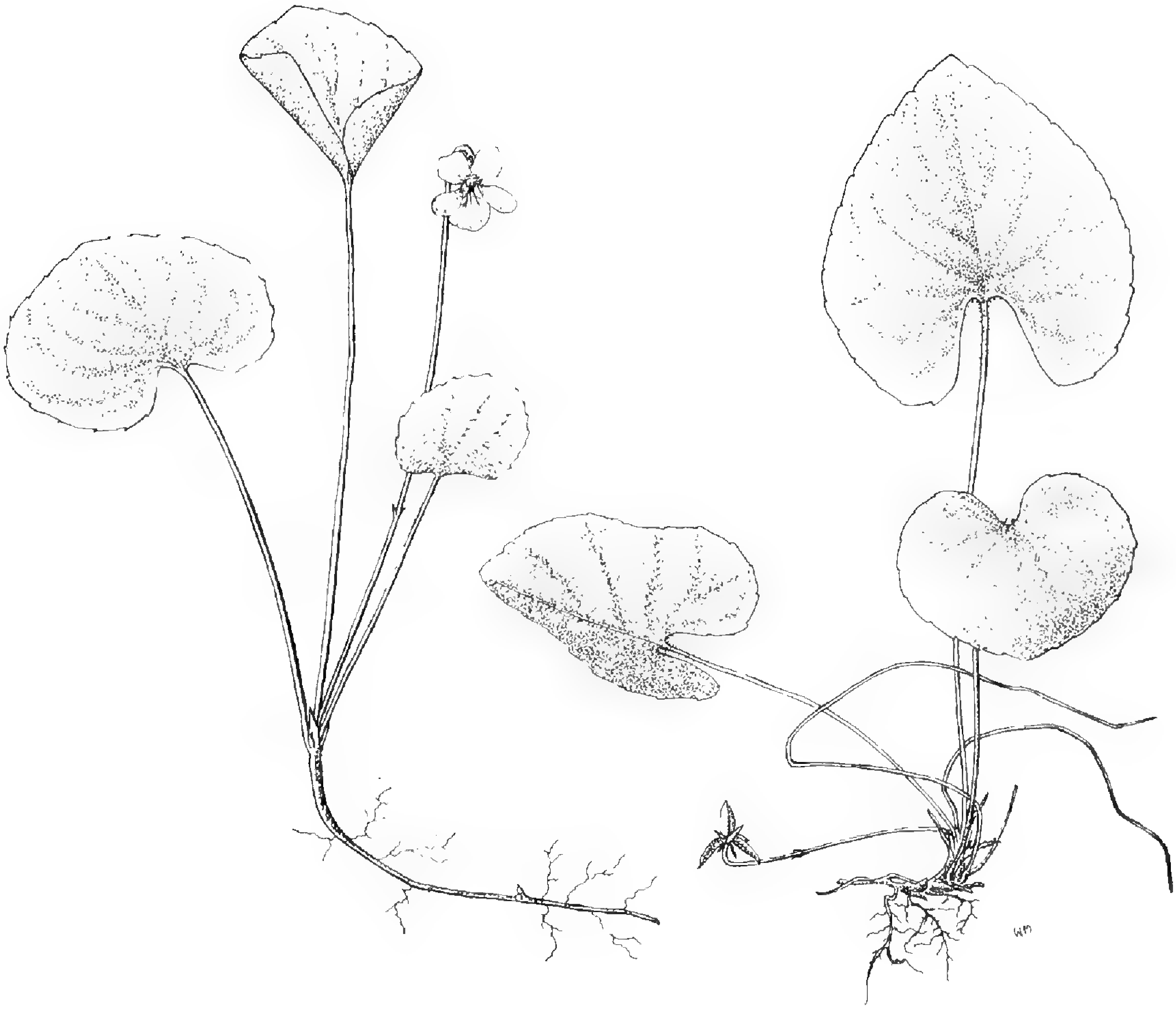
Viola incognita differs from *V. blanda* and the other stemless whites by the combination of the following characteristics: a marked beard on the inner faces of the lower pair of petals, broadly cordate leaves with large, diverging lobes, laminas always pubescent, vigorous vegetative stolons (not so leafy as thoses of *V. blanda)*, cleistogamous fruits purple or purple-flecked on prostrate peduncles, and seeds 1.6-2.0 mm. long.

Morphological variation, though not obvious, is considerable, and shows (as in *V. blanda)* patterns centering in the Southern Appalachians (Russell, 1956c). Lamina pubescence varies bewilderingly. Brainerd and others recognized (nomenclaturally) two varieties, one with the pubescence on both surfaces of the lamina (var. *incognita)* and the other with the pubescence only on the upper surfaces (var. *forbesii)*, as in *V. blanda*. An extensive geographical analysis of lamina pubescence types (Russell, 1954a) failed, however, to reveal the presence of two such entities; instead, virtually every conceivable pattern of distribution of lamina pubescence was found, and no geographical or ecological isolation of a particular type was evident.



As noted in the discussion of *V. blanda, V. incognita* apparently hybridizes occasionally with *V. blanda* and perhaps also with *V. macloskeyi* subsp. *pallens*. It is most similar to *V. blanda* and may have been derived from the same ancestral form.

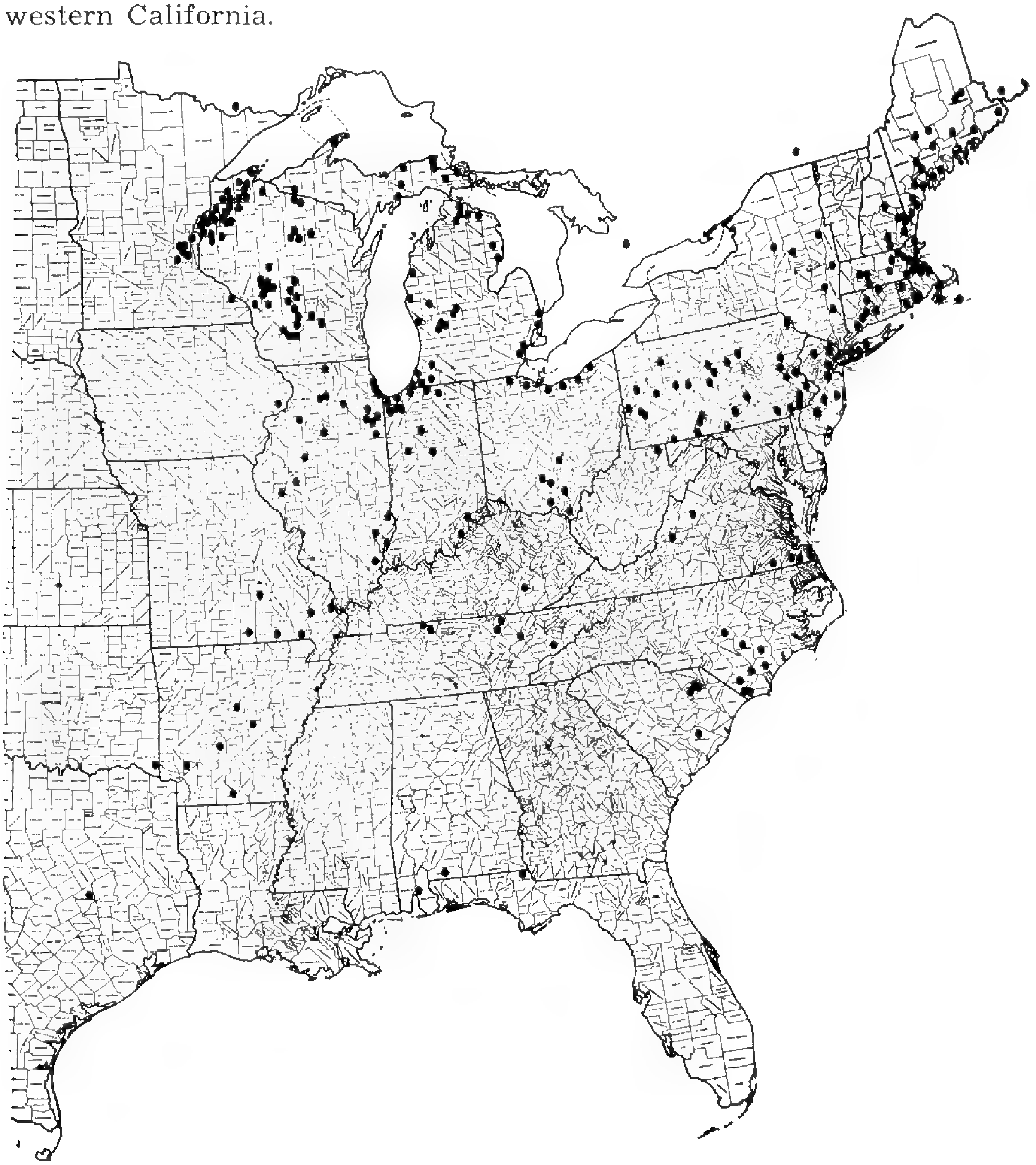
Viola incognita occurs usually in rich deciduous forests as well as occasionally under pines and hemlock in mixed forests. Where the soil is rich and undisturbed the plants may spread rapidly by means of vegetative stolons and form large colonies. It is found extensively in southeastern Canada, extending as far northward as southern Labrador.

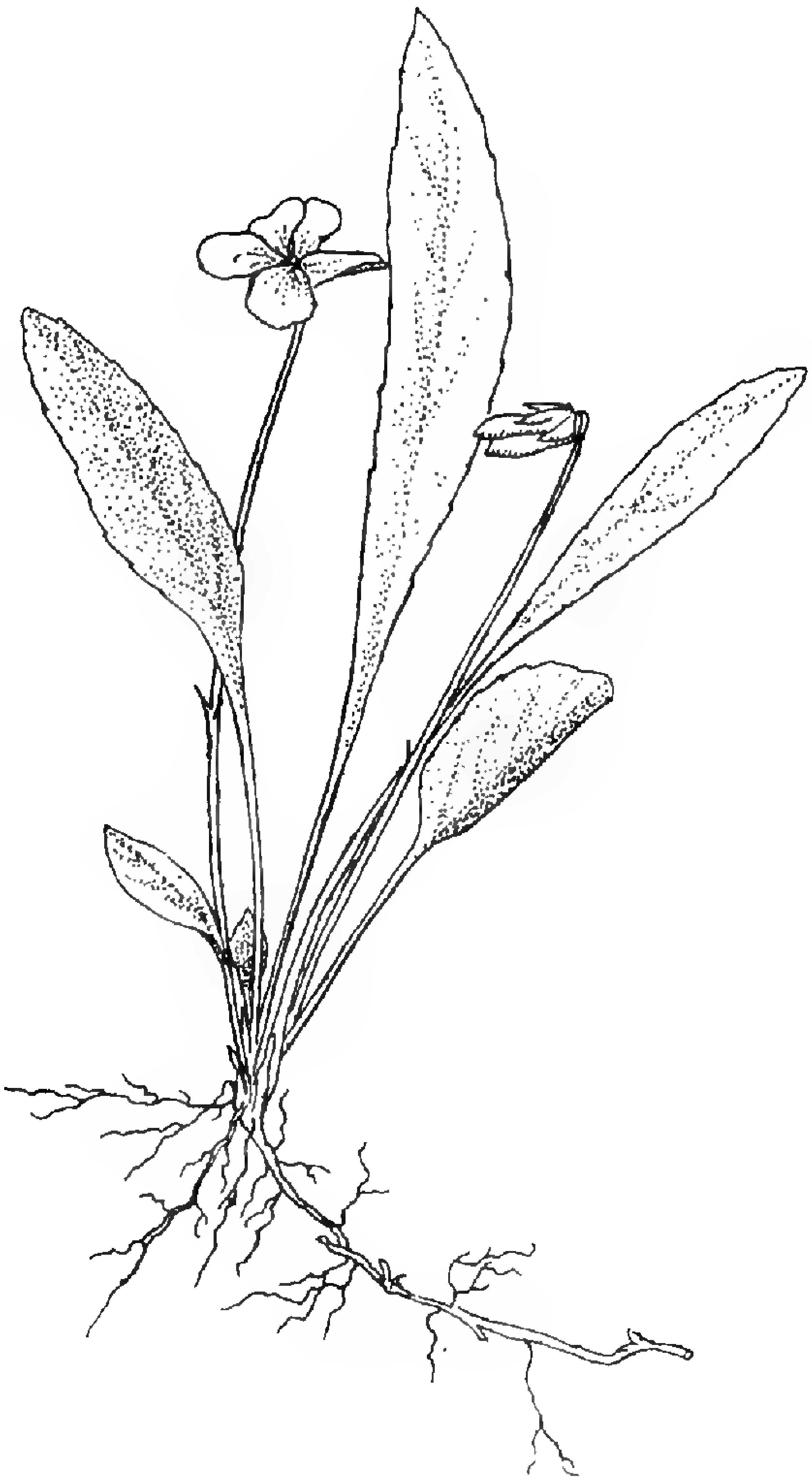


37. **Viola lanceolata** L., Sp. Pl. 134. 1753.

37a. **Viola lanceolata** subsp. **lanceolata.**

This is found in open, sunny, sandy areas, frequently beside streams and ponds. In the eastern part of its range it often occurs with *V. primulifolia,* with which it hybridizes and backcrosses freely. In the northern parts of its range it sometimes grows with *V. macloskeyi* subsp. *pallens* and produces a hybrid with that species which remarkably resembles *V. primulifolia* (see discussion of *V. macloskeyi* subsp. *pallens*). To the south *V. lanceolata* subsp. *lanceolata* gradually merges with *V. lanceolata* subsp. *vittata,* from which it differs primarily in leaf shape. In addition to its eastern range it has also been collected in cranberry bogs in western Washington. A third form, *V. lanceolata* subsp. *occidentalis* (Gray) Russell, is found in southwestern Oregon and northwestern California.

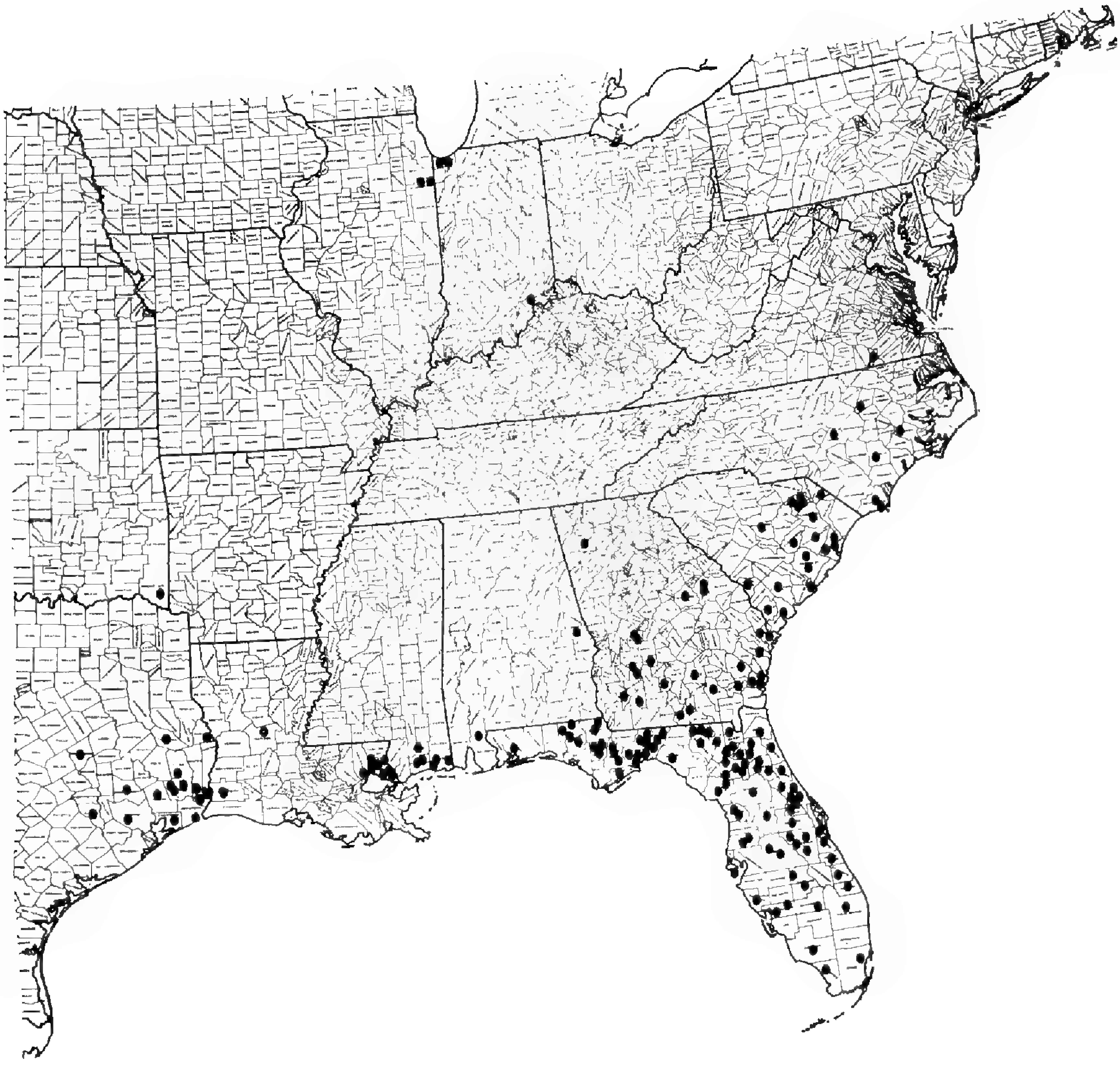




37b. **Viola lanceolata** subsp. **vittata** (Greene) Russell, Amer. Midl. Nat. 54: 484-485. 1955.

This distinctive violet occurs abundantly on the southeastern coastal plain in sandy soil in open ditches and beside streams. The mature summer leaves may be as much as a foot in length and up to fourteen times as long as broad. To the north it gradually merges with *V. lanceolata* subsp. *lanceolata*. It occasionally hybridizes with *V. primulifolia*.

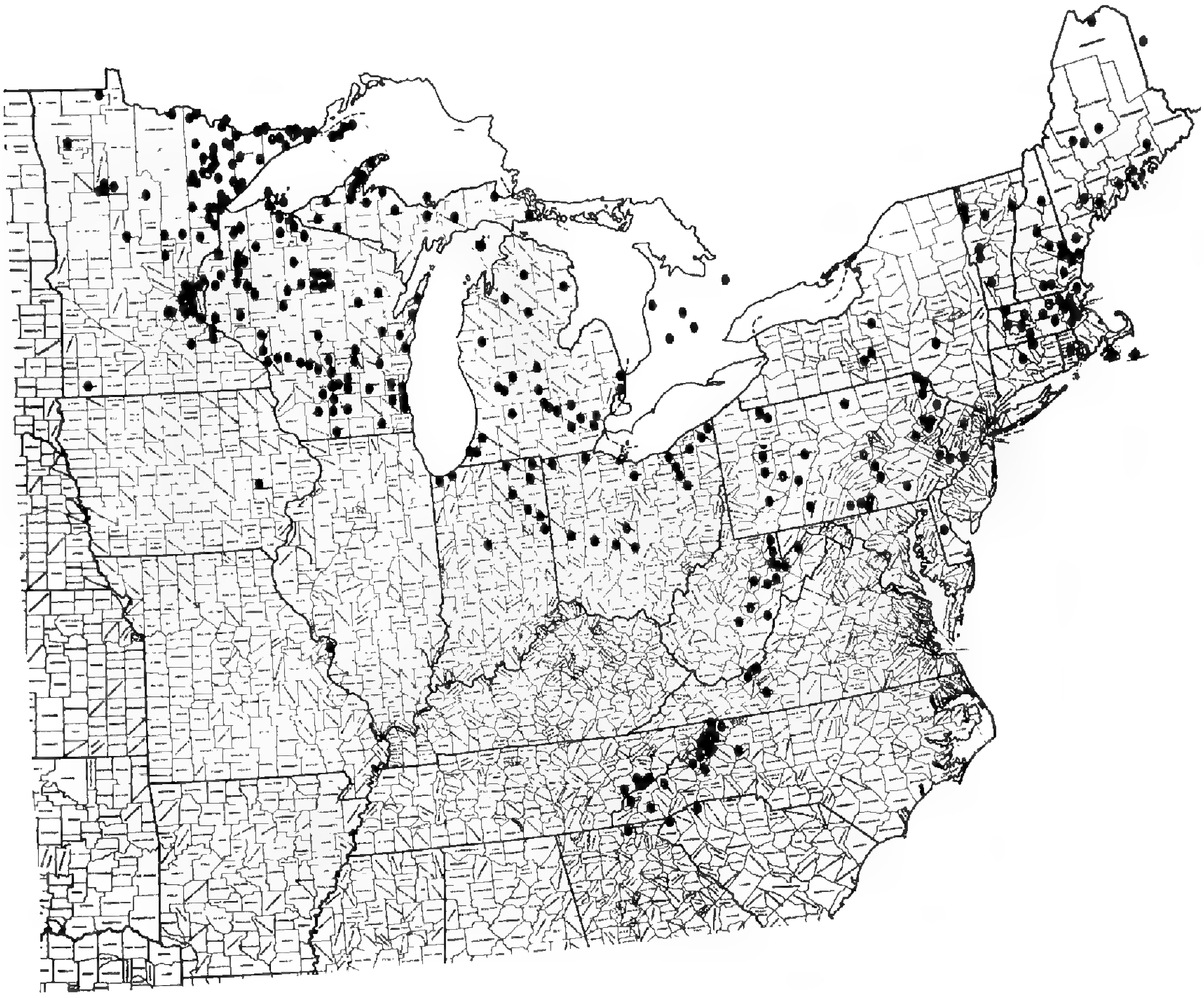
On the preceding page, the specimen at the right is a spring plant of this subspecies.



38. **Viola macloskeyi** Lloyd subsp. **pallens** (Banks) M. S. Baker, Madrono 12: 60. 1953.

Viola macloskeyi subsp. *pallens* has a divided range, not being found in the central prairie states of North Dakota, South Dakota, and Nebraska. In the western part of its range, it grades gradually into *V. macloskeyi* subsp. *macloskeyi*. Its variation patterns in the east indicate an Appalachian extreme of variation in most morphological characteristics with gradual clines outward from this. The peculiar western and eastern patterns were explained in a previous paper (Russell, 1956c) as probably being the result of two range separations in the past. The first, perhaps in the early Tertiary, resulted in the formation of the two subspecies; the second, probably in the Pleistocene, resulted in separating the two portions of *V. macloskeyi* subsp. *pallens*.

This tiny violet is found in very wet situations, either in the open or in partial shade. It frequently occurs with other stemless white violets, and may be distinguished from *V. incognita*, *V. renifolia*, and *V. blanda* by its completely glabrous leaf blades with pubescent petioles (usually). The flowers are the tiniest found in the stemless white violets.



Viola macloskeyi subsp. *pallens* has been demonstrated to hybridize with *V. lanceolata* subsp. *lanceolata* where they grow together, as occasionally happens in the upper midwest (Russell, 1954b). The F_1 generation is usually very sterile and resembles *V. primulifolia* (No. 39), for which it is often mistaken. I have seen these hybrids from Minnesota, Wisconsin, Michigan, and New England. In New England *V. primulifolia* also occurs, and specimens must be examined carefully to determine whether or not they are the hybrids.

This violet has generally been known as *Viola pallens* (Banks) Brainerd.

39. **Viola primulifolia** L., Sp. Pl. 934, 1753.

In a previous study (Russell, 1955b), two subspecies *(primulifolia* and *villosa)* were recognized, but subsequent observation of herbarium material and especially field populations in southeastern United States has convinced me that they are not distinct. There is a great deal of variation among plants of *V. primulifolia* in leaf shape and pubescence, but it follows no discernible geographical or ecological patterns (Russell, 1956c).

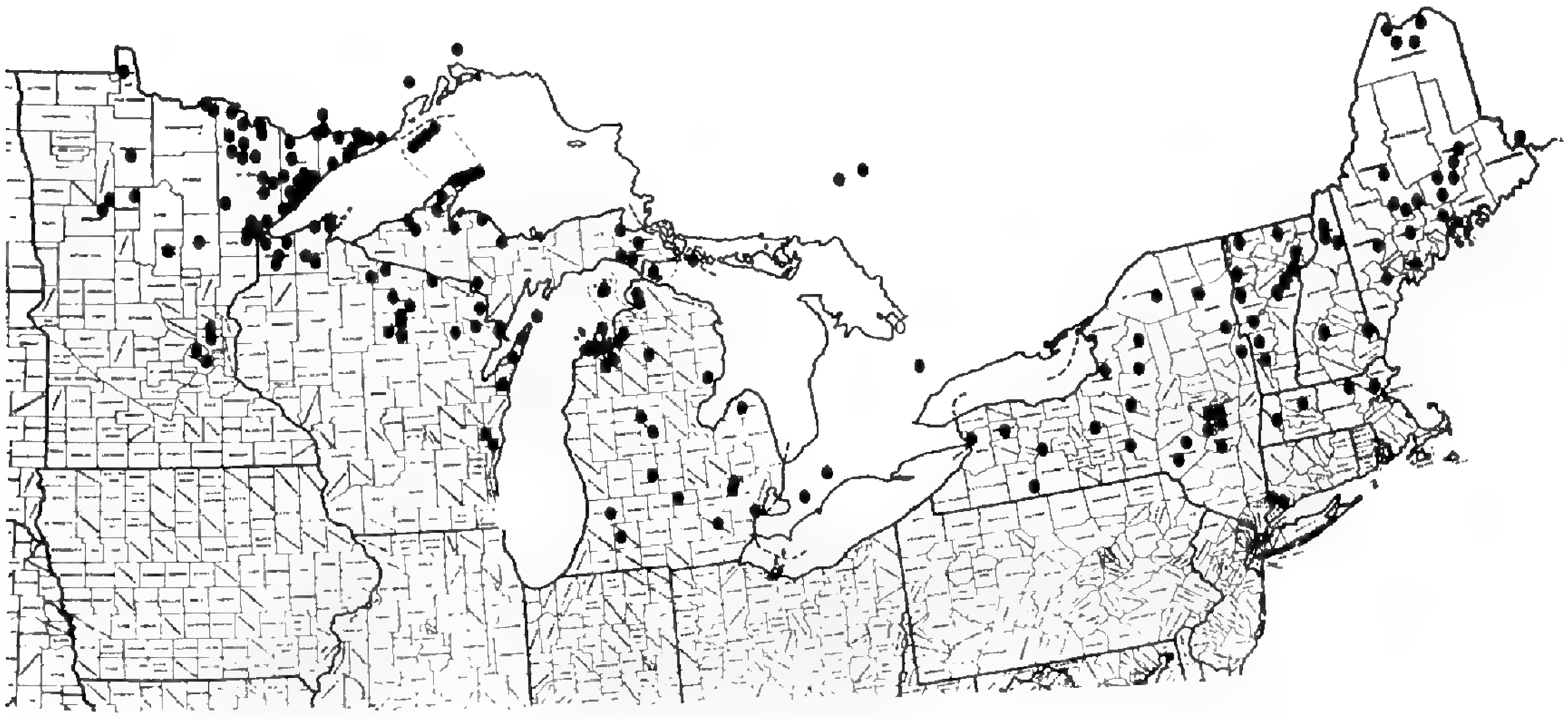
Viola primulifolia occasionally hybridizes with *V. lanceolata* and *V. macloskeyi* subsp. *pallens.* It occurs in moist open meadows and along the edges of streams, particularly in sandy soil.

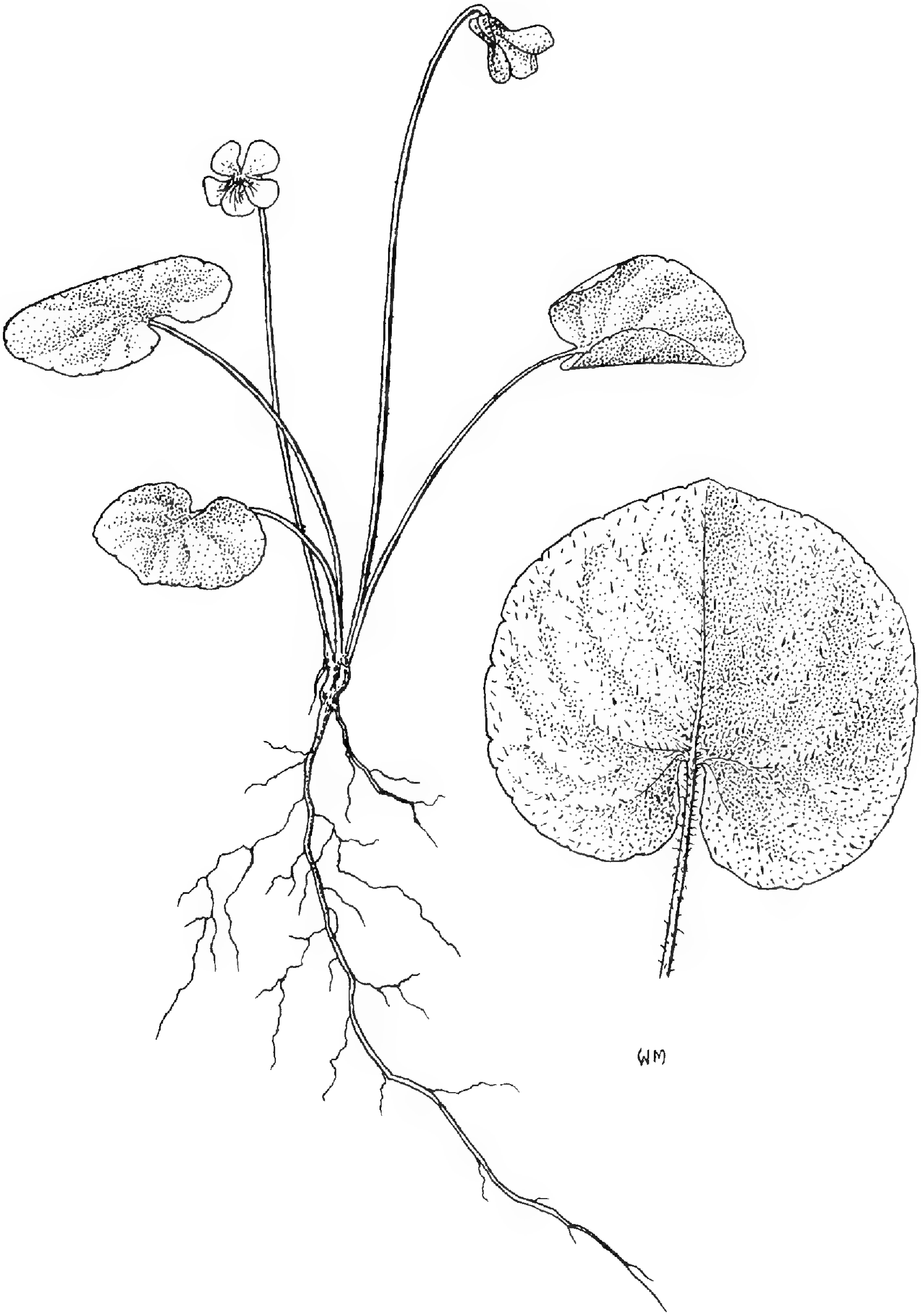
40. **Viola renifolia** Gray, Proc. Amer. Acad. 8: 288. 1870.

Viola renifolia is a widespread and relatively frequent violet in Canada, occurring from southern Labrador to northern British Columbia. In eastern and north central United States it is found entirely in glaciated territory, growing usually under evergreens, particularly spruces, firs, hemlocks, and white cedar. It may be looked for in rather moist, deeply shaded forests, where it occurs as scattered plants, rarely if ever in dense colonies. It has a short, rather thick, often vertical rootstock and never produces above-ground stolons, though rarely it may reproduce vegetatively by short, subterranean rhizome branches. Leaf form is distinctive, all but the first leaf or two produced each year being broadly reniform. Leaf pubescence varies greatly; three classes may be distinguished with difficulty: leaves completely glabrous, laminas pubescent on lower surface and glabrous on upper, and laminas heavily pubescent on both surfaces. However, in a regional analysis of pubescence types (Russell, 1954a), I concluded that these types were not sufficiently distinct morphologically or geographically to merit nomenclatural recognition.

In an analysis of variation of several morphological characteristics throughout its range (Russell, 1956c), I found *V. renifolia* to be one of the two or three least variable of the North American violets. Specimens from various parts of its range are virtually indistinguishable. In addition, the only instance I have seen where there was a suspicion of hybridization was in a white cedar bog forest north of Minneapolis, Minnesota (Russell, 1954b). Here *V. renifolia* grew with *V. incognita* and *V. macloskeyi* subsp. *pallens*. Specimens of all three species had unusual characteristics that may have arisen as a result of hybridizations and resultant introgression.

Viola renifolia has been said to have a diploid chromosome number of 24 (Gershoy, 1934). Some other distinctive characteristics are the absence of beards on the petals, and the summer production of purple or purple-flecked cleistogamous capsules on short, deflexed peduncles.

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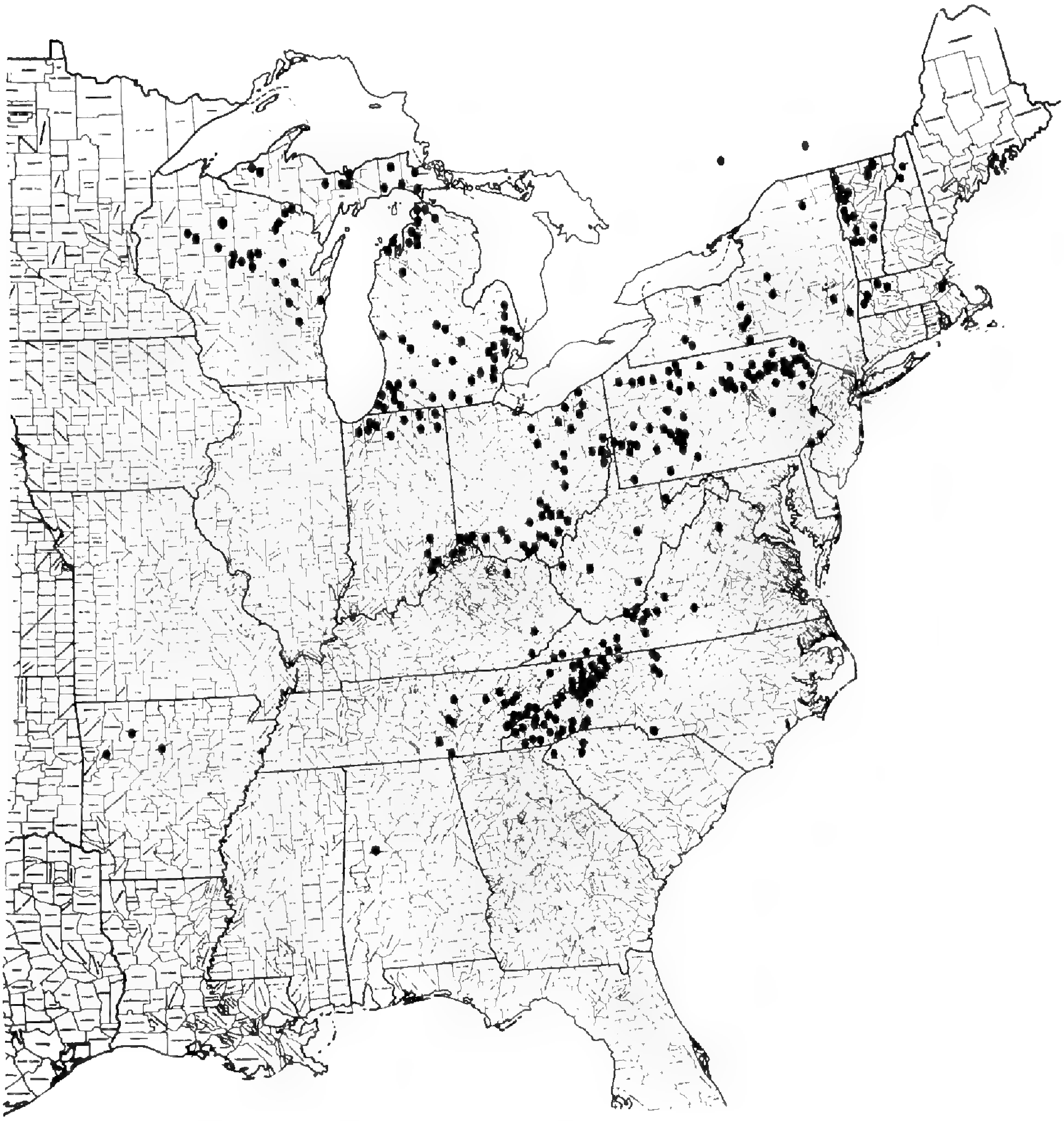
GROUP V. STEMMED WHITE VIOLETS.

41. **Viola canadensis** L., Sp. Pl. 936. 1753.

41a. **Viola canadensis** var. **canadensis.**

This beautiful violet, like *V. adunca* and *V. nephrophylla,* occurs commonly both in northeastern United States and in the mountains of the west. It has been studied extensively in the Rocky Mountains, where the greatest morphological variation is found, by Mrs. Shirlee Cavaliere (Cavaliere and Russell, ms.), and the statements below are based in large part upon her observations and population analyses.

Taxonomists in the past have considered the *V. canadensis* complex as consisting of four species: *V. canadensis, V. rugulosa* Greene, *V. scopulorum* (Gray) Greene, and *V. rydbergii* Greene. Several other entities were named by E. L. Greene but reduced to synonymy by



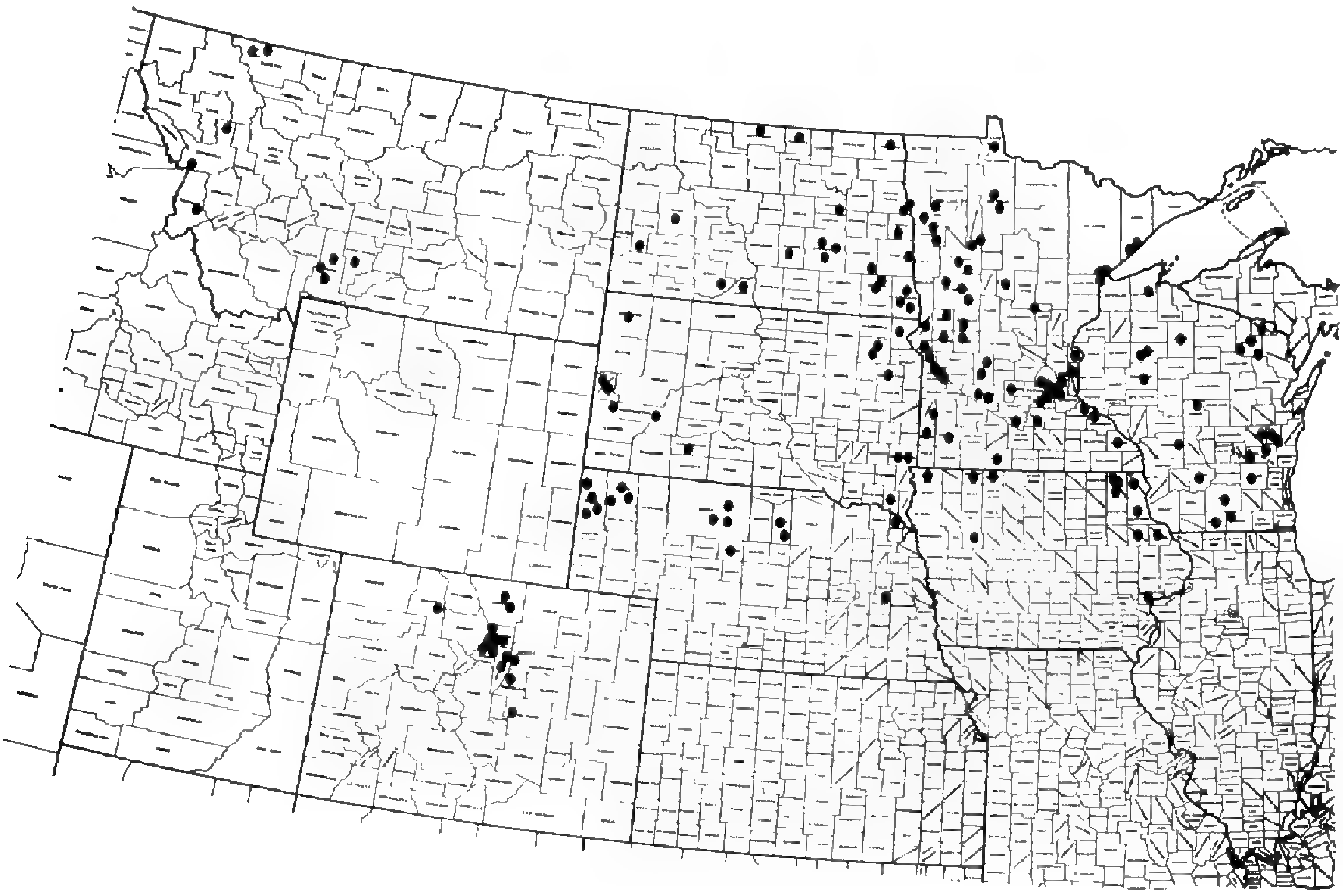
Brainerd (1921). I consider only a single species to be present, with an eastern and western form (var. *canadensis*), and a midwestern form (var. *rugulosa*). Mrs. Cavaliere was unable to find altitudinal or latitudinal forms in the Rockies. Both in the lower forests on the eastern front of the Rocky Mountains and in Wisconsin, where the two varieties meet, there is a gradual change from one to the other. In the Rockies there is a diminution in size of plants of var. *canadensis* at higher elevations, but this is not marked.

The two recognized varieties differ in a number of characteristics. Variety *rugulosa* has long, cord-like rhizomes, while variety *canadensis* ordinarily has short, slow-growing, thicker rhizomes. However this characteristic is not always constant. I have collected specimens of var. *canadensis* in the southern Appalachians and in New York with rhizomes like those of variety *rugulosa*. Indeed, based on just this characteristic, variety *rugulosa* has been reported in the east (Pratt, 1950).

Leaf shape differs in the two varieties. Variety *canadensis* has leaves about as long as broad, with attenuate apices, especially high on the flowering stem. Variety *rugulosa* has broad, reniform basal leaves with acute apices. Variety *rugulosa* tends to be slightly more hairy than variety *canadensis*, and its flowers are smaller with broader lateral petals. The petals of variety *rugulosa* are often completely purple-tinged on the back sides, and only partially so in variety *canadensis*.

41b. **Viola canadensis** var. **rugulosa** (Greene) C. L. Hitchcock, Vasc. Pl. Pacific N.W. 3: 442. 1961.

Miss Monserud's drawing is of a specimen from the type locality near Minneapolis, Minnesota, and illustrates very well the characteristics which separate variety *rugulosa* from variety *canadensis*. These are



discussed under the latter. In the Rocky Mountains Greene recognized a *Viola rydbergii*, but plants of this are not distinguishable from the more eastern ones which he placed under *V. rugulosa*.

Viola canadensis var. *rugulosa* grows in sandy soil in rather open, often disturbed, river forests. Occasionally it may occur in other habitats, such as open pine forests.

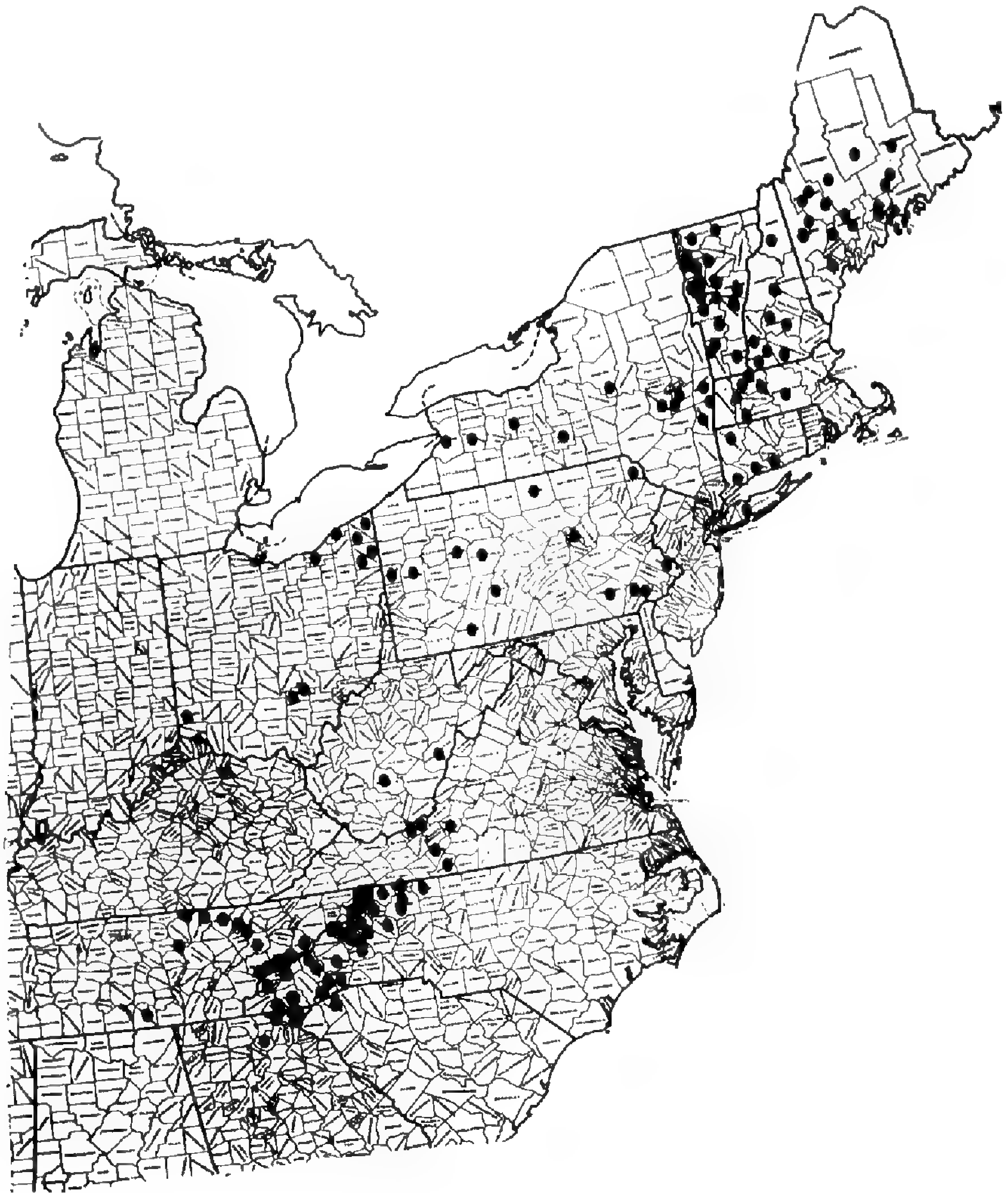
GROUP VI. STEMLESS YELLOW VIOLETS.

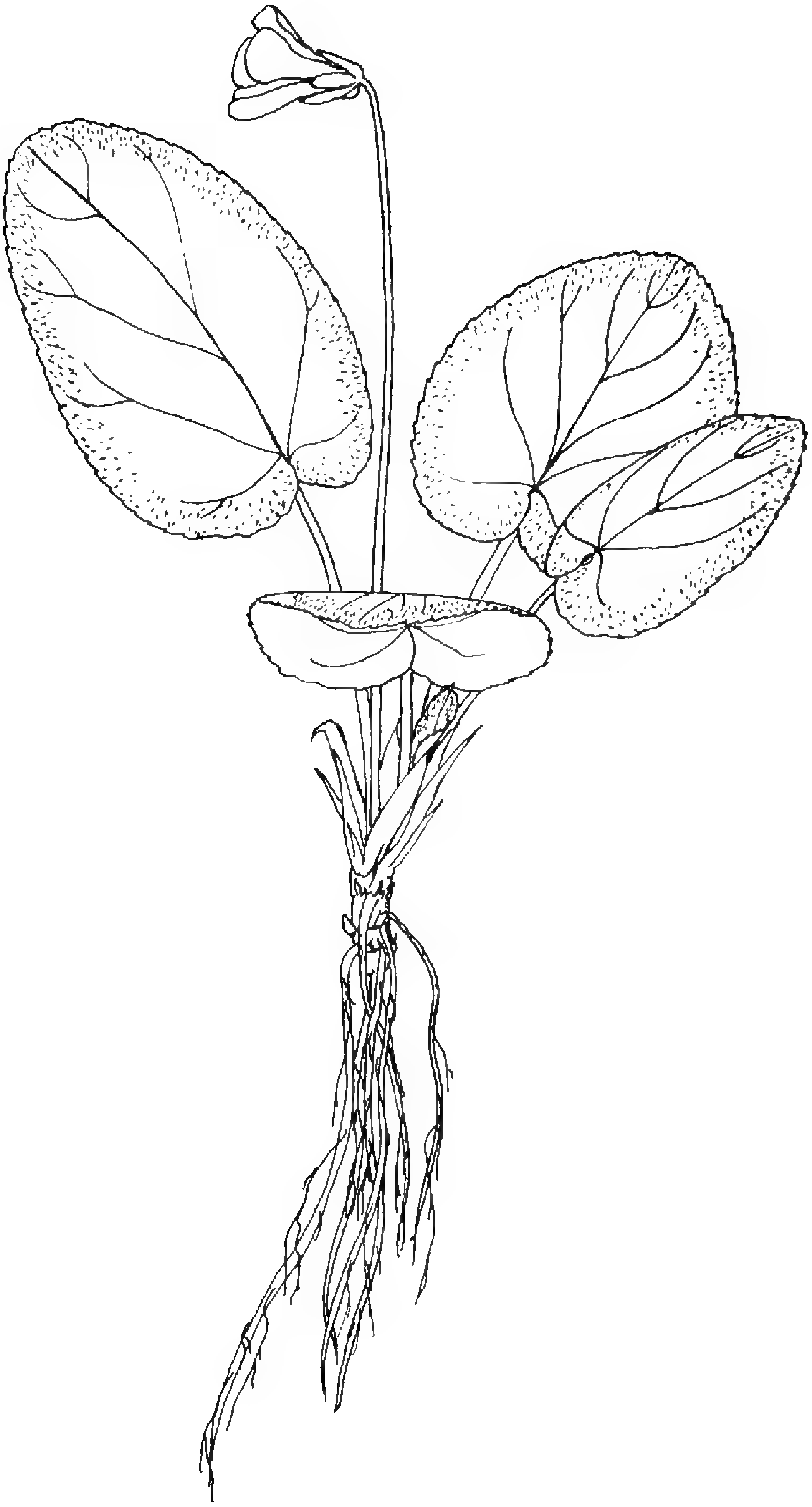
42. **Viola rotundifolia** Michx., Fl. Bor.-Am. 2: 150. 1803.

The nearest relative of this distinctive and beautiful violet is *Viola orbiculata* Geyer, native of the Pacific Northwest. *V. rotundifolia* is one of the most invariable of violets. In an earlier study (Russell, 1955a) no clinal variation in morphological characteristics could be found and little variation of any sort, for that matter.

Viola rotundifolia occurs in rich deciduous (especially beech) and hemlock-hardwood forests throughout its range, often forming mixed colonies with *V. blanda.* In the spring it can be distinguished by its small leaves and tiny yellow flowers; in summer by the large, oval, fleshy leaves which lie flat on the soil. In addition it sometimes produces raceme-like clusters of purple cleistogamous capsules. It is not known to hybridize with any other violet.

Viola rotundifolia has the lowest chromosome number known for North American violets (n=6, Gershoy, 1934) and may thus be considered one of the more primitive of violets (Clausen, 1929). Its western relative, *V. orbiculata,* has a chromosome number of n=12 and may have arisen as an autopolyploid of *V. rotundifolia* or as an allopolyploid from a cross between *V. rotundifolia* and one of the stemmed yellow violets.





GROUP VII. WILD PANSIES.

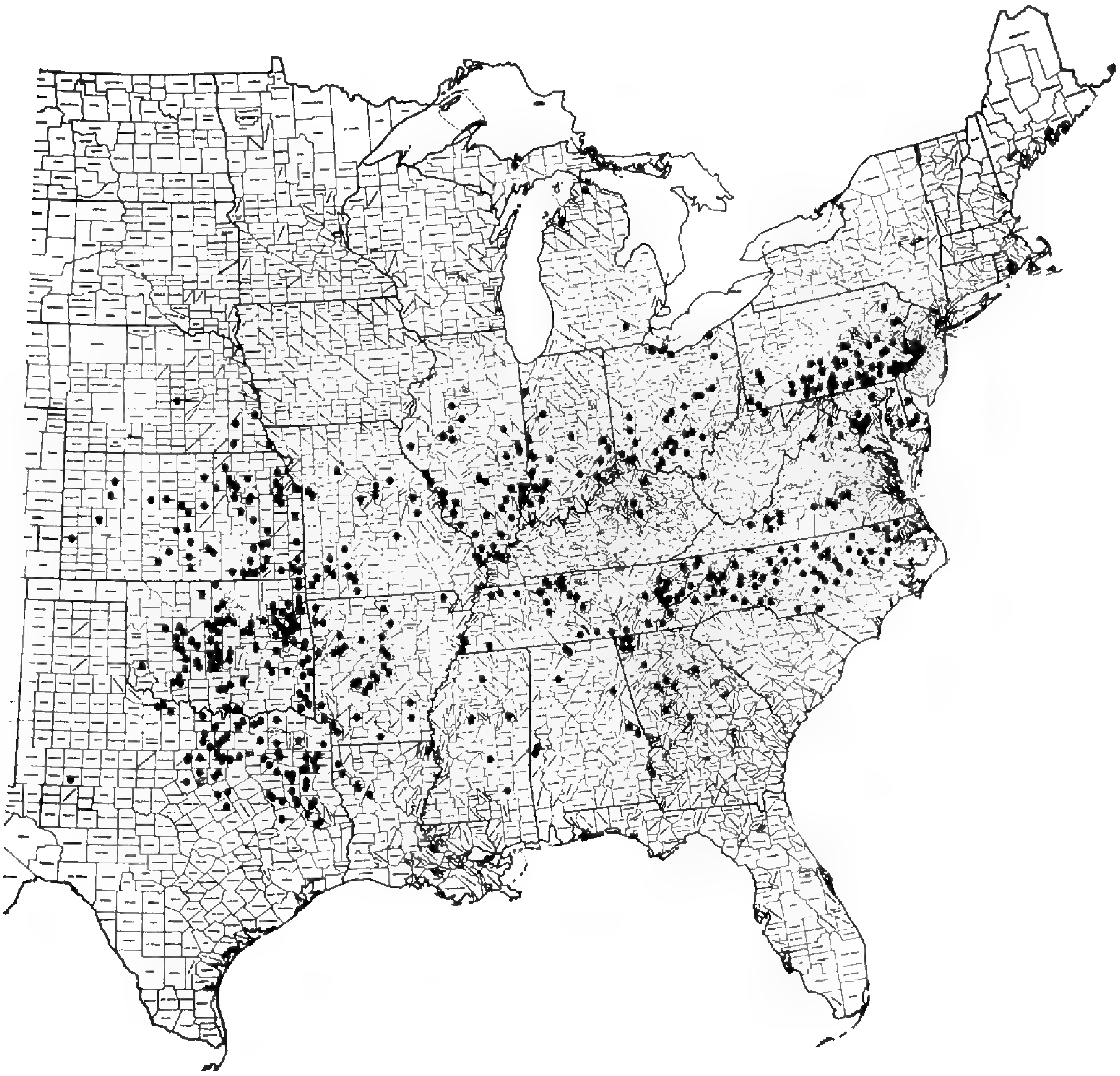
43. **Viola arvensis** Murray, Prodr. Stirp. Goetting. 73. 1770.

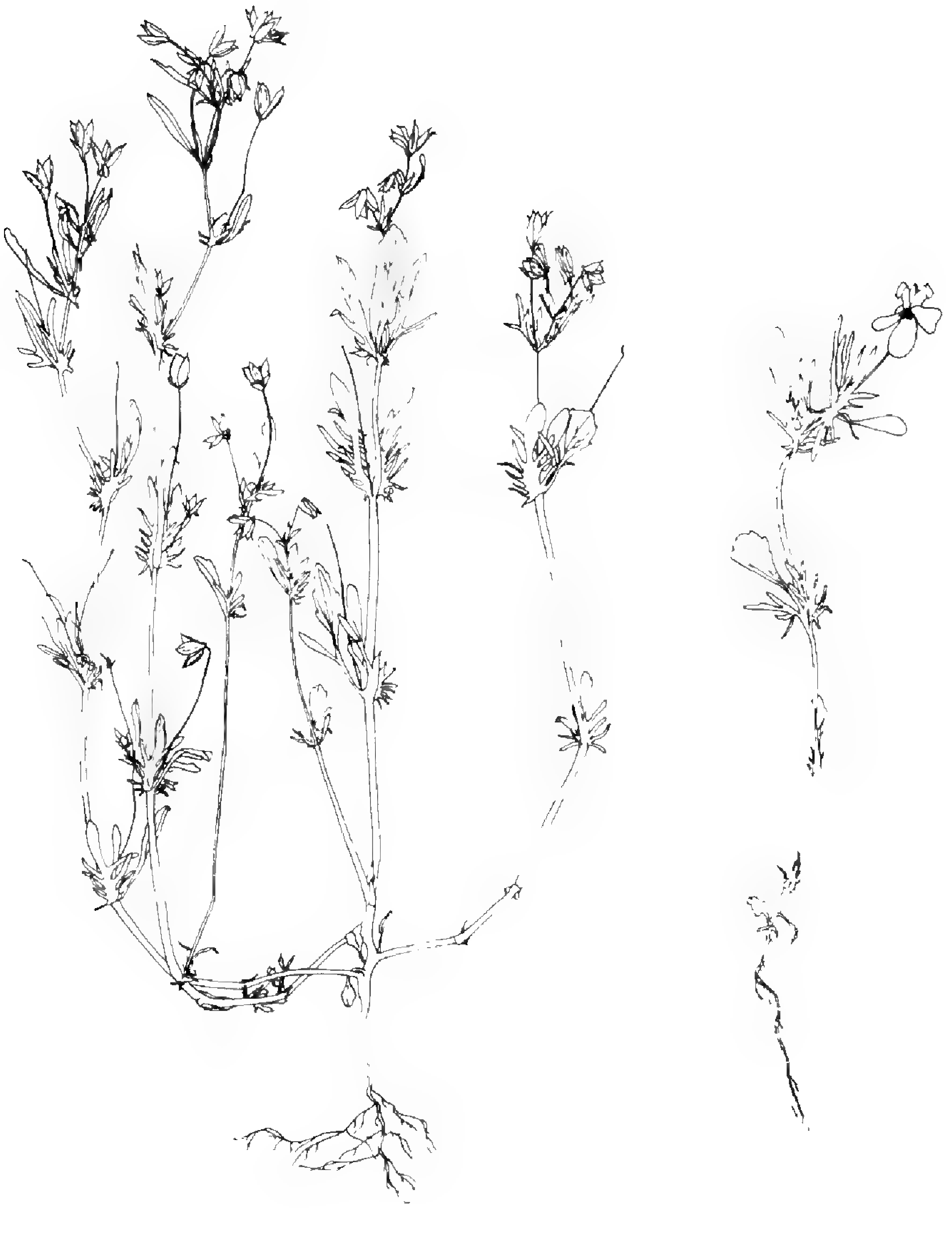
This species has been introduced from Europe and occurs sparingly in the United States, usually in or near cultivated fields or on weedy roadside banks. It is probably more common than the map shows, due to the tendency of many botanists to ignore weeds. Brainerd (1921) said that "sometimes it is a troublesome weed in the South." It resembles *V. rafinesquii* but differs in having more or less yellow petals equalled or exceeded by the sepals.

44. **Viola rafinesquii** Greene, Pittonia 4: 9. 1899.

This species has in recent years been called *V. kitaibeliana* var. *rafinesquii* and *V. bicolor*. Fernald, Asa Gray, and others maintained that it was introduced from Europe. My own strong conviction, based upon observations of its range and ecology, is that it is a native American species, a long-time member of the midwestern and southwestern flora, perhaps originally derived from Mexico. Shinners (1961) and Clausen, Channell, and Nur (1964) have very convincingly presented the case for its acceptance as a native species of the United States.

Viola rafinesquii is a delicate, beautiful little violet, related to the wild pansies of Europe. It is an annual, and like most annuals is more abundant in some years than in others. In addition to the locations shown on the map, it has been collected near Boulder, Colorado (Brainerd, 1921), and at several locations near Payson on the Mogollon Rim in central Arizona.





GROUP VIII. MISCELLANEOUS.

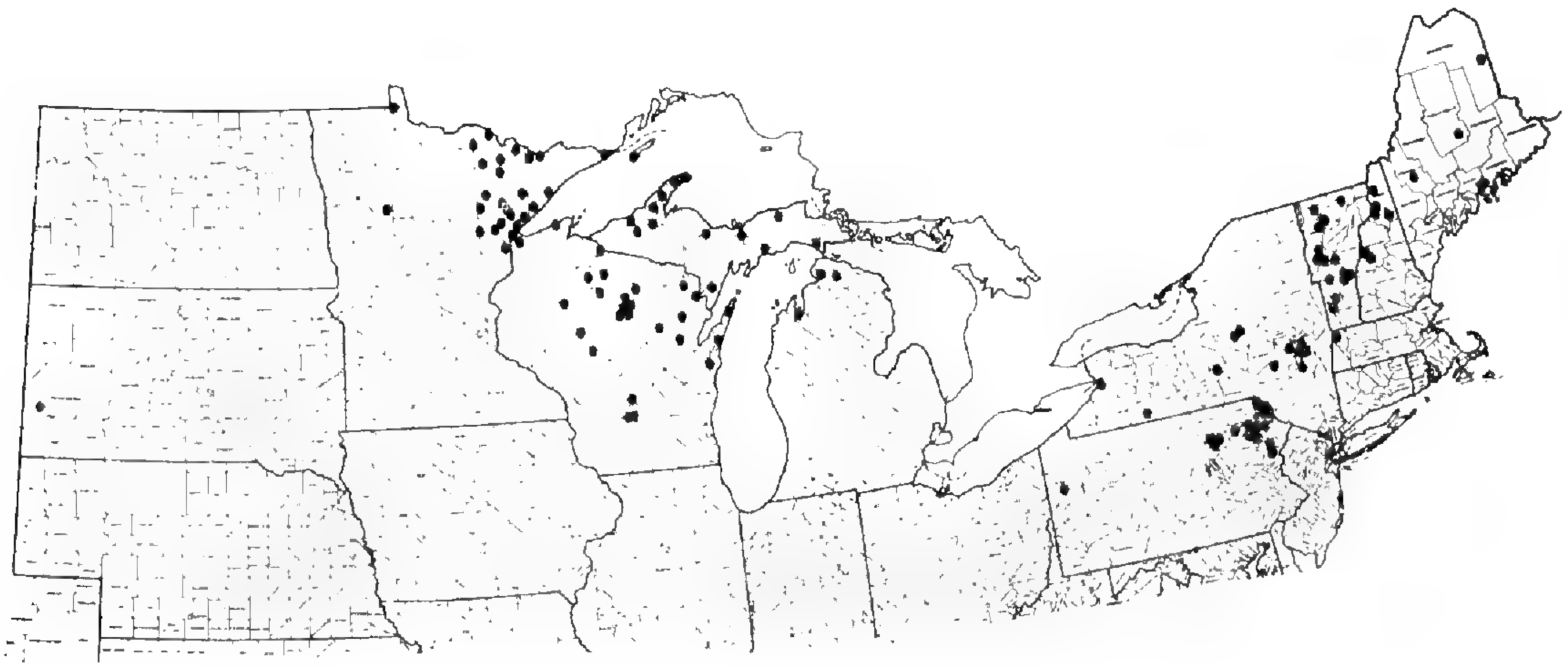
45. **Viola palustris** L., Sp. Pl. 934. 1753.

Though not uncommon in the subalpine zone of the Rocky Mountains, *V. palustris* is rare in eastern United States, reported only from the White Mountains of New Hampshire. It is a circumpolar species, found across Canada, in Alaska, and in northern Europe and Asia. It is most likely to be confused with *V. macloskeyi* subsp. *pallens*, with which it sometimes occurs in western North America, beside cold, open bogs or along mountain streams through alder thickets. *Viola palustris* differs from *V. macloskeyi* subsp. *pallens* in having larger, somewhat reniform leaves and thicker, somewhat cord-like green stolons. The flowers are often tinted lavender or light blue. In addition its petioles are never pubescent as those of *V. macloskeyi* subsp. *pallens* often are. Both its capsules and seeds are larger.

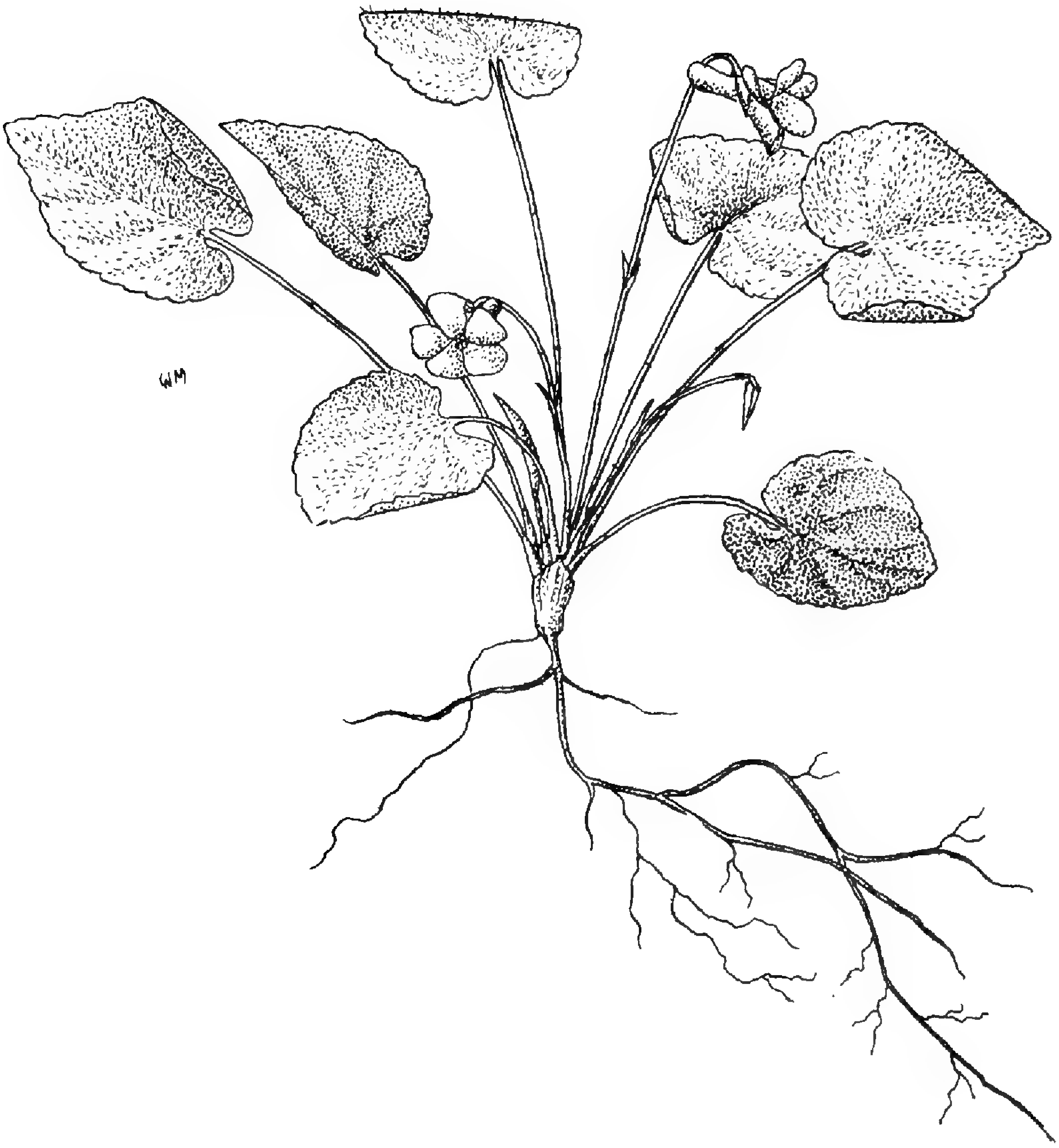
46. **Viola selkirkii** Pursh ex Goldie, Edinb. Phil. Jour. 6: 324. 1822.

Viola selkirkii is circumpolar, occurring in high latitudes in Greenland, Europe, and Asia. In North America it has been found from southern Labrador to northern British Columbia. It is quite distinct from other violets, and I know of no instance of natural hybridization. It usually grows under evergreens, particularly hemlock, frequently on rotting logs. The leaves are heart-shaped and scalloped, with conspicuous crenations. Other distinctive features are a slender, cord-like rhizome, and tiny, globose capsules.

In North America there is some evidence of east-west clinal variation, especially in lamina shape (Russell, 1956d). From Minnesota to eastern Quebec, there is an indistinct change from relatively narrow leaves (length/breadth ratio of about .95) to broader leaves (l/b ratio of about .85).

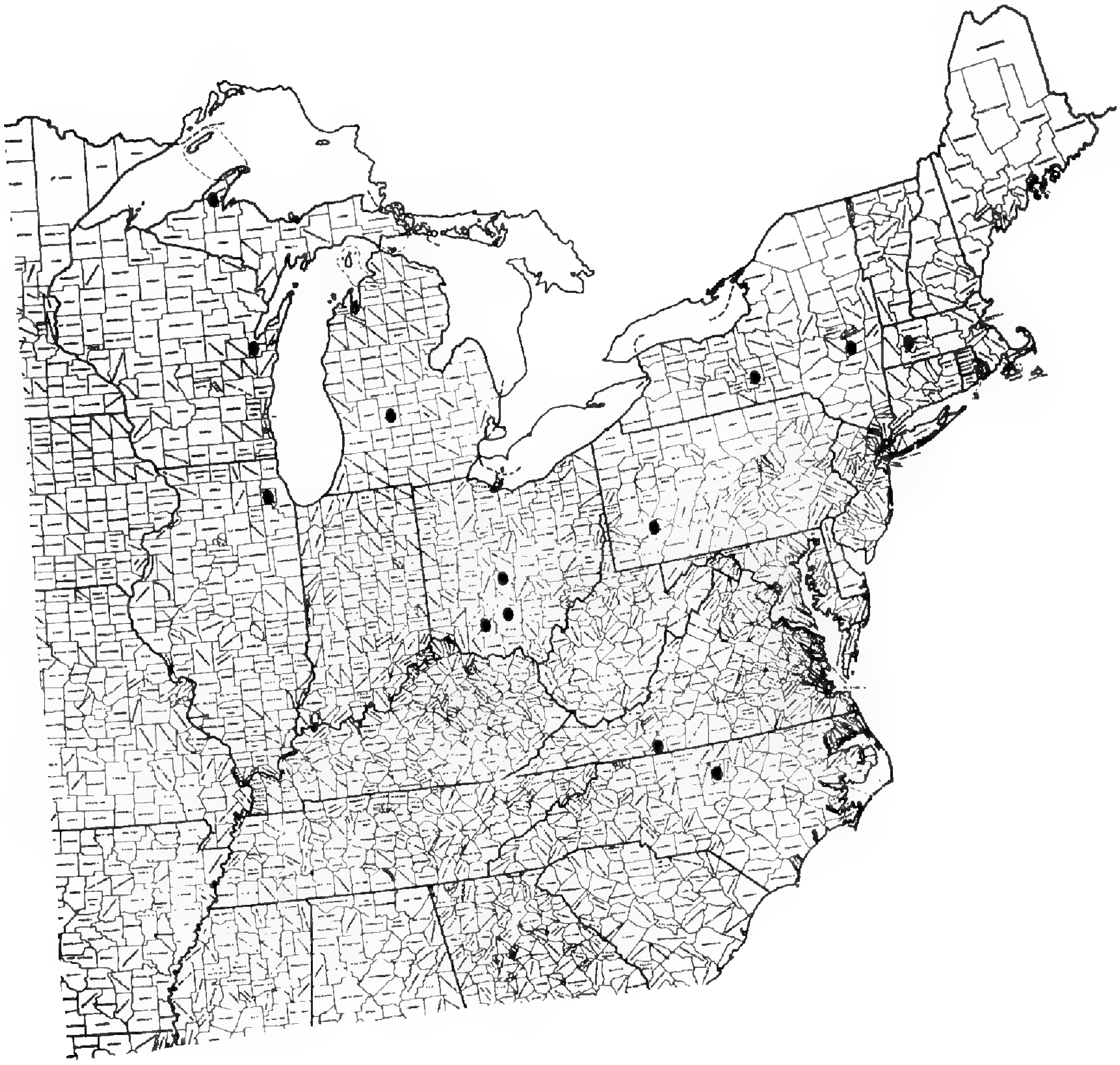


The past history of V. *selkirkii* has been the subject of speculation by several authors. As its closest relatives (morphologically) are all native to eastern Asia, Brainerd (1921) suggested that its ancestors may have arrived in North America from the west. The clinal variation may be interpreted to favor this view.



47. **Viola odorata** L., Sp. Pl. 934. 1753.

I have included this introduced violet because it seems to have established itself securely in several habitats, both cultivated lawns and woodlands. It superficially resembles a stemless blue violet, such as *V. sororia,* but can be easily distinguished because of its spreading stolons, which enable it to form large mats. So far as I know, it is not closely related to any North American violet.



EXCLUDED SPECIES

Viola emarginata (Nutt.) LeConte. For a number of years I have puzzled over the nature of this morphologically indefinable violet. It seemed a catchall for a variety of violets which would not fit exactly into other species descriptions. In addition specimens of *V. emarginata* always seemed in some ways reminiscent of *V. sagittata*. In 1959 Mr. Arthur Risser and I made an extended trip on the southeastern coastal plain, collecting and studying population samples of "*V. emarginata*" wherever we found them, as well as the violets growing with them. It was our conclusion that violets labeled as *V. emarginata* are *V. sagittata* hybrids, the other parent usually, but not always, being either *V. affinis* or a member of the *V. affinis* complex (Russell and Risser, 1960)

Viola latiuscula Greene. This species is said to be characterized by lengthened sepal auricles, and the leaves sometimes 3-5 pedately lobed. I have been unable either in herbarium studies or in the field to distinguish a violet with these characteristics and that was not easily referable to *V. affinis, V. langloisii,* or *V. septemloba*. Fernald (1950) mentions another characteristic — "granulose-angled petioles." I have occasionally seen specimens from the Appalachians with peculiar granulations on the upper part of the petiole. As they occur sporadically and in all other respects are *V. affinis*, I do not consider them as worthy of a name.

Viola stoneana House. I have collected this violet several times in the southern Appalachians, in Virginia, North Carolina, and Tennessee and in addition have seen several dozen herbarium specimens so labeled. I have been unable to find any specific characters for this violet, and I strongly suspect the specimens referred to it represent a melange of hybrids, involving *V. sagittata, V. affinis, V. palmata, V. triloba, V. fimbriatula,* and perhaps other species. For this reason it is excluded from the present treatment. An unpublished analysis I made of a large population near Mountain Lake, Virginia, shows evidences of hybridization among *V. sagittata, V. cucullata,* and *V. fimbriatula*.

Viola tricolor L. This violet, the cultivated johnny-jump-up, occasionally escapes and is found wild. However, I do not believe it maintains itself in nature, and so have excluded it. The modern garden pansy, *V.* × *wittrockiana* Gams, is a complex hybrid with *V. tricolor* as only one of several species in its ancestry; it is often incorrectly referred to as *V. tricolor* (cf. Shinners, 1958).

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SIDA CONTRIBUTIONS TO BOTANY

VOLUME 2 NUMBER 2 DECEMBER 1965

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SIDA is privately published by Lloyd H. Shinners, SMU Box 473, Dallas, Texas 75222, U.S.A. Subscription price $6 (U.S.) per volume of about 360—400 pages, parts issued at irregular intervals.

GROWTH OF RELIC HEMLOCK IN NORTHEASTERN OHIO

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The hemlock, *Tsuga canadensis* (L.) Carr., is a climax dominant in the forests of the upper Great Lakes Region, New England, and parts of the Appalachians. It also occurs in small, disjunct, relic colonies which are isolated from the climax range of the species. Several studies on the growth of hemlock have been made within its climax range by determining age-diameter relationships (Gates and Nichols, 1930; Morey, 1936; Oosting and Bourdeau, 1955), but no comprehensive study of this kind has been accomplished in a relic colony. In order to determine whether or not the growth of hemlock in relic colonies is comparable to that in the climax range, the following study was initiated.

Two stands were studied in Summit County, Ohio. One was at Sand Run Park on steep, sandy ravines; the other was at Kendall Park on sandstone ledges. Sand Run Park lies on the northern city limit of Akron, and Kendall Park is 7 miles northeast of Sand Run Park. The nearest extension of the climax range of hemlock is about 79 miles to the northeast (Braun, 1950). Both areas were lumbered about 1880 and now support mature, second-growth hemlock-hardwood stands in which seedlings and saplings occur.

The height, diameter at breast height (including the bark), and age, as determined by counting annual rings from increment cores taken at breast height, were determined for 212 trees: 117 at Kendall Park and 95 at Sand Run Park. Measurements of trees with more than a little heart rot and of trees severely damaged by topping were excluded from the data. The ages of a few trees in excess of 20 inches in diameter could not be determined because of the inadequate length of the increment borer.

Growth in diameter of ⅜ in. per year was found in many trees; however, the extremes were from ⅜ in. in 26 years. to 1¼ in. in 1 year. Slow growth was characteristic of certain trees during various years but not of all such trees during the same years. Many trees had groups of narrow rings, which often abruptly alternated with groups of wider rings. Such variations in growth probably reflect either topping or various degrees of shading rather than climatic fluctuations.

The age-diameter and age-height relationships respectively of hemlocks in both parks are shown in Figures 1 and 2. All data were combined for these figures, because the growth at both parks was similar. The wide variation in growth for any age-class could not be correlated with soil type, texture, or humus content near each tree, the exposure

SIDA 2 (2): 115—118. 1964.

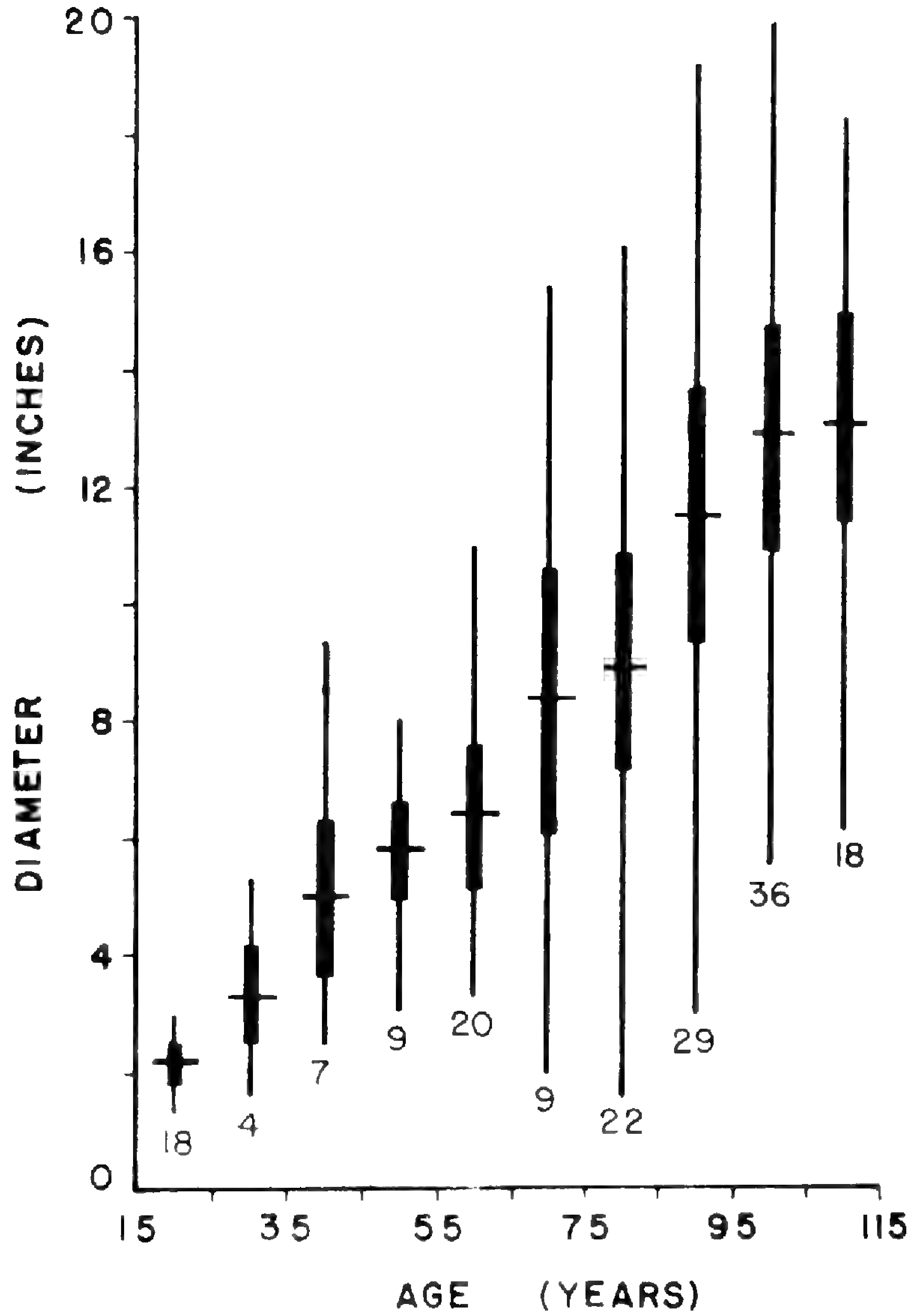

FIGURE 1. AGE-DIAMETERE RELATIONSHIP. The mean dbh in inches (cross line), 1 standard deviation of the mean (broad bar), and range (narrow bar) are given for each 10 yr. age-class (16-25, 26-35, etc.). The number of trees measured in each age-class is given beneath each bar.

or the position of each tree on a slope, or any combination of these factors. Both stands occupy several habitats of differing exposures and vegetational compositions, but no differences in growth between habitats was recorded.

An obvious increase in the rate of growth between the 76-85 and the 86-95 yr. age classes correlates with the time of lumbering. This is interpreted as release from suppression and suggests that the amount of light is the limiting factor significantly affecting growth.

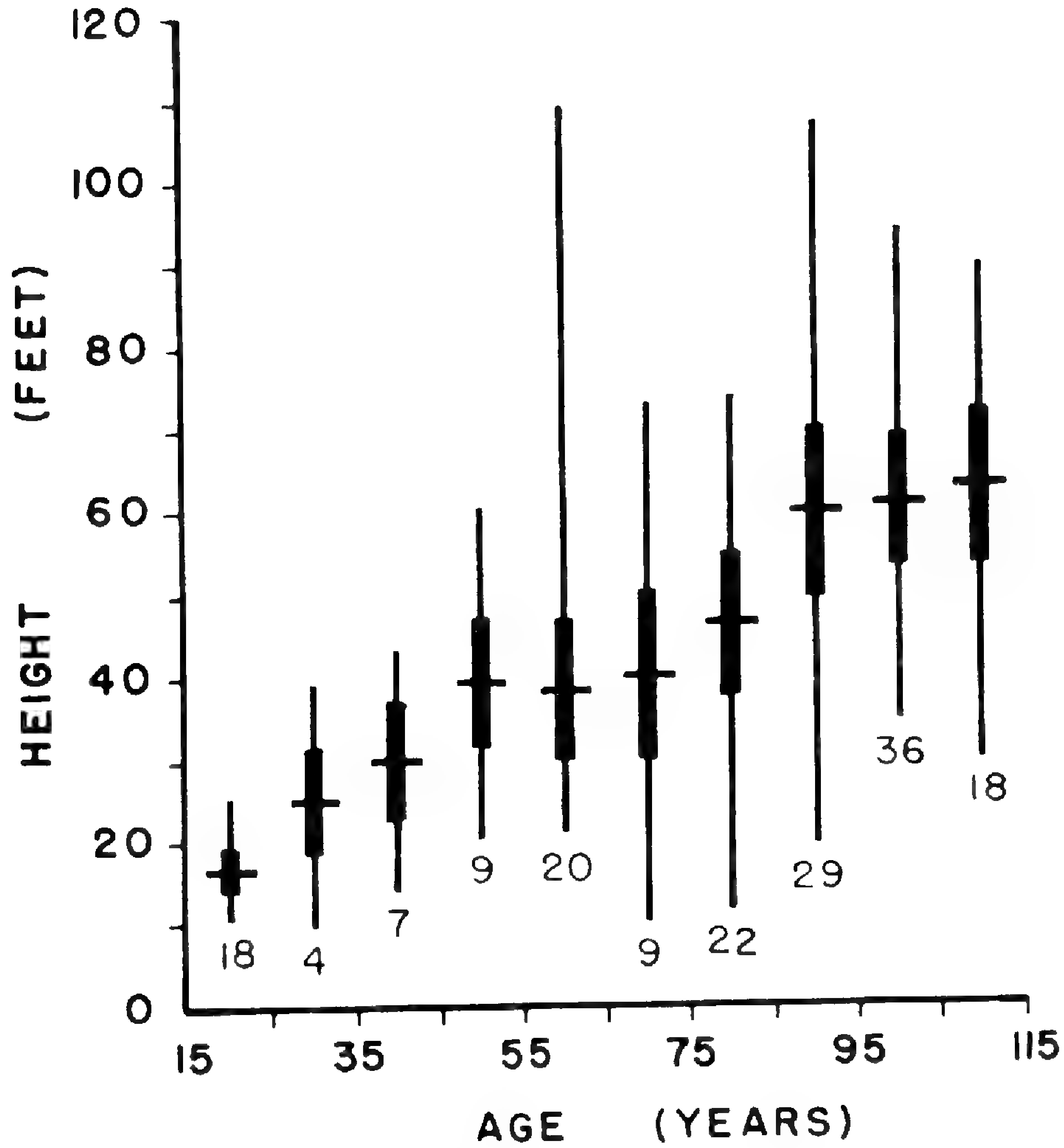

FIGURE 2. AGE-HEIGHT RELATIONSHIP. The mean height in feet (cross line), 1 standard deviation of the mean (broad bar), and range (narrow bar) are given for each 10 yr. age-class (16-25, 26-35, etc.). The number of trees measured in each age-class is given beneath each bar. Height, as determined by a pocket transit, may be underestimated by as much as 2 feet.

The average growth of the 2 stands studied is generally greater than that of hemlocks growing within the climax range of the species. These Ohio hemlocks grew in diameter slightly faster than those in a hemlock-beech stand in Pennsylvania (Morey 1936), 1.33 to 1.5 times as rapidly as those in a hemlock forest in Pennsylvania (Morey 1936), 1.33 times as fast as those in a virgin stand in North Carolina (Oosting and Bourdeau 1955), and 1.5 times as fast as those in a virgin stand in the lower peninsula of Michigan (Gates and Nichols 1930). In height the Ohio hemlocks grew approximately as fast as did hemlocks in Morey's (1936) hemlock-beech stand and .8 times as fast as in his hemlock stand.

Since the trees studied in Pennsylvania, North Carolina, and Michigan may have grown under different degrees of shading than the hemlocks of this study, these comparisons must be considered tentative. The data suggest that once hemlocks reach breast height, they do not suffer in their rate of growth for being outside of the climax range of the species.

I am grateful to Mr. H. S. Wagner for allowing this study to be made within Akron Metropolitan Parks and to Dr. R. W. Dexter of Kent State University, who directed this study which resulted in a master's thesis in 1957.

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HOLOSTEUM UMBELLATUM (CARYOPHYLLACEAE) IN THE UNITED STATES: POPULATION EXPLOSION AND FRACTIONATED SUICIDE[1]

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"Among other common lies, we have the *silent* lie—the deception which one conveys by simply keeping still and concealing the truth. Many obstinate truth-mongers indulge in this dissipation, imagining that if they *speak no lie,* they lie not at all."

Thus Mark Twain on the Silent Lie. His comments apply well to the customary treatment given introduced plants in American floras and monographs. Weeds are considered unworthy of serious attention, and when not ignored completely are so superficially treated that accurate information about them cannot be obtained from standard reference works. This is a violation of the supposed objectivity of science. Weeds have much to tell us about migration which could shed light on such problems as the post-glacial spread of plants and the history of the Coastal Plain flora; much about adaptability and variability that could shed light on the evolution of higher plants in general, and about the origins of cultivated plants in particular. The United States, with its continent-wide area, ready accessibility, and historically recent invasion by alien plants, offers a rare opportunity to study unwitting experiments in phytogeography and evolution. It is particularly reprehensible for American botanists to be so neglectful of weeds.

Dr. Piehl's report in 1962[2] of *Holosteum umbellatum* as new to Michigan prompted me to look further into available information about this Old World species. Material in the SMU Herbarium indicated that Piehl's report, citing references dealing only with the northeastern states, did not give anything like an accurate picture of the plant's distribution. A check of additional regional and state floras, of reports published in botanical journals, and of Old World floras, revealed that the history of *Holosteum umbellatum* in the United States has followed a distinctive pattern, one that is entirely logical in relation to what is apparently its true home, and suggests what may have been its unrecorded history in Europe and northern Africa. It strikingly refutes the vulgar notion that the geography of weeds is meaningless. It also illustrates another common dissipation of American botanists, the *careless* lie: the loose assertion that most of our weeds are introduced from Europe or native of Europe, which is at best imprecise and at worst untrue.

Let me review in order the facts I was able to uncover, beginning with the best possible kind of recorded facts, actual specimens of the plant.

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[1] All notes are at end of article.

HERBARIUM COLLECTIONS[3]

Though not huge, the SMU Herbarium does have a well diversified representation of the floras of the United States and Europe. The label data for the collections of *Holosteum umbellatum* had, in skeleton form, most of the essentials of the whole story of the species as later developed. There are at present 26 specimens, as follows.

ARKANSAS. Washington Co.: Fayetteville, *D. M. Moore 490008,* 31 March 1949. GEORGIA. Clarke Co.: waste places at edge of University campus [Athens], seen only in one spot, *Arthur Cronquist 4223,* 1 April 1947. ILLINOIS. Champaign Co.: roadside, 2 miles south of Philo, *R. A. Evers 78879,* 30 April 1964. Shelby Co.: roadside, 3 miles east of Westervelt, *Evers 78931,* 1 May 1964. Vermilion Co.: along C. & E. I. R. R., south of Rossville, *Evers 78975,* 5 May 1964. KANSAS. Barber Co.: 1 mile east of medicine Lodge, sandy soil, gypsum, locally abundant, *R. L. McGregor 14192,* 24 April 1959. Douglas Co.: 2 miles south of #59 & 50 junction, in thick patches scattered on shoulder of highway, *S. W. Jacks 320,* 19 April 1960. Montgomery Co.: 5 miles south of Independence, roadside bank, *McGregor 15253,* 14 April 1960. Woodson Co.: 8 miles north of Yates Center, roadside bank, locally abundant, *McGregor 16821,* 2 May 1961. MASSACHUSETTS. Essex Co.: in beds at Gray & Cole's Nursery, Ward Hill, Haverhill, *S. K. Harris (Pl. Exs. Gray. 833),* 14 May 1933. NORTH CAROLINA. Cabarrus Co.: cultivated field, 3 miles north-northeast of Harrisburg, *Harry E. Ahles (with C. R. Bell) 11642,* 29 April 1956. OKLAHOMA. Cleveland Co.: ½ mile east of Biology Building, Oklahoma University [Norman], *U. T. Waterfall 7858,* 10 April 1948. OREGON. Sherman Co.: along route 30, west of Biggs, *Albert N. Steward 6866,* 6 May 1955. Wasco Co.: along banks of Deschutes River at Shearars Bridge, *W. H. Baker 611,* 10 April 1938. TENNESSEE. Rutherford Co.: roadside, 7 miles north of Murfreesboro, *Ralph M. Kriebel 9256,* 13 April 1941. VIRGINIA. Montgomery Co.: campus weed, V.P.I. [Blacksburg], *R. Kral 9790,* 5 April 1960. Spotsylvania Co.: fields, Fredericksburg, *Hugh Iltis 118,* 14 April 1941. WASHINGTON. Benton Co.: abundant in fine-grained soil among basaltic outcrops along the Columbia River, 1.5 miles east of Mottinger, *Cronquist 5650,* 4 April 1950.

AUSTRIA. Vienna (other data illegible), *J. Kerner 4901,* in 1869. CZECHOSLOVAKIA. Vicinity of Brno, weedy places, *Collector Unknown,* "April, sometimes October," year not given (1830—1840?). GERMANY. Brandenburg, sandy fields, *Goerz,* 1 May 1912. Oberhessen, Kr. Alsfeld, Gr. Felda, fields, *H. Hupke,* 11 May 1960. SWEDEN. Oeland, Vickleby s:n, Sandbergen, gravelly beach, *C. M. Norrman,* 20 May 1960. SWITZERLAND. Valais (Wallis): region of Ausserberg, copses on the chalets of Leiggern, alt. 1590 m., *P. Villaret 11923,* 3 June 1951. Sitten, *Dr. E. Rohrer,* 9 April 1912.

IRAQ. Ledges on broken limestone slopes, Aqra, in Mosul Liwa, *N. Polunin et al. (Fl. Iraq 35)*, 16 March 1956.

When Dr. Piehl's paper appeared, I had on loan the Caryophyllaceae from North Carolina State College. Later (October, 1964) I examined specimens on visits to the Missouri Botanical Garden and Iowa State University (Ames). Evidence from the additional material was in agreement with that from the SMU collections, except for supplying some older U.S. records. Two deserve mention here. NORTH CAROLINA. Buncombe Co.: Biltmore, cultivated grounds, *Biltmore Herb. 1340*, 18 April 1896 (NSC); also *1340b*, same but dated 3 April 1897 (MO, NSC). OREGON. Grant Co.: along rocky dry bed of wash, Kimberley, *L. F. Henderson 5019*, 1 May 1925 (MO).

Several items of interest emerge from the above. First, of course, the western limits known to Piehl (Michigan, Ohio, Kentucky; partly quoted from Fernald) had been greatly exceeded, even within the Gray's Manual range, for more than a decade before his paper appeared. Though present in the eastern states for more than a century, and persisting at some of its early localities, it has not become generally distributed or common there, where it is most often found in cultivated habitats (fields, lawns, gardens). In the central and far western states, where it appeared much later, it has been spreading much more rapidly, mainly on non-cultivated habitats (roadsides, naturally disturbed ground along streams), and appears to be distinctly calciphile (basalt and gypsum mentioned for two collections; many localities in areas of limestone or calcareous glacial till). It also appears not to favor extremely cold regions, and to be appearing more extensively in somewhat drier sections. The European collections mostly confirm what Linnaeus said about the habitat of the species when he named it in 1753: "in fields of Germany and France." This matches the preference it has shown in the eastern United States, and raise the suspicion that in Europe also it was an introduction. The Iraq specimen cited, from naturally disturbed habitat on limestone, parallels Oregon and Washington reports, and suggests that in those states the species has found something more like its original home than it did in the Atlantic states or Europe.

PUBLISHED RECORDS: CENTRAL AND EASTERN

Fortunately *Holosteum umbellatum* is very distinct from other chickweeds, and it is probable that most if not all published records can be accepted as correct. For a number of the following reports I have seen confirming specimens (not always the original ones). Although the information about *Holosteum umbellatum* in current manuals is quite incomplete, the reports are worth quoting, especially for comparison with older publications. Below are summarized the reports in manuals and state or local floras in chronological order; those from journals follow in a separate list.

1856. Hills around Lancaster, Pennsylvania, abundant. (Gray, Man. 2nd ed.; same statement in 3rd ed., 1857, and 4th ed., 1862.)

1867. Hills around Lancaster, Penn., and Morris Co., N. Jersey. (Gray, Man., 5th ed.; same statement in 6th ed., 1889.)

1897. Locally established in Pennsylvania, New Jersey, and Delaware. (Gray, Syn. Fl. vol. 1 pt. 1.)

Very abundant in the vicinity of Lancaster, Pa.; Delaware. Naturalized from Europe. Native also of northern Asia. (Britton & Brown, Ill Fl. 1st ed.)

1901. Penn. and Del. (Britton, Man., 1st ed.; same statement in 2nd ed., 1905, and 3rd ed., 1907.)

1903. In waste places and cultivated grounds, Pennsylvania, Delaware and Gerogia. (Small, Fl. S.E. U.S., 1st ed.)

1908. Roadsides, fields, etc., N.J. and Pa. to Ga. (Gray, Man., 7th ed.)

1913. Common, in fields, woods, and waste places. (Small & Carter, Fl. Lancaster Co., Pa.)

1933. Cult. grounds, roadsides, and waste places, Coastal Plain, Ga. to Pa. and N.J. (Small, Man.)

1943. Grassy fields and roadsides, Fayette Co., Kentucky. (Braun, Annotated Catalog of Spermatophytes of Kentucky.)

1950. Fields, roadsides and cult. ground, e. Mass. to Ga., Ky., and O. (Gray, Man., 8th ed.)

1952. Native of Eurasia; naturalized at various stations from N.J. and Pa. southward and perhaps elsewhere. (Gleason, New Britton & Brown Ill. Fl.)

1953. Established at Enterprise, Harrison Co., W. Va. (Strausbaugh & Core, Fl. W. Va.)

1954. Native of Eurasia, occasionally found as a weed in our range. (Gleason & Cronquist, Man.)

1955. Range: Mass.-Ohio-Ill.-Mo.-Ga.; Wash.-Ore.-Ida.; Eurasia; N. Africa. Roadsides, fields, and waste places; nat. from Europe. ILLINOIS: Christian Co., in 1953; Johnson Co., 1951, 1952; Lawrence Co., 1952. (Jones & Fuller, Vascular Plants of Illinois.)

1958. (Included without remarks in Goodman, Spring Flora of Central Oklahoma.)

1960. Add 11 more Illinois counties. (Winterringer & Evers, New Records for Illinois Vascular Plants, Sci. Pap. Ill. State Mus. vol. XI.)

1961. In fields and waysides, middle Coastal Plain to Blue Ridge, 9 counties in Virginia. (Massey, Virginia Flora.)

1962. Occurs along roadsides and railroads. Recently introduced . . . now spreading rapidly. Established in southern and central Missouri north to St. Louis and Boone counties. First recorded from Washington County in 1950. (Steyermark, Fl. Missouri.)

1964. Fields, roadsides, and waste places; mts. and pied., North Carolina; specimens also seen from Va., Ga., Tenn., Ky., W. Va. (Radford, Ahles & Bell, Guide to the Vascular Flora of the Carolinas.)

1965. Mapped for 20 counties in North Carolina, 5 in South Carolina. (Radford, Ahles & Bell, Atlas of the Vascular Flora of the Carolinas.)

To the above may be added information from botanical journals with records of eastern plants. Of those checked, three fortunately had most helpful cumulative indexes, two had only annual volume indexes. The oldest journal, *Bulletin of the Torrey Botanical Club*, (started 1870), contained only a single reference to *Holosteum umbellatum* in the United States. This was in a table listing plants germinated from soil taken from old fields and forests in Durham County, North Carolina, showing that the species grew in 1938 from soil from a field cultivated in 1937, but was not obtained from any other soil samples (vol. 67: 258, 1940). The now defunct companion journal *Torreya* (1901—1945) also contained but one reference: the species was observed at Orient State Park, Long Island, New York (34: 141, 1934). *Bartonia* (started 1908) had no records. *Castanea* (started 1936) reported the species twice: in 1950 for Amherst County, Virginia, where collected in 1947 (15: 16); in 1955 from near Collinsville, Polk County, North Carolina, "infrequent in old fields," year not stated (1951 or later) (20: 45). Much more numerous were the records in *Rhodora* (started 1899), which are summarized below in chronological order (volume and page in parentheses).

1924 (26: 199). Found at the Hiti Nurseries, Pomfret, Connecticut, 30 May 1924, "abundant all through the nurseries." First authentic record for New England.

1931 (33: 211). Found in the edges of lawns along the Cliff Walk at Newport, Rhode Island, 30 May 1931.

1933 (35: 261). In beds in Gray and Cole's Nursery, Haverhill, Massachusetts, spring of 1932; new to the state. Thought to have come with plant shipments from the Hiti Nurseries (see 1924 report).

1938 (40: 415). Cultivated field 1 mile south of Emporia, Greensville County, Virginia; found in April, 1938, stated to be "very local in eastern Virginia."

1943 (45: 400). Found in Essex and Hanover counties, Virginia, April, 1942. "Apparently spreading; new or sandy roadside-fills. . . . Perhaps introduced in foreign seed used on new soft shoulders."

1945 (47: 45). Cultivated field at State College, Pennsylvania, 17 May 1943; first collection from local area.

1952 (54: 253). Collected 1 mile south of Caledonia, Washington County, Missouri, 22 April 1950; new to the state.

1958 (60: 15). Roadside, northwest of Gaffney, Cherokee Co., South Carolina; Anderson Bridge over the Enoree River, Spartanburg Co., South Carolina; first definite records for the state.

1960 (62: 93, 108, 115, 262). "This naturalized species has become somewhat frequent in central and southcentral Kansas . . . on sandy soils of lawns, fields, and roadside banks." Six counties listed; one specimen cited as collected in 1959, no other dates given.—Listed for Massachusetts, Connecticut, and Rhode Island only among New England states, said to be local.—Found still persisting after 22 years in nursery at Haverhill, Massachusetts (see 1933 record).

1962 (64: 222). Reported from three stations in southeastern Michigan, lawns and gardens, collected 1949, 1955, 1958; new to Michigan.

Allowance must of course be made for the fact that there was not uniform collecting throughout the central and eastern states, coverage being much better for the Northeast and Midwest than for the South. Also some likely sources, such as state academy transactions, have not been checked. Some have been omitted because they merely repeated references in the above lists, or were entirely negative. One in the latter category deserves mention here because of its thoroughness: Deam's *Flora of Indiana* (1940), in which there is no record of the plant. But if the assembled information is not complete, it is extensive, and permits some conclusions to be drawn.

Most of the manuals, especially the more recent ones, are guilty in varying degree of the silent lie. This perhaps is justifiable, since they attempt to condense a vast amount of information. Less excusable is what may be called the *careless* lie. For example, when the distribution is given as "Mass. to Ga., Ky., and O.," the implication is that the area is more or less continuous within those limits, but this is not so. Then there is the constantly repeated statement, "introduced from Europe." This really is not known; it might have been from Asia or Africa, or another part of North America (in fact the first Massachusetts occurrence was quite definitely stated to be the result of introduction from Connecticut). The similar statement, "native of Europe," is a loose assumption for which there is no positive proof. It is also quite indefinite; the flora of Europe is not homogeneous throughout.

The general picture obtained from published records agrees with and amplifies that from herbarium specimens. *Holosteum umbellatum* was introduced into the United States, precise source and means of entry unknown. Reported in 1856 as abundant around Lancaster, in southeastern Pennsylvania, it was recorded as common there in 1913; yet at State College in central Pennsylvania, less than 100 airline miles away, it was collected for the first time in 1943. Collections and reports show that during the 1940's and 1950's it appeared rather suddenly at many widely separated localities. In Illinois, Missouri and Kansas, in contrast with its behavior in Pennsylvania, it proceeded to spread rapidly. The suggestion made in 1943 that it was perhaps introduced with foreign seed used on new road shoulders in Virginia seems a very probable explanation for its sudden appearance in other states as far away as Kansas. Difference in quantity of seed brought in during the earlier and later periods, and difference in climatic and soil conditions between Midwestern and Atlantic states, may explain the great increase in number of localities from about 1940 on, and the much greater success in becoming established and spreading locally in the Midwest than was the case when first introduced farther east.

PUBLISHED RECORDS: FAR WESTERN

The qualifying remarks about central and eastern records apply here also, but again the available information is reasonably adequate, particularly in view of the much shorter period of time and smaller area involved. Of the two western botanical journals searched for records, *Madrono* (started 1916) contained none, and *Leaflets of Western Botany* (started 1932) only one, included below with those from manuals and floras. The 1925 Oregon collection cited previously is one year older than the earliest report in print.

1937. A weed, recently introduced from Europe, collected in 1926. Fields, Pullman; opposite Clarkston; Lewiston. Upper Sonoran, Arid Transition. (St. John, Fl. S.E. Washington & Adj. Idaho, 1st ed. Same statement in 2nd ed., 1956, and 3rd ed., 1963.)

1941. Established in various places along the Columbia R. east of the Cascades. (Peck, Man. Higher Plants of Oregon, 1st ed.)

1944. Sparingly introduced in eastern Oregon, Washington, and also in the Atlantic States. Native of Europe and northern Asia. (Abrams, Ill. Fl Pacific States.)

1952. Introduced into E. Wash. and Oreg., W. Idaho, and the Atlantic States. (Davis, Fl. Idaho.)

1957. A native of Europe, this species has become established sparingly east of the Cascades, sometimes occurring as a grainfield weed. (Gilkey, Weeds of the Pacific Northwest.)

1961. Established in various places along the Columbia R. east of the Cascades and in central Lake Co. (Peck, Man. Higher Plants of Oregon, 2nd ed.)

1964. Collected . . . on May 11, 1964, at Grenada, Siskiyou County, California . . . It has been known along the Pacific Coast from southern British Columbia to Lake County, Oregon, but this is the first record we have seen from California. (J. T. Howell, Leafl. Western Botany 10: 128.)

Silent lies and careless ones are less obtrusive than in some of the eastern manuals. Abrams' reference to northern Siberia, evidently copied from the Britton and Brown *Illustrated Flora* (1st or 2nd ed.), belongs to the kind for which a polite adjective cannot be used. The general picture for the far western states resembles that for the central ones. Introduction came relatively late, and there has been markedly successful establishment and local spread. Although Howell used the phrase "along the Pacific Coast," all records for the United States are from inland.

PUBLISHED RECORDS: OLD WORLD

The number of references in which Old World occurrences of *Holosteum umbellatum* are reported is of nearly astronomic proportions. There is also the complication of segregate species recognized by some authors but not others. With one exception (Egypt) I have considered only listings of *H. umbellatum* var. *umbellatum*. Following is a selection of reports in standard floras, translated into English when not originally in that language, sometimes paraphrased or summarized.

EUROPE. On light often sandy soils, usually in disturbed habitats. Most of C, E. & S. Europe, extending northwards to S. Sweden and England. (Tutin et al., Flora Europaea vol. 1, 1964.) SCANDINAVIA. Mapped for eastern Denmark, along or near the coast in extreme southern to southeastern Sweden, and nearby islands in the Baltic Sea. (Hulten, Atlas of the Distribution of Vascular Plants in N.W. Europe, 1950.) BRITISH ISLES. Doubtfully native. A very rare plant of walls, roofs and sandy soils. Formerly Surrey, Norfolk and Suffolk, where it may still persist. Europe northwards to S. Sweden, N. Africa, W. Asia. Commonly with other small annuals . . . in C. Europe usually in man-made habitats. (Clapham, Tutin & Warburg, Flora of the British Isles, 2nd ed., 1962.) FRANCE. Sandy and rocky places, in a large part of France; rare in the Southwest and in the Mediterranean section. (Coste, Flore Descriptive et Illustrée de la France, vol. 1, 1901. Fournier, Les Quatre Flores de la France, 1936 (reprint 1946 and 1961), apparently says much the same, but uses some abbreviations which are nowhere explained.) SPAIN. (Caballero, Flora Analítica de España, 1940, includes the species, but since the book consists only of keys, there is no information as to distribution or habitat.) PORTUGAL. Fields, roadsides, walls; vicinity of Braganca and Miranda, Upper Douro. (Coutinho, Flora de Portugal, 2nd ed., 1939. Sampaio, Flora Portuguesa, 2nd ed., 1946, mentions only the province in which these localities are found, Tras-os-Montes, extreme northeastern Portugal.) ITALY. Weedy and cultivated places, sea level to 1300 m. (Eur., W. Asia to India, Siberia; N. Afr.; naturalized in N.A.) (Fiori, Nuova Flora Analitica d'Italia, vol. 1, 1923.) CENTRAL EUROPE. Frequent to common (but in places entirely absent), on dry sandy fields, sandy meadows, fallow ground, lawns, sunny hills, roadsides, field borders, walls, sandbars, vineyards, chiefly at lower altitudes, scattered to the Voralpens (Stubai Valley in Tirol 1700 m.). Often impermanent and merely transient. General Distribution: Europe (north to England and south Sweden), North Africa, adjacent Asia (east to the Himalaya). This small, easily recognized species is completely absent in scattered local areas (perhaps sometimes overlooked) or has just recently appeared. In North Germany it is generally frequent and apparently indigenous, but becomes progressively scarcer both northwestward and northeastward (absent in particular in northern East Prussia). In Kaernten (Austria) reported as only introduced with grain and then disappearing. Also in Switzerland it has in places an adventive character and has only very recently appeared in some cantons (Tessin ca. 1906, Solothurn 1906). In North Germany this little plant belongs in many places to the spring flora of rather poor sandy fields. In other places it appears on lighter soils as a weed of crops. Recently Holosteum has appeared in many places as "anthropochore" on railroad beds and about stations. (Hegi, Illustrierte Flora von Mittel-Europa, vol. 3, 1909-1912. The account in the 2nd edition may be in press; the Caryophyllaceae were partly treated in vol. 3 pt. 2 fasc. 5, 1962, ending with *Arenaria.)* BALKANS. Grassy places, along roads. Recorded for 14 geographic subdivisions, Yugoslavia south to Crete. (Hayek, Prodromus Florae Peninsulae Balcanicae, Feddes Repert. Beih. 30 pt. 1, 1927).

SOVIET UNION. In grasslands on solonets, on sand, less often alluvial gravels, occasionally in cultivated ground. EUROPEAN SECTION. Upper Dnepr (south), Volga-Don (south), Trans-Volga (south), Black Sea, Crimea, Lower Don, Lower Volga districts. CAUCASUS. Cis-Caucasus, Dagestan, W., E. & S. Trans-Caucasus, Talysh districts. CENTRAL ASIA. Aral-Caspian, Pri-Balkh., Kyz-Kum., Kara-Kum., Gorny Turkm., Syr-Daria, Amu-Daria, Tian Shan districts. GENERAL DISTRIBUTION. Scandinavia (southern), Central Europe, Atlantic Europe, W. & E. Mediterranean, Balkans-Asia Minor, Iran, Indo-Himalayan region, W. China (Sinkiang). Sometimes infests cultivated ground, but does not attain the importance of a serious pest (Murav'eva in Fl. URSS vol. 6, 1936.)

NEAR EAST. In cultivated and sandy places of the entire region from sea level to montane and alpine sections, from Greece, Macedonia, Caucasus to Syria, Palestine, southern Persia. (Boissier, Flora Orientalis, vol. 1, 1867.) Fields and sandy places, common. (Post, Flora of Syria, Palestine and Sinai, 2nd ed. (by Dinsmore), vol. 1, 1932.) Nearly everywhere. (Parsa, Flore de l'Iran, vol. 1, 1951.) Tigris Plain, 250—300 m. (Rechinger, Flora of Lowland Iraq, 1964.) Kashmir only. (J. D. Hooker, Flora of British India, vol. 1, 1872.)

EGYPT. Only *H. liniflorum,* very rare, restricted to Sinai. (Tackholm, Students' Flora of Egypt, 1956.) NORTHWEST AFRICA. In cultivated fields, rocky and sandy pastures in the mountains from 300 to 2,300 m., in well watered and semiarid regions, rare on the coast. Tunisia, Algeria, Morocco. Geographic Distribution: Europe. Asia to Siberia, the Himalaya and India. (Maire, Flore de l'Afrique du Nord, vol. 9, 1963.) (Species not listed in Durand & Barratte, Florae Libycae Prodromus, 1910.)

Again there are silent and careless lies, and the outright error about

Siberia, but as might be expected from the longer and more intensive study, Old World information is more precise and more complete than that for the United States. There are some striking and suggestive resemblances, and some curious peculiarities. The story for England, with few records and failure of the plant to become thoroughly established or to spread, is exactly like that for New England. In view of its behavior in drier and warmer regions, it seems probable that climate has been the major hindering factor. In Central Europe there have been repeated introductions, just as in the United States; that it appears indigenous in places may indicate only that some introductions were very early. The long persistence without spread in some United States localities makes this seem plausible. Its rarity in southern France and Portugal, and presence only in the western part of North Africa, raise doubts about its being native in those places, in contrast with conditions farther east. Its prevalence and abundance in the Near East, and presence of closely related species (or infraspecific races), leave little doubt that it is native there. It may never be possible to determine its prehistoric limits. I suspect that most, possibly even all, of its present European area is due to the activities of man, beginning long before there were botanists there to observe.

CONCLUSION

Weeds have much to tell us, if only they are properly studied. They offer clues about man's pre-history, and may help us to unravel the origins of cultivated plants. They offer concrete evidence about adaptability and potentials for migration. But they must be given much more serious study than is now the case. Otherwise we shall merely go on expanding a dismal accumulation of silent and careless lies.

A science which deliberately ignores part of its facts commits partial suicide. Isolated reports of the occurrence of weeds may seem trivial in themselves, but cumulatively they become revealing and significant. If from shallow thinking, witless prejudice, and plain laziness we ignore them, we are continually losing data of unpredictable value for science.

NOTES

[1] Some of the highlights of this paper were used in a talk entitled "Weeds, Man and Science," given at the Missouri Botanical Garden's Symposium on the Systematics of Weedy Plants and Animals, St. Louis, 17 October 1964.

[2] Piehl, Martin A. 1962. *Holosteum umbellatum* L., an angiosperm new to Michigan. Rhodora 64: 222—225.

[3] I am indebted to Dr. Kenton L. Chambers, Oregon State University, Corvallis, and Dr. Robert A. Evers, Illinois Natural History Survey, Urbana, for both specimens and references; and to Dr. James W. Hardin, North Carolina State College, Raleigh, for the loan of specimens.

THE GENUS GENTIANOPSIS (GENTIANACEAE): TRANSFERS AND PHYTOGEOGRAPHIC COMMENTS

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I. THE GENUS GENTIANOPSIS.

The large genus *Gentiana* has long since been recognized as a very heterogeneous assemblage of morphologically diverse groups, so diverse that until recently no one has attempted in a rigorous way to delimit its more natural components. Rork (1949) and Löve (1953) pointed not only to the morphological diversity, but showed how extensive is the variation in chromosome number. Gillett (1957), in a careful and well illustrated monograph, removed from the North American *Gentianae* all taxa of *Gentianella,* a segregate genus long recognized by some European workers. *Gentianella, sensu stricto,* including *Gentianella campestris, G. germanica, G. quinquefolia, G. acuta,* and their allies, is certainly a very natural genus. However, Gillett's inclusion within his *Gentianella* of the celebrated and beautiful Fringed Gentians (as subgenus *Eublephis)* still leaves the botanist with an unnatural genus, for not only in floral characters and general aspect, but also in many other ways, such as their angular papillose seeds and the distribution of the ovules on the placentae, the Fringed Gentians form a natural and distinctive taxon easily distinguished from *Gentianella.* The segregated *Gentianopsis* thus gains a meaningful phytogeography and taxonomic integrity that would be lost within either *Gentiana* or *Gentianella.*

A recent clear segregation of the Fringed Gentians was carried out by Ma (1951), who established for the Asiatic and for some of the New World Fringed Gentians the genus *Gentianopsis,* giving full reasons in a short but clear English discussion (pp. 16-19). In his beautiful study of Japanese Gentianaceae, Toyokuni (1963) upheld Ma's genus, discussed its synonomy, and placed it in perspective to the rest of the Eastern Asiatic genera. Ma evidently intended to include all Fringed Gentians, but probably due to lack of available literature and specimens made transfers of only a few of the American taxa. The present study completes the transfers of these.

The generic characters of *Gentianopsis* on which it was established include, to quote Ma (1951:17):

1. its large and somewhat flattened ellipsoidal flower bud,
2. two dissimilar pairs of calyx lobes which are distichously imbricate in aestivation,
3. four triangular, ciliated intracalyx membranes at the base of and alternate with calyx lobes,

SIDA 2 (2): 129—154. 1965.

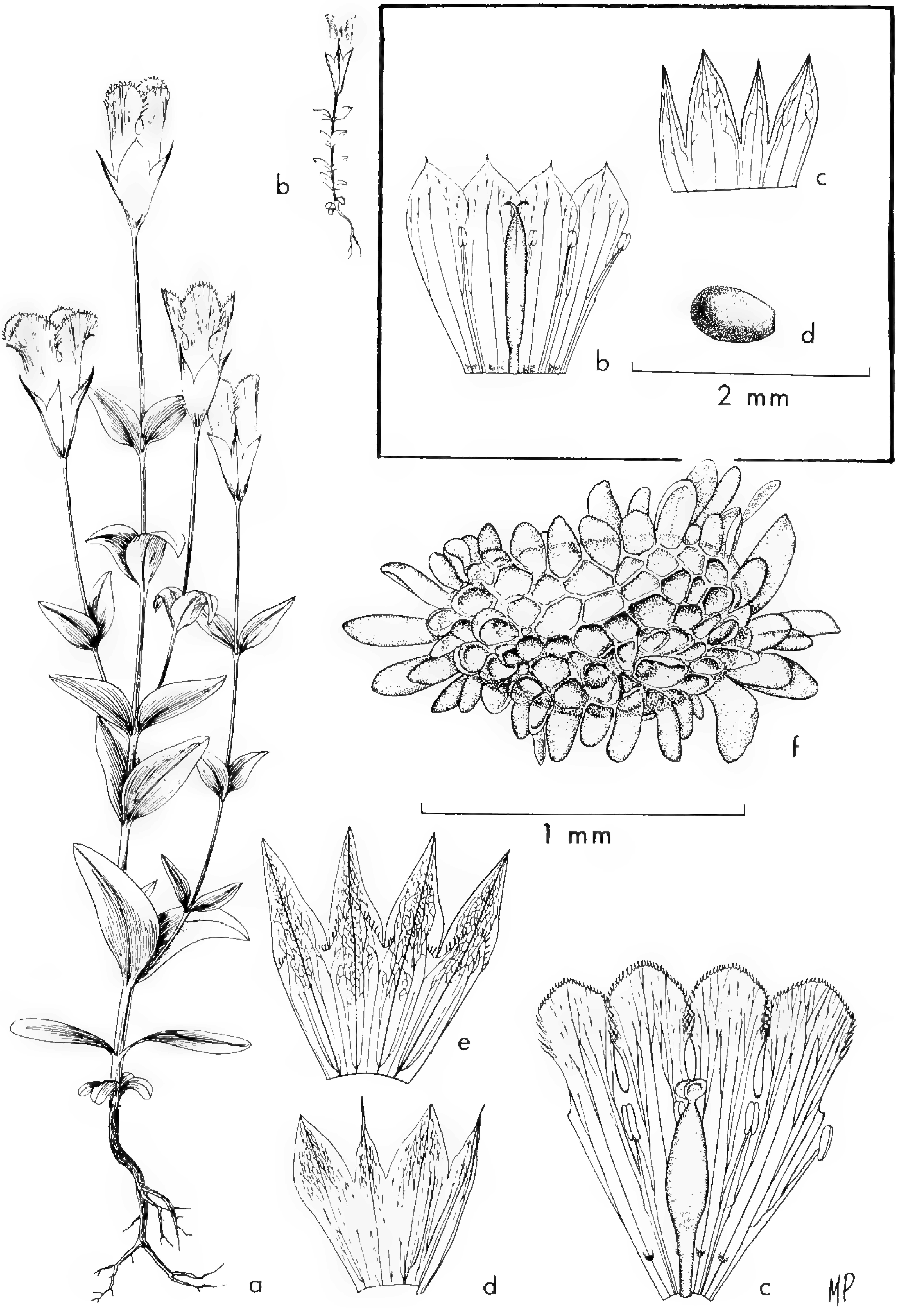


Fig. 1. *Gentianopsis crinita* and (insert) *Gentianella propinqua*, rearranged from Gillett (1963), with permission.

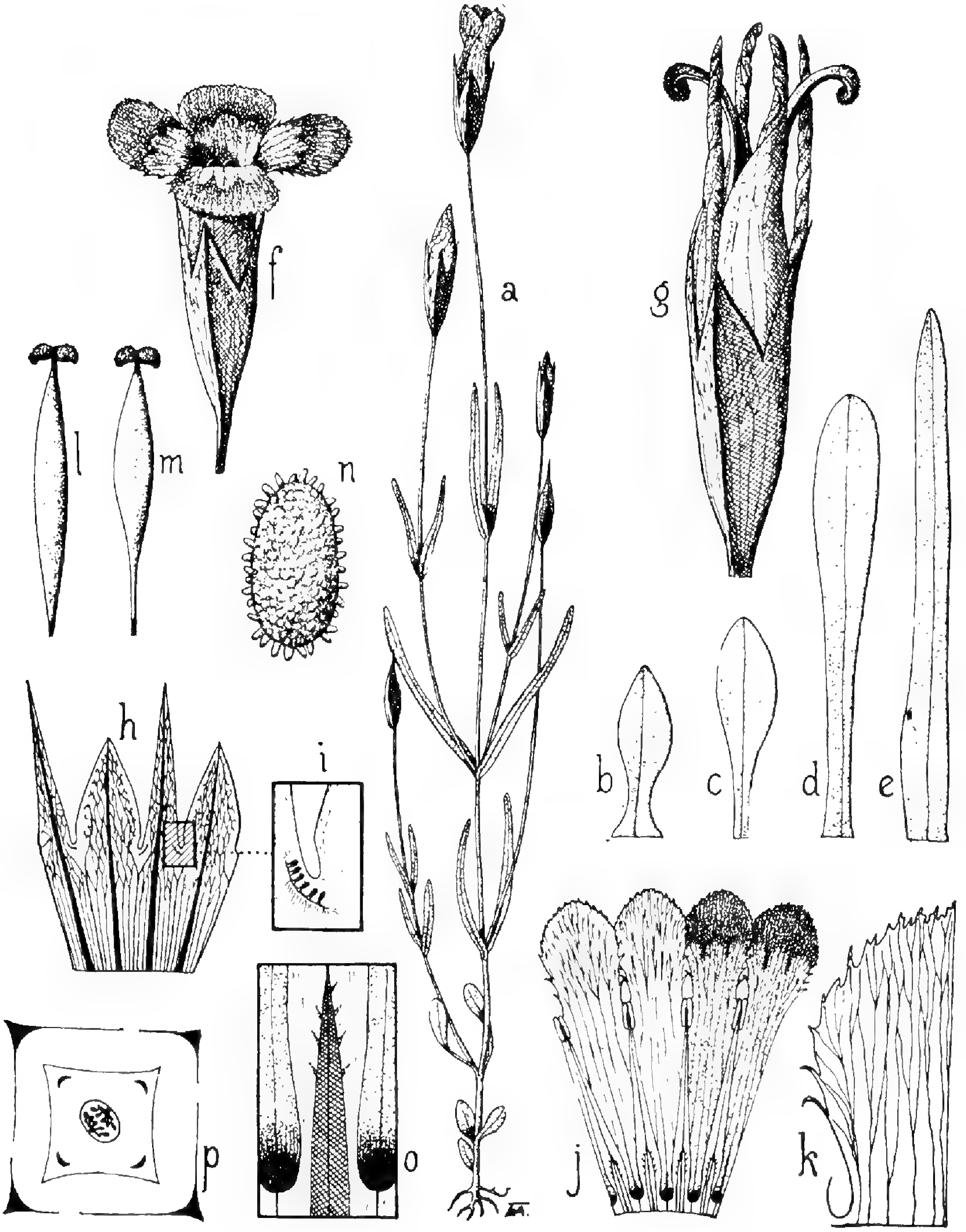
4. distinct gynophore, and
5. enlarged stigma (Fig. 2)

To these one might add:

6. the pronouncedly papillose angular seeds (Fig. 1),
7. the distinctive placement of the ovules, covering nearly the entire surface of the ovary wall,
8. the 4-merous flowers, and
9. the frequently fringed or toothed corolla-lobes.

All but one of these attributes apply well to the American taxa listed below, as can also be seen from the beautiful illustrations in Gillett (1963). The only character which does not hold uniformly is number 2, the dissimilarity in length of the calyx lobes, for while there is a tendency for unequal sepals, in many species the lobes are quite equal, as in *G. simplex*, *G. barbellata* and *G. raupii*. Lindsey (1940) showed that Sect. *Crossopetalum (=Gentianopsis)* has a markedly different floral anatomy from all other groups in *Gentiana, sensu lato*. Some of these characteristics are mentioned by Ma (1951) who contrasts them with those of *Gentianella, sensu stricto*, mentioning the distinctive vascularization of the calyx (eight bundles, four dorsal and four fused ventral, rather than 3 unfused ones in each lobe as in *Gentianella)*, of the corolla (5 bundles in each lobe rather than 3, but with the laterals branched), and of the ovary (6 bundles rather than 4 main bundles). Two plates (our figs. 1 and 2) are here reproduced to illustrate the generic characters of *Gentianopsis*. *Gentianopsis* Ma is based on *Crossopetalum* Roth (1827), a generic name which cannot be used since it has a much earlier homonym in the *Celastraceae*. *Anthopogon* Necker (Elem. 2:12. 1790), used by Rydberg and others for this group, likewise is generally considered a *nomen invalidum*, for the components of Necker's "species," which correspond to our genera, are very inadequately described and mostly not indentifiable (cf. Gillett 1957:202). Furthermore, *Anthopogon* Nutt. 1818, a validly published generic synonym of the grass genus *Gymnopogon* Beauv., makes Rafinesque's validation of the Gentian genus, i.e. *Anthopogon* Necker ex Raf., a later, generic homonym.

Löve (1953) suggests on cytotaxonomical grounds that *G. crinita* and *G. procera* with 78 chromosomes (base number 13) should perhaps be placed in a different genus from *G. detonsa* and *G. ciliata* with 44 chromosomes (base number 11). It would seem, however, that the relatively small morphological differences are at most of infrageneric rather than generic magnitude, and that, considering how few of the *Gentianopsis* taxa are known cytotaxonomically and how many different chromosome numbers appear in *Gentiana, sensu stricto*, such a course would be at least premature. Incidentally, Toyokuni (1963: 148-9), who leaves *G. crinita* and *G. procera* in *Gentiana*, places *G. cruciata* and *G. phlogifolia* into *Gentianopsis*, though fortunately just in a list and without formal transfers. Both of these species belong to *Gentiana* Sect.



Gentiana Victorinii. — (a) Plante entière (× 0.6). — (b,c,d) Feuilles de la base (× 1). — (e) Feuille normale (× 1). — (f) Fleur à l'anthèse (× 1). — (g) Fruit à la déhiscence (× 1.25). — (h) Calice, face ventrale (× 1.25). — (i) Détail du précédent. — (j) Corolle et androcée (× 1). — (k) Nervation d'un lobe du calice. — (l) Pistil d'une plante vivante (× 1). — (m) Le même après dessiccation. Le style et le stipe sont en noir. — (n) Graine (× 25). — (o) Base de l'étamine et nectaires. On voit par transparence la zone de concrescence du filet et de la corolle, et les poils cachés par les ailes. — (p) Coupe schématique de la fleur au-dessus du point de concrescence des sépales.

Aptera (Rork 1949), a group rather closely related to Sect. *Pneumonanthe* which includes the American "Bottle Gentians." *Gentiana cruciata*, despite its 4-merous flowers, is in no way related to *Gentianopsis*.

SYSTEMATIC LIST OF SPECIES AND INFRASPECIFIC TAXA

GENTIANOPSIS Ma, in Acta Phytotax. Sinica. 1:7. 1951; Satake, Bull. Chichibu Mus. Nat. Hist. 6:3. 1955; Toyokuni, Jour. Faculty Sci. Hokkaido Univ. Ser. V, Botany VII:198-202. 1963. (Type: *Gentiana barbata* Froel.).

GENTIANA L. Sp. Pl., ed. 1, 227. 1753, *pro parte;* Gen. Pl. ed. 5, 107. 1754, *pro parte.*

ANTHOPOGON Necker *ex* Raf., Fl. Tellur. 3:25. 1837, *pro parte; Gentiana* subgenus *Anthopogon* (Necker *ex* Raf.) Toyokuni, Hokuriku Jour. Bot. 6:33. 1957, *pro syn., non Anthopogon* Nutt. Gen. North Am. Plants 1:181. 1818. = *Gymnopogon* Beauv. in Gramineae.

GENTIANELLA Moench, Meth. Pl. 482. 1794, emend, Schustler, in Vestn. 1 Sjezdu Cesk. Bot. v Praze, 34. 1923, *pro parte;* Gillett, Ann. Mo. Bot. Gard. 44:208, 1957, *quoad* subgenus *Eublephis.*

GENTIANA **** CROSSOPETALAE Froel., Gent. Diss. 109. 1796.

CROSSOPETALUM Roth, Enum. Pl. Phaen. Germ. 1:516. 1827, *non Crossopetalum* P.Br. Hist. Jamaic. 145. 1756 *(Crossopetalon* Adans. Fam. ii. 1763) = *Myginda* L. in Celastraceae (*Fide* Index Kew.).

GENTIANA subg. EUBLEPHIS Raf., Med. Fl. 1:208. 1828; *Gentianella* subg. *Eublephis* (Raf.) Gillett, Ann. Mo. Bot. Garden 44:210. 1957.

GENTIANA subg. GENTIANOPSIS (Ma) Toyokuni, Hokuriku Jour. Bot. 6:33. 1957; *Gentiana* sect. *Gentianopsis* (Ma) Satake, Natur. Sci. Mus. Tokyo 24:141. 1957.

1. GENTIANOPSIS BARBATA (Froel.) Ma, Acta Phytotax. Sinica 1:8. 1951.

   Gentiana barbata Froel. Gent. Diss. 114. 1796.

2. GENTIANOPSIS BARBATA (Froel.) Ma, var. SINENSIS Ma, *loc. cit.* 1:9. 1951.

3. GENTIANOPSIS GRANDIS (H. Smith) Ma, *loc. cit.* 1:9. 1951.

   Gentiana grandis H. Smith, in Sitzungsanz. Ak. Wiss. Wien 63: 100. 1926.

4. GENTIANOPSIS SCABROMARGINATA (H. Smith) Ma, *loc. cit.* 1:10. 1951.

   Gentianella scabromarginata H. Smith, in Hand. Mazz., Symb. Sin. 7:980. 1936, *nom. nud. in obs.*

   Gentiana detonsa var. *ovato-deltoides* Burkill, Jour. Asiat. Soc. Bengal, n. ser., 2:319; Ling, in Fl. Ill. Nord. Chine 2:23, pl. 7. 1933.

5. GENTIANOPSIS PALUDOSA (Munro) Ma, *loc. cit.* 1:11. 1951.

   Gentiana detonsa var. *paludosa Hook.* f., Hook. Ic. pl. 9: *tab.* 857. 1852.

   Gentiana paludosa Munro MS. ex Hook. f. *loc. cit. pro syn.*

Fig. 2 (opposite). *Gentiana victorinii* (i.e. *Gentianopsis procera*, a segregate population from Quebec). From Rousseau (1932), with permission.

6. GENTIANOPSIS NANA (Ling) Ma, *loc. cit.* 1:12. 1951.
   Gentiana detonsa var. *nana* Ling, Fl. Ill. Nord Chine 2:23, pl. 7. 1933.
7. GENTIANOPSIS LONGISTYLA Ma, *loc. cit.* 1:12. 1951.
8. GENTIANOPSIS LUTEA (Burkill) Ma, *loc. cit.* 1:13. 1951.
   Gentiana detonsa var. *lutea* Burkill, Jour. Asiat. Soc. Bengal, n. ser., 2:319. 1906.
9. GENTIANOPSIS CONTORTA (Royle) Ma, *loc. cit.* 1:14. 1951.
   Gentiana contorta Royle, Ill. Bot. Himalaya 278, t. 68, fig. 3. 1839.
10. GENTIANOPSIS CONTORTA var. WUI Ma, *loc. cit.* 1:15, 1951.
11. GENTIANOPSIS YABEI (Takeda & Hara) Ma, *loc. cit.* 1:19. 1951.
    Gentiana yabei Takeda & Hara, Jour. Jap. Bot. 13:600, *f. 45.* 1937.
12. GENTIANOPSIS CILIATA (L.) Ma, *loc. cit.* 1:19. 1951.
    Gentiana ciliata L. Sp. Pl. ed. 1. 231. 1753, exclusive of specimens from Canada.
13. GENTIANOPSIS DETONSA (Rottb.) Ma, *loc. cit.* 1:9. 1951.
    Gentiana detonsa Rottb. Kiob. Selsk. Skr. (Acta Hafn.) 10:435. 1770.
    Gentianella detonsa (Rottb.) G. Don, ssp. *yukonensis* Gillett, Ann. Missouri Bot. Gard. 44:215. 1957.
14. GENTIANOPSIS **nesophila** (Holm) Iltis, comb. nov.
    Gentiana nesophila Holm, in Ottawa Naturalist 15:11. 1901.
15. GENTIANOPSIS **raupii** (Porsild) Iltis, comb. nov.
    Gentiana Raupii Porsild, Sargentia 4:60. 1943.
16. GENTIANOPSIS **thermalis** (O. Ktz.) Iltis, comb. nov.
    Gentiana thermalis O. Ktz. Rev. Gen. 2:427. 1891.
    Gentiana elegans A. Nelson, in Bull. Torr. Bot. Club 33:148. 1898.
    Gentianopsis elegans (A. Nelson) Ma, *loc. cit.* 1:19. 1951.

While Harrington (1954), for example, accepts *G. thermalis*, Gillett (1957) considers *G. elegans* Nelson the valid name, because a) "it is more widely known," b) "Nelson's specimen is of fine quality and is distributed among at least three herbaria and probably more" and c) "Kuntze's specimen has not been found."

Kuntze's description (1891:427), 10 full lines of print, is detailed and gives exact locality data, viz., "At the hot springs of the Geyser region of the United States Yellowstone National Park." Around these hot springs, which give this species its specific name, *G. thermalis* (= *G. elegans*), the only fringed gentian in the area, is exceedingly common, and forms at times a magnificent solid purple-blue border. In fact, it is so common that

> "in 1926 the Fringed Gentian was chosen as the [Yellowstone National] park flower. It was an excellent choice, not only because it is considered one of the most beautiful of all the park flowers, but because it blooms throughout the entire tourist season. It is found

> blooming at the beginning of the tourist season in June on the warm earth of the geyser basins, and it is still in bloom on some of the more protected places in the park when the last tourists leave in late September." (McDougall and Baggley 1936:100).

The original description does indeed suggest that "*G. thermalis* Kuntze [is] based on depauperate specimens" (Rydberg 1906), plants of which, Kuntze observed, he was "unfortunately able to collect only very few." His description reports flowers with greatly foreshortened peduncles and plants with low stunted growth, much smaller than is normally the case. Small wonder! For Otto Kuntze visited Yellowstone National Park probably in early (or mid?) October ["23/IX-18/X. Side trip by wagon later by horse through Idaho to Virginia City and Yellowstone Park (geyser region); Madison River Valley"—Translated from Kuntze, 1891, vol. I:XI] What a very late collection date, when heavy snows often fall in the region! This would easily explain the rarity of the species, as well as the low growth form, for even occasional mid-season plants are many-stemmed and seemingly acaulescent [e.g. *Denniston* Aug. 7, 1929 (WIS!); *Cowen s.n.* and *Cowen 1509* (P!); and fig. 76, p. 100 in McDougall and Baggley, 1936]. Thus the flower description, both as to size, internal structure (gynophore!) and erose-fimbriate margin, the fact that there are no other species of *Gentianopsis* in the region, and the very specific habitat information leave no doubt whatsoever that *G. thermalis* is conspecific with *G. elegans,* and thus the valid name of what has generally been called *G. elegans.*

17. GENTIANOPSIS **macrantha** (D. Don) Iltis, comb. nov.

Gentianella macrantha D. Don, ex G. Don, Gen. Syst. 4:179. 1838.
Gentiana superba Greene, Pittonia 1:155. 1888.

The original description of *G. macrantha* leaves no doubt that its "corolla [has] . . . fringed segments" . . . Since there are only two Fringed Gentians in Mexico and *G. lanceolata* is *not* fringed, the name *G. macrantha,* clearly belonging to the northern taxon, because of priority should be utilized. Search in European herbaria should reveal a Sessé and Mociño type; yet a recent search of the Geneva, the British Museum, and Paris herbaria did not turn up such a collection.

18. GENTIANOPSIS **lanceolata** (Benth.) Iltis, comb. nov.

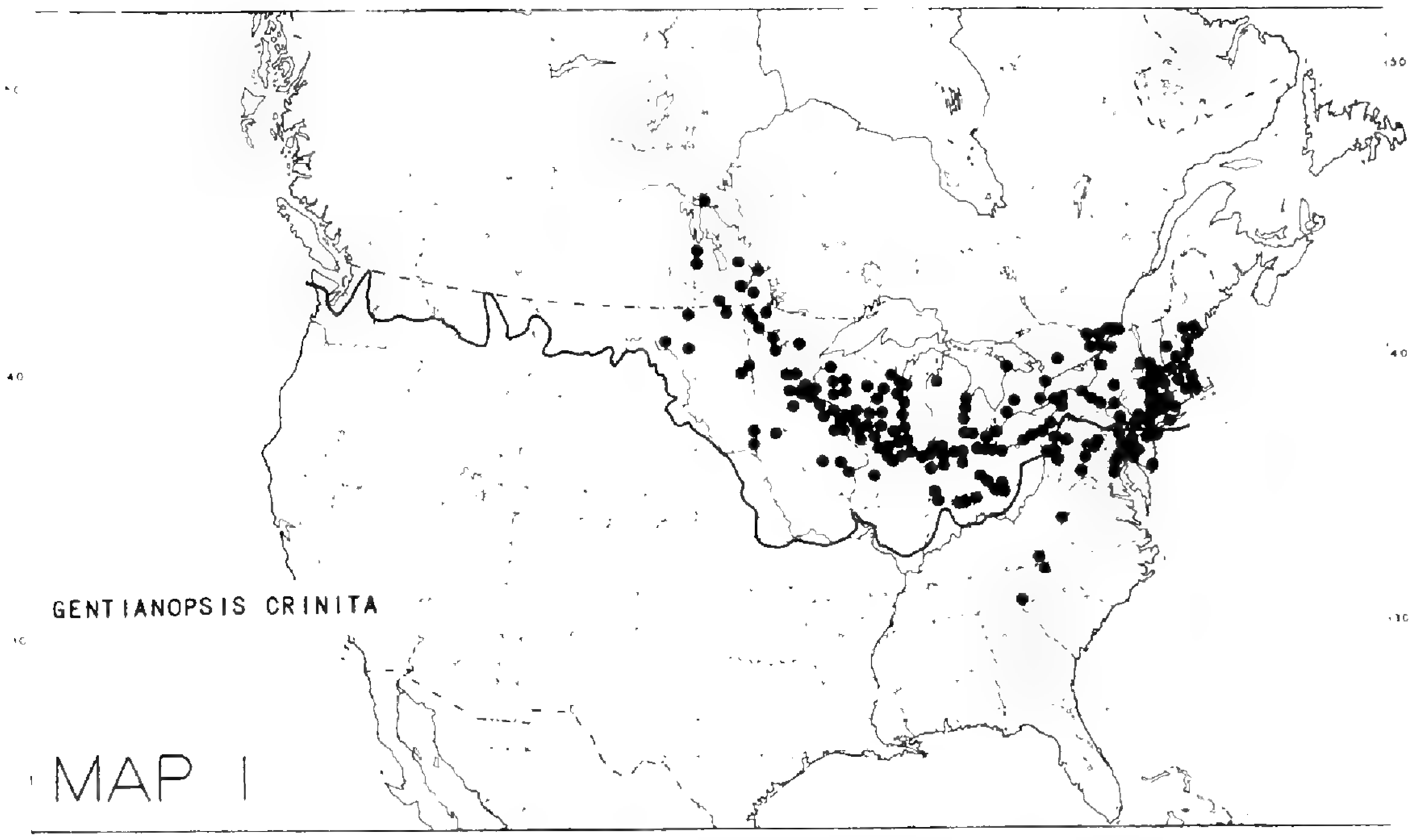
Leianthus lanceolatus Benth., Pl. Hartw. 24. 1839.

Gentiana macrocalix Lex. may well belong here. While the description is not clear and its type is lost, its "Habitat prope Vallisoletum et Irapaeum" would suggest affinity to the Southern Mexican *G. lanceolata* rather than the Northern Mexican *G. macrantha (G. superba),* since "Vallisoletum" refers to Morelia (*Fide* McVaugh) and "Irapeo" is a settlement west of Toluca (ca. 19°N, 100W), both south of the range of *G. macrantha.*

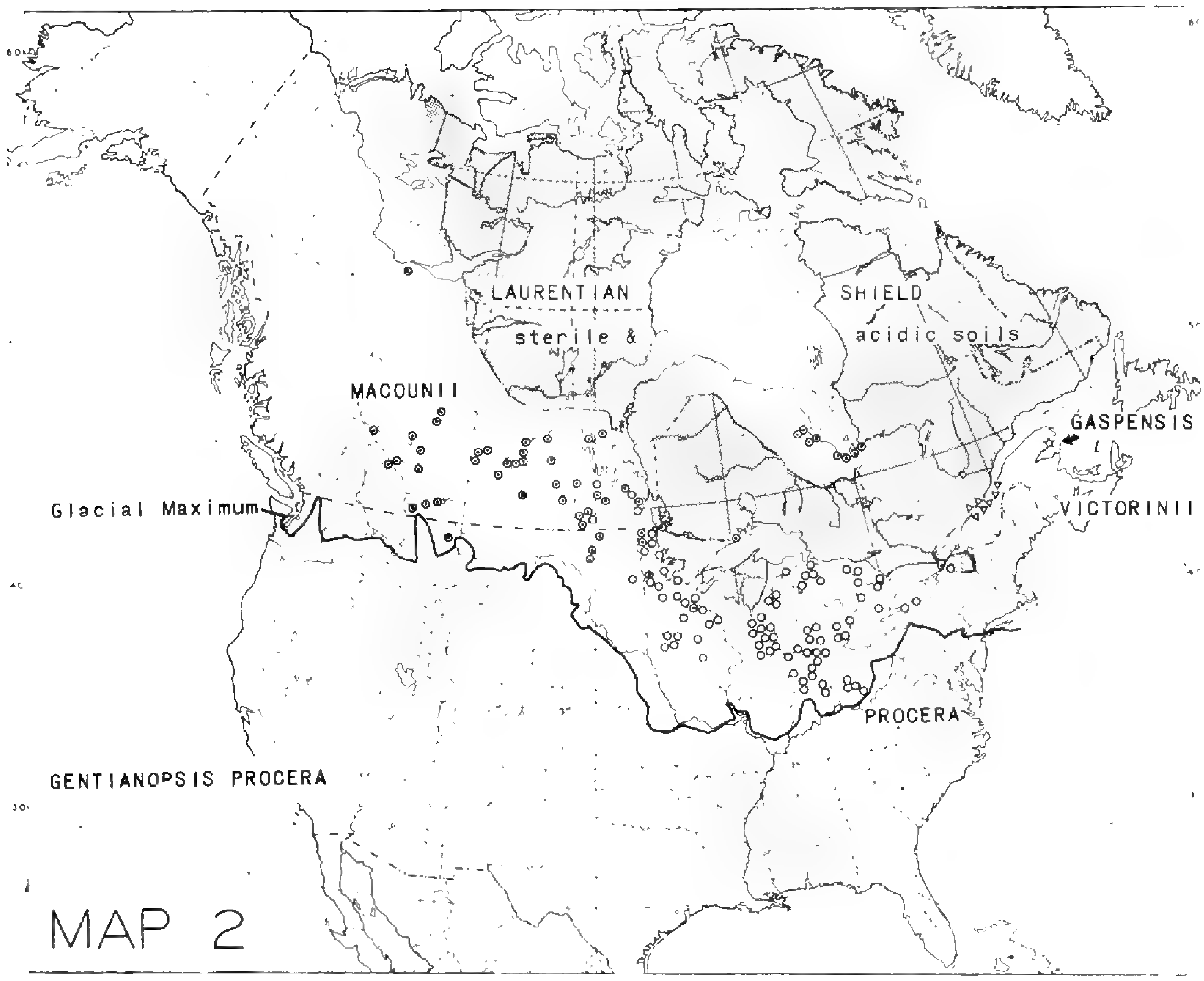
19. GENTIANOPSIS **holopetala** (A. Gray) Iltis, comb. nov.
    Gentiana serrata Gunn. var. *holopetala* A. Gray, Bot. Calif. 1:481. 1876.
    Gentiana holopetala (A. Gray) Th. Holm, in Ottawa Naturalist 15:110. 1901.
20. GENTIANOPSIS CRINITA (Froel.) Ma, *loc. cit.* 1:19. 1951.
    Gentiana crinita Froel. Gent. Diss. 112. 1796.
21. GENTIANOPSIS CRINITA (Froel.) Ma, f. **albina** (Fern.) Iltis, comb. nov.
    Gentiana crinita Froel. forma *albina* Fern. in Rhodora 19:152. 1917.
    Albino plants of *G. procera* are also known (though as yet not formally recognized), from Bailey's Harbor, Door County, Wisconsin, from color photographs (WIS!) taken by Karl Bartel of Blue Island, Illinois.
22. GENTIANOPSIS PROCERA (Th. Holm) Ma, *loc. cit.* 1:19. 1951.
    Gentiana procera Th. Holm, in Ottawa Naturalist. 15:111. 1901. It is of interest, especially to one working with Wisconsin plants, that an Increase A. Lapham sheet originally in the C. W. Short herbarium, but now in the Paris herbarium, and collected ca. 1840 or 1850, says "Gentiana, a new species from Wisconsin."
23. GENTIANOPSIS **victorinii** (Fern.) Iltis, comb. nov.
    Gentiana Victorinii Fern., Rhodora 25:87. 1923.
24. GENTIANOPSIS **macounii** (Th. Holm) Iltis, comb. nov.
    Gentiana Macounii Th. Holm, Ottawa Naturalist 15:110. 1901.
    Gentiana gaspensis Vict. Contr. Lab. Bot. Univ. Montreal 20:10. 1932.
25. GENTIANOPSIS **barbellata** (Engelm.) Iltis, comb. nov.
    Gentiana barbellata Engelm., Transact. Acad. Sci. St. Louis 2:216. 1862.
26. GENTIANOPSIS **simplex** (A. Gray) Iltis, comb. nov.
    Gentiana simplex A. Gray, Newberry, Bot. Rept.
    U.S. Pac. R.R. Survey 63:87. 1857.

II. THE FRINGED GENTIANS EAST OF THE ROCKY MOUNTAINS

The Eastern and Middle-western Fringed Gentians, *G. crinita, G. procera, G. victorinii* and *G. macounii* (incl. the indistinguishable *G. tonsa* and *G. gaspensis)* have recently been treated in many different ways. Thus Fernald (1950) recognizes all of these as valid species of *Gentiana,* while Gleason (1952), in listing *G. crinita, G. procera, G. Victorinii* and *G. tonsa* (incl. *G. gaspensis),* comments (3:62) that ". . . [*procera*] and the next two species [*victorinii, tonsa*] are so closely similar that they might well be reduced to varieties of a single widely varying species." Gillett (1957, 1963) visualized an all-inclusive *Gentianella crinita,* composed of 4 *equivalent subspecies,* with *G. gaspensis*



MAP 1



MAP 2

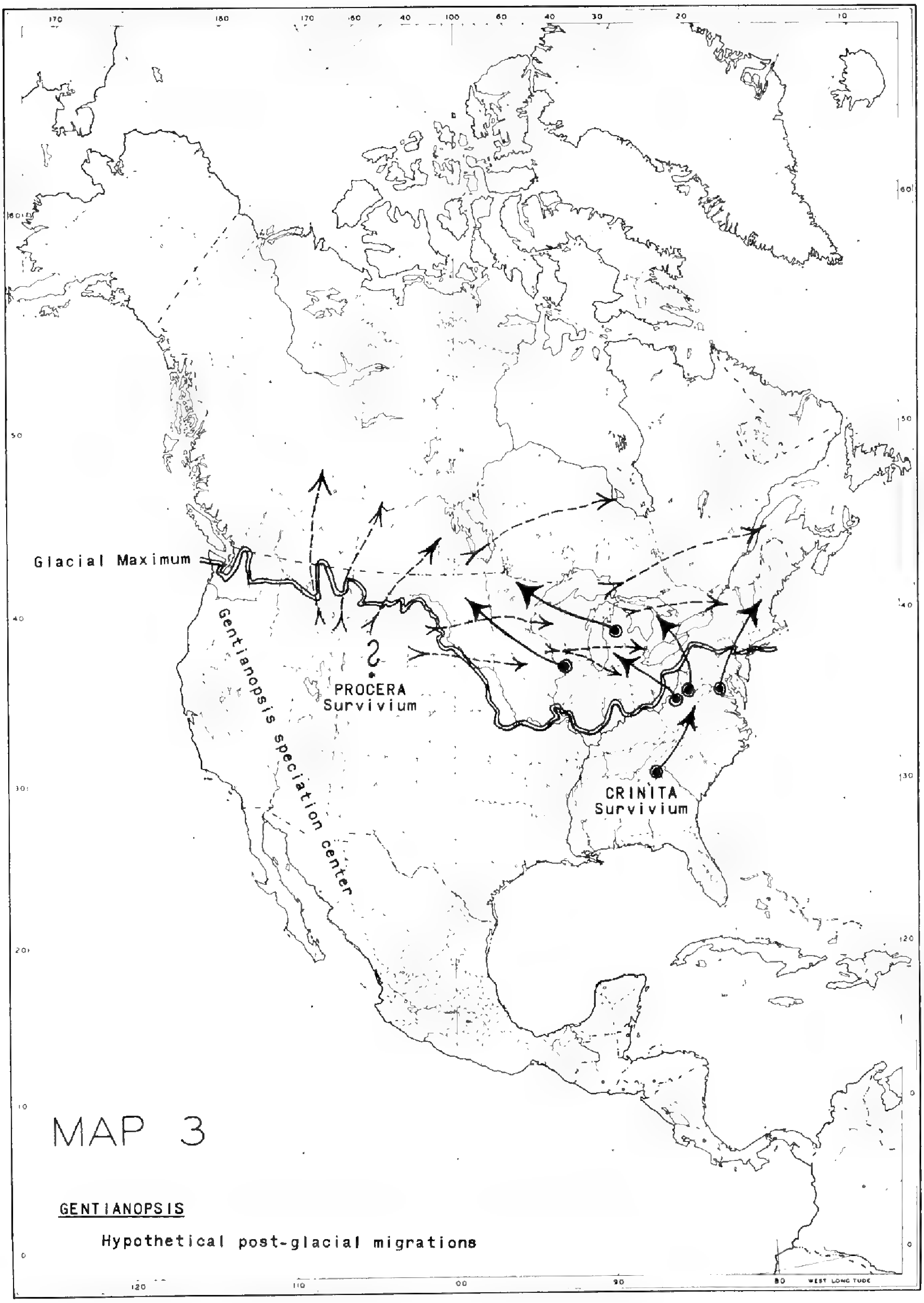
and *G. tonsa* synonymized under ssp. *macounii*. (Actually, many of Gillett's comments in the 1957 study make it obvious that he is in essential agreement with Gleason and the views presented here.) In evaluating the morphological features of these plants it became evident that neither

Fernald's "splitting" nor Gillett's "lumping" properly reflects the natural relationships of these taxa. Furthermore, a reconsideration of ecology, geography and morphology suggests a synthesis of the above viewpoints into a more natural and dynamic taxonomy (closely resembling the arrangement of Gleason), a system more compatible with evolutionary and historical factors. It will be maintained here that only two species should be recognized, the distinctive and rather stable *G. crinita,* and the variable *G. procera.* The latter includes all the other taxa mentioned above, some clinal, others discrete local populations, which might, if needed, be recognized at most as weak varieties.

The following remarks are partly based on field observations of Wisconsin and Michigan plants (cf. Mason and Iltis, 1965), and are partly the result of editing two studies on Wisconsin *Gentianaceae* (by J. S. Pringle, 1964, 1965).

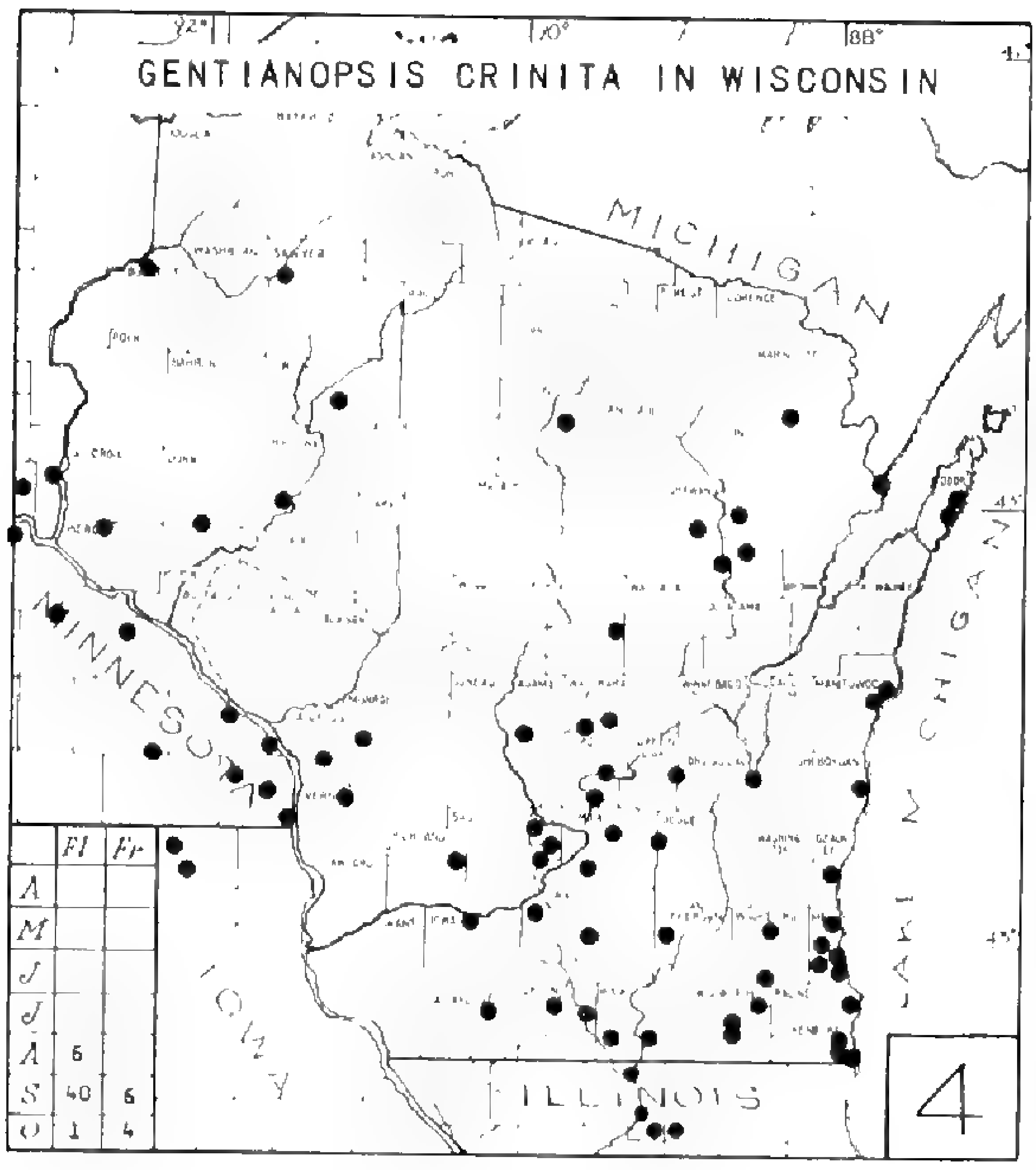
In Wisconsin and the Middle West in general, *G. crinita, sensu stricto,* is widely distributed (Map 4) and locally common to rare in marshy or sandy sedge meadows, swales and moist dunes, damp open woods, seepage slopes, dolomitic sandstone cliffs, and low wet sandy flats on Lake Michigan shores, there with *Parnassia caroliniana,* and on low calcareous prairies, apparently not requiring, but tolerating, as calcareous a habitat as *G. procera.*

The closely related, sometimes very similar *G. procera* (Map 5), on the other hand, is much more locally distributed in Wisconsin than *G. crinita,* though, as on the Kenosha Prairie, Lake Wingra Marsh (Dane Co.) and Ennis (Muir) Lake Fen (Marquette Co.), the two species may sometimes grow together or near each other. *Gentianopsis procera,* in contrast to *G. crinita,* prefers *distinctly* alkaline habitats (as judged from associated plants), such as calcareous or marly, often springy, low prairies or sedge meadows, which in Wisconsin and Iowa have sometimes been referred to as "fens" (Anderson 1943, Curtis 1959), or moist calcareous (Niagara Dolomitic) sands on Lake Michigan shores, as at Bailey's Harbor, Door Co., (there with *Gentianella quinquefolia,* soil pH 8, *fide* Fuller), and springy seepage on the Lake Michigan bluffs (pH 7, *fide* Pohl). These usually wet calcareous sedge prairies or fens, which are best developed on calcareous drift derived from the Niagara Dolomite, on the dolomite itself, or around calcareous springs, are characterized by a distinctive assemblage of calciphiles whose distribution patterns often closely resemble that of *G. procera.* These include *Solidago ohioensis, S. riddellii,* and perhaps *S. patula* (Salamun 1963), *Salix candida* (Argus 1964), *Lysimachia quadriflora* (Iltis & Shaughnessy 1960:133), *Lobelia kalmii, Aster junciformis, Parnassia caroliniana, Potentilla fruticosa* (Mason & Iltis 1958: Map 16) *Valeriana ciliata (V. edulis),* the rare *Scleria verticillata* (cf. Iltis 1957) and others. All of these together with *G. procera* are rare or absent from the Driftless Area



of SW Wisconsin, not apparently because of any historical factors or absence of calcareous rocks, but because of deficiency in moisture, of flat marly springs and seepage, and wet calcareous glacial till.

Gentianopsis procera flowers in Wisconsin from (mid-) late August



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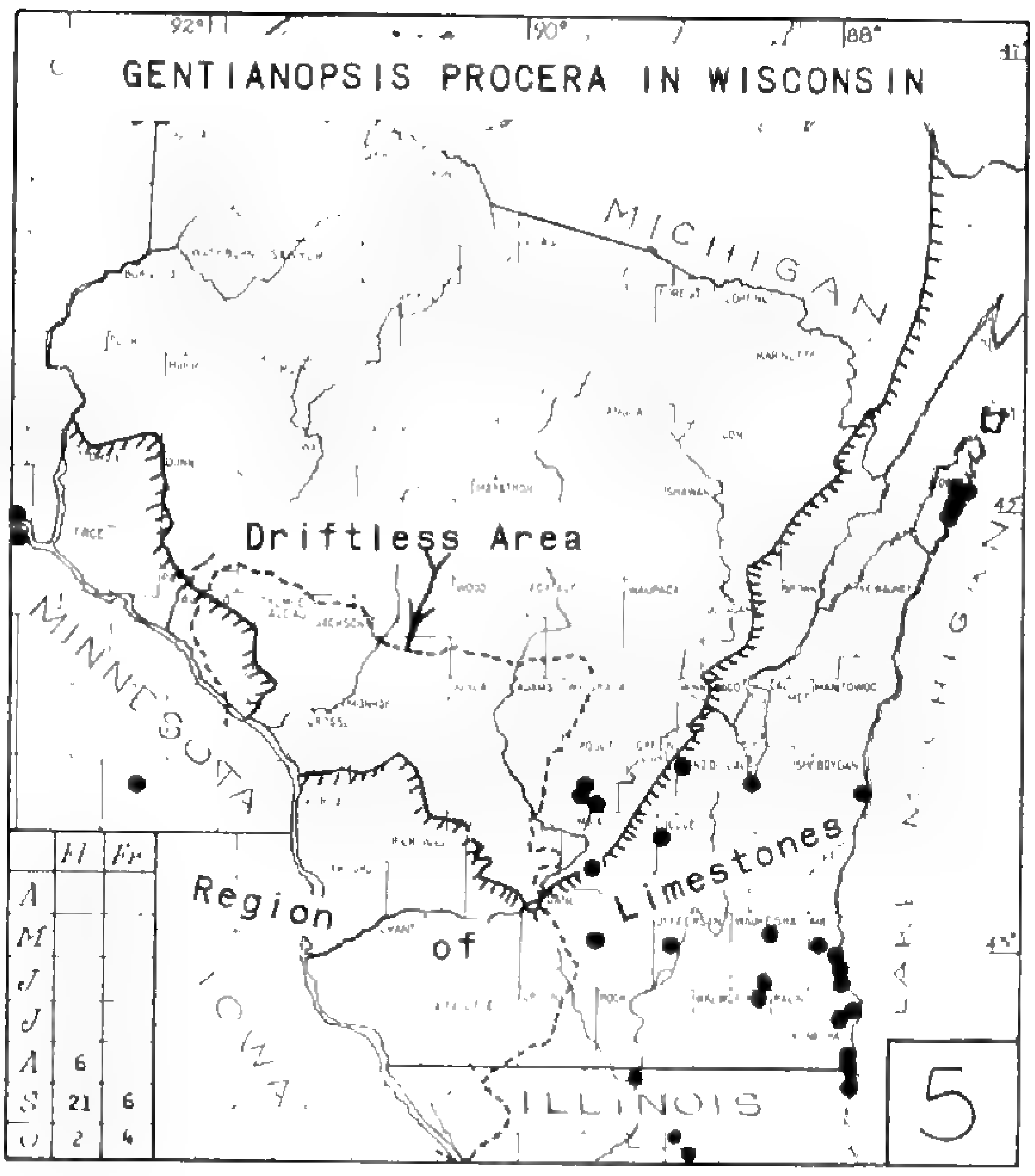


5

into early October, with a peak in the *second week* of September, apparently blooming just a little earlier than *G. crinita* (which blooms from mid-August into October, with a peak in the second and *third week* of September), a fact mentioned for Indiana by Deam (1940) and for the Northeastern United States by Fernald (1950).

In Minnesota, where the overall occurrence of the two species is similarly scattered, the detailed ranges (courtesy Dr. J. Moore) show that only in a few instances do the species grow near each other, with a tendency for *G. crinita* to grow in the eastern, more wooded, moister areas, *G. procera* in the western, more open, drier prairie sections of Minnesota. Similar comments apply to Iowa (cf. Anderson 1943; Beal and Monson 1954:76, map 182).

In Indiana, Deam (1940) reports that, when the two species occur together, *G. procera* prefers moister sites. The same can be said for Wisconsin.

The striking absence of *G. procera* from interior Ontario and Quebec south of Hudson Bay (cf. Map 2) is no doubt due to the absence of calcareous rocks, a fact of great phytogeographical importance first pointed out by Wynne-Edwards (1937:24, map 2). As a matter of fact, the contrasting ecological behavior is well brought out by a comparison of not only the Wisconsin map (Map 5), where all *G. procera* stations are either over dolomite or near calcareous springs, but also by their total distribution (Map 2). For here we can see that *G. procera* follows the Niagara dolomite from Wisconsin across Upper Michigan to the Bruce Peninsula of Ontario and beyond to Niagara Falls, a region through most of which *G. crinita* is lacking (Map 1). Though the species at rare times do occur together in the Middle West and show some overlap in blooming periods (as seen in herbarium records), there is only indirect and inconclusive evidence that hybridization or introgression has taken place between them (see below), their distinct geographic patterns, ecology, genetic behavior, seasonal isolation and morphology suggesting two clearly marked, well isolated taxa.

What relationship do *G. crinita* and *G. procera sensu stricto* have to the other Eastern taxa of *Gentianopsis?* Herbarium specimens, or the exquisite illustrations in Gillett's 1963 study, clearly show *G. crinita* to be relatively unique, while *G. macounii* (incl. *G. gaspensis*), *G. procera* and *G. victorinii* form a unified series of morphologically either essentially identical or completely confluent populations, with only minor quantitative differences between them. To understand the variation patterns it is well, however, first to represent the local or regional populations on scatter diagrams, second, to explain some of the anomalies shown in these scatter diagrams in terms of taxonomy, climatic trends and possibly introgressive hybridization, and last, to synthesize all data in historical perspective.

CHARACTERS USED IN SCATTER DIAGRAMS

The following scatter diagrams show graphically and quantitatively the differences between *G. crinita* and the other taxa, and demonstrate the morphological congruence of the members within the *G. procera* complex. Of the many morphological features cited in the literature, only few were found to be of value. Thus flower size, plant size, length of petal cilia, and extent of and scabrosity of calyx keels are characters sometimes used, but difficult to evaluate on herbarium material and are of limited biological significance.

The following characters were used in the scatter diagrams: 1) the relationship of leaf length to width of the median leaves *(longest leaf subtending the first flowering branch of each plant)*, which seemed to vary least with plant size (the lowermost leaves cannot be used as they are nearly identical in all taxa); 2) The measure of the longest pedicel of each plant, which is related sometimes (in small plants) to plant size but which differs significantly between the *G. procera* complex (long) and *G. crinita* (generally short); 3) flower number generally low in *G. procera*, and high in *G. crinita* (1 to 176!, according to Fernald 1950).

Each glyph represents one plant, with each millimeter on the left glyph arm equalling 3 cm of pedicel length, while each mm on the right arm equalling 6 flowers. The slanted line bisecting the scatter diagram indicates the division between *G. crinita* and *G. procera*. Thus, taking the attributes of the two taxa in consideration, the glyphs of *G. procera*, even when very close to this dividing line, will generally have very long pedicels (long left glyph arm) and very few flowers (short right glyph arm), while in *G. crinita* glyphs it will be the reverse. There are of course very robust *procera* giants with many flowers, and

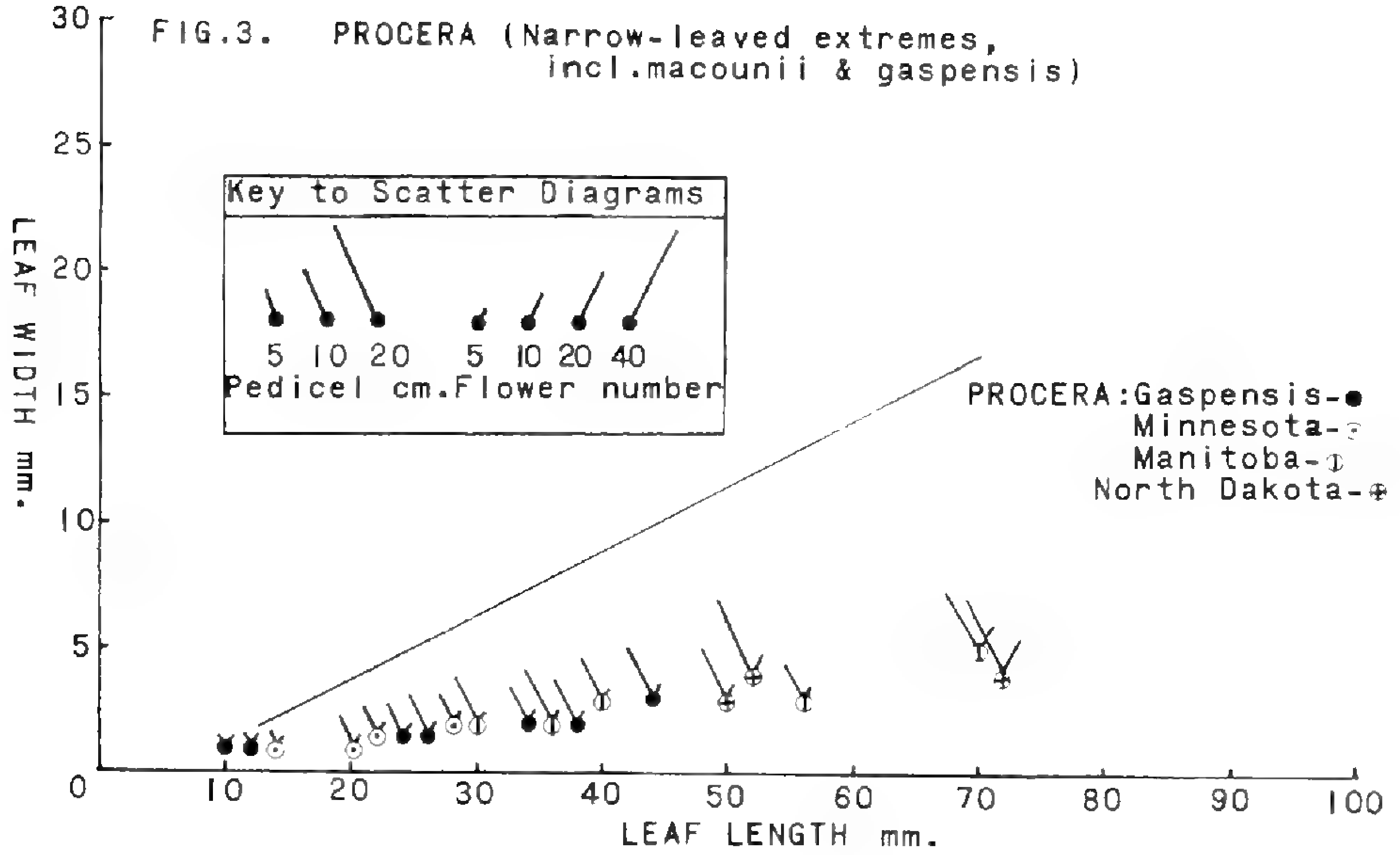


FIG.3. PROCERA (Narrow-leaved extremes, incl. macounii & gaspensis)

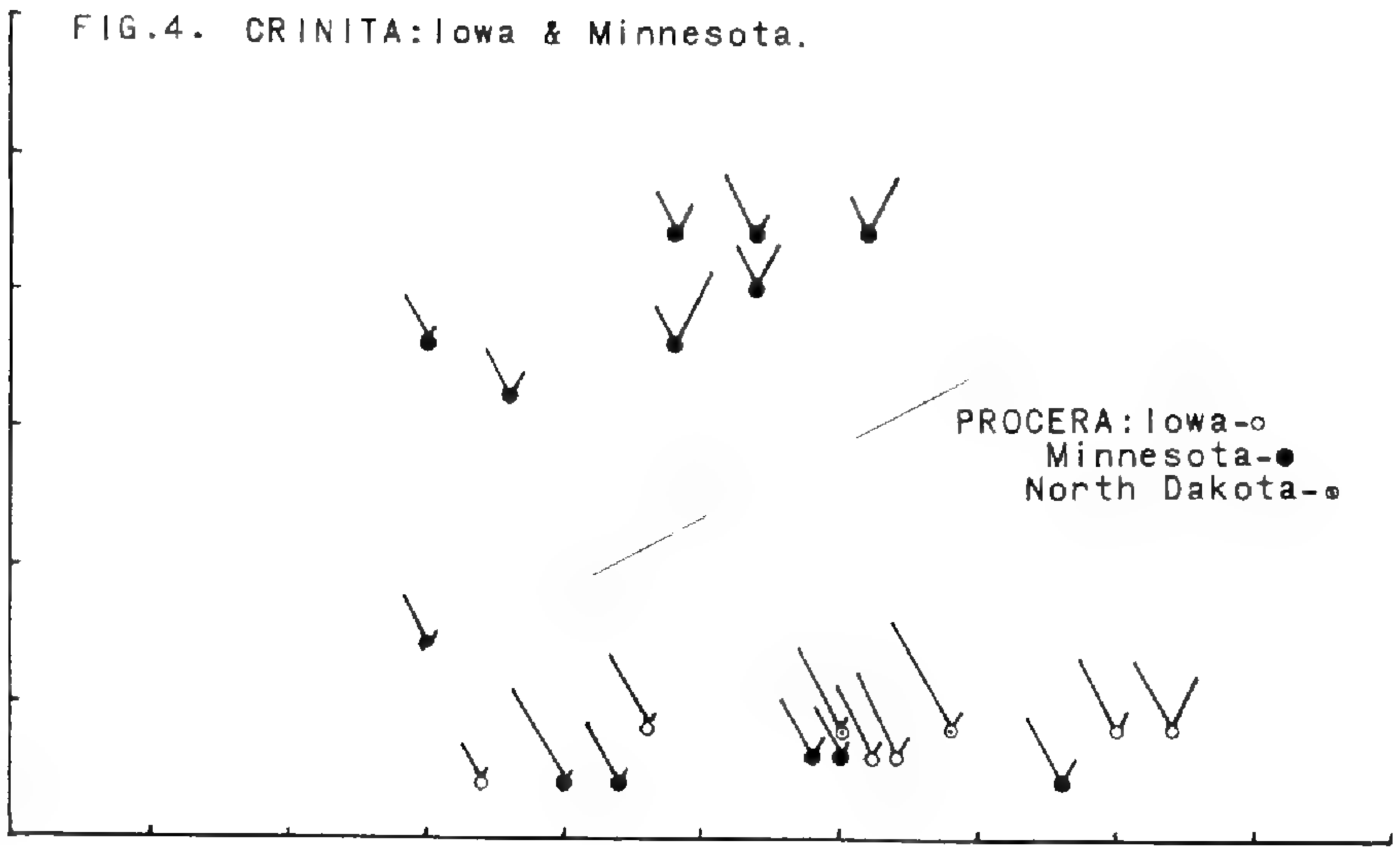


FIG.4. CRINITA: Iowa & Minnesota.

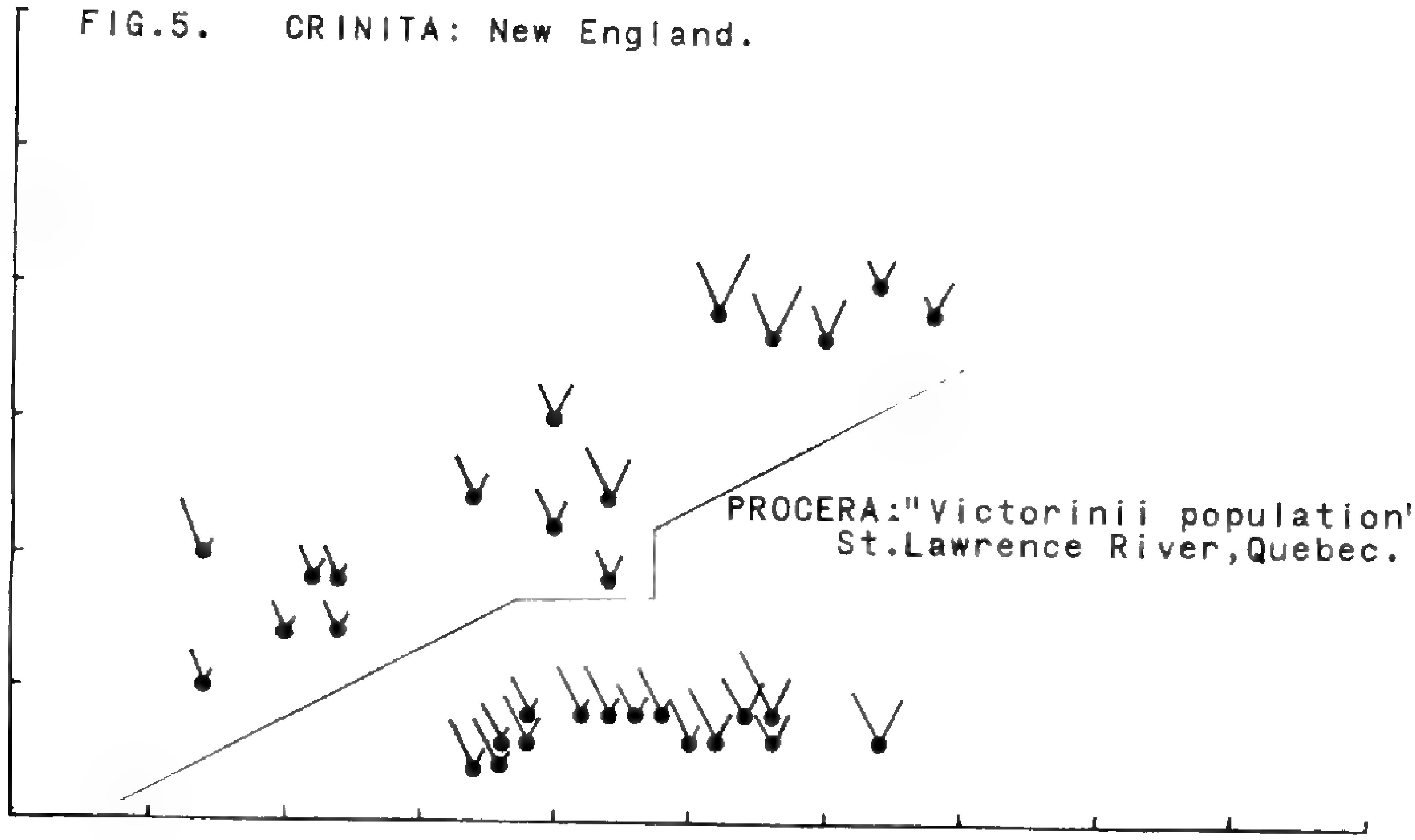


FIG.5. CRINITA: New England.

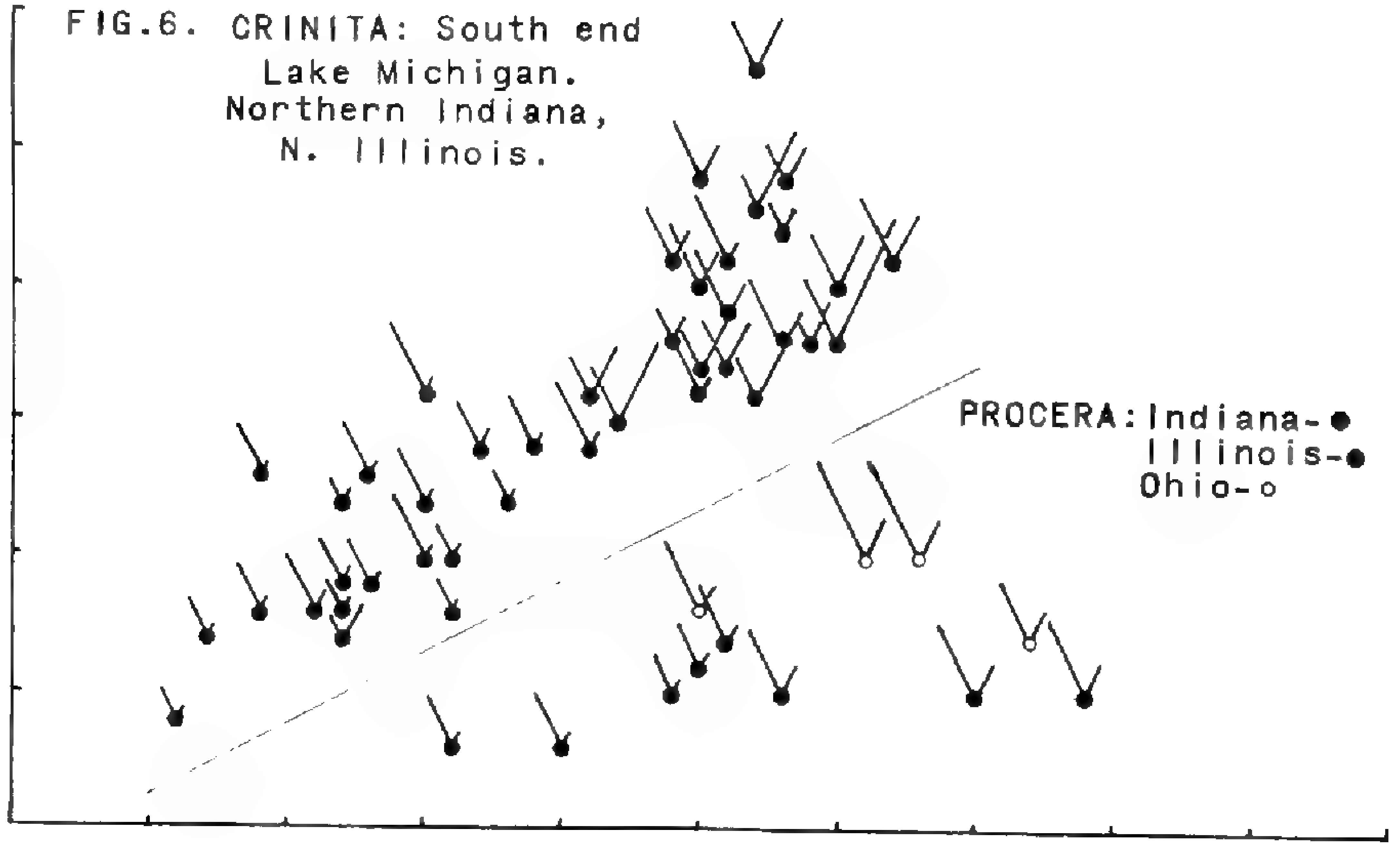


FIG.6. CRINITA: South end Lake Michigan. Northern Indiana, N. Illinois.

occasional small *crinita* plants with only one flower, these then often with rather long pedicels. Distinctions between species break down in the smallest depauperate plants (cf. Figs. 3, 8, and 9, lower left corner), whose identification is often only possible in conjunction with normal plants of the same population (see Fig. 9).

Though only material from the University of Wisconsin Herbarium was used (truly a major limitation), the resultant graphs nevertheless clearly illustrate many of the relationships of these taxa. Grateful acknowledgement is due to Dr. Gillett, who in 1956 and 1957 named nearly all our material, and whose names have been followed in nearly all cases.

DISCUSSION OF THE SCATTER DIAGRAMS. (Figs. 3-10)

Fig. 3. *G. macounii* (incl. the very local, quite indistinguishable *G. gaspensis*). Solid dots are *G. gaspensis (Victorin et al. 4008)*, the hollow dots collections one each from Minnesota, North Dakota, and Manitoba. The Gaspé plants (triangles on Map 2) are generally smaller, and have narrower and shorter leaves. However, the variation pattern is continuous with that of plants from Minnesota and further west. All plants have very few flowers, and, except for the very slender depauperate ones, usually have long pedicles. These are the narrow-leaved extremes of the *G. procera* complex.

Fig. 4a. *G. procera* in Minnesota, Iowa and North Dakota. Except for being a little more robust and wider-leaved (hence their identification as *G. procera)*, sometimes with longer pedicels and/or more flowers (e.g. the far right glyph), none of these plants differ in any marked way, either in the herbarium or on the graph, from the plants named *G. macounii* of Fig. 3.

Fig. 4b. *G. crinita* in Minnesota and Iowa is sharply distinct from *G. procera*, and graphs essentially as other *G. crinita* collections, such as those from New England (Fig. 5).

Fig. 5a. *G. procera (G. victorinii* population from the shores of the St. Lawrence River, Quebec; cf. Fig. 2). These differ in no marked way from the *G. procera* of Fig. 4, except that the glyphs are grouped more closely together, indicating lower variability.

Gentianopsis victorinii grows on the twice-daily inundated, nearly bare limestone slabs of the fresh-water intercotidal zone along the St. Lawrence River. *Gentianopsis gaspensis* (unless one wishes to follow some Canadian authors who consider the Hudson Bay populations *G. gaspensis* also) is restricted to a minute area of brackish "marshland" or open gravelly grassy "swale" at the mouth of the Bonaventure River near the tip of Gaspé Peninsula. Both populations are limited to local and ecologically open environments. Though a great deal has been made of the peculiar habitat of *G. victorinii* (Rousseau 1932—who reports a pH of 7.5; Raymond 1951; Marie-Victorin 1938), this is not too different

FIG. 7. PROCERA: Michigan & adjoining Ontario.

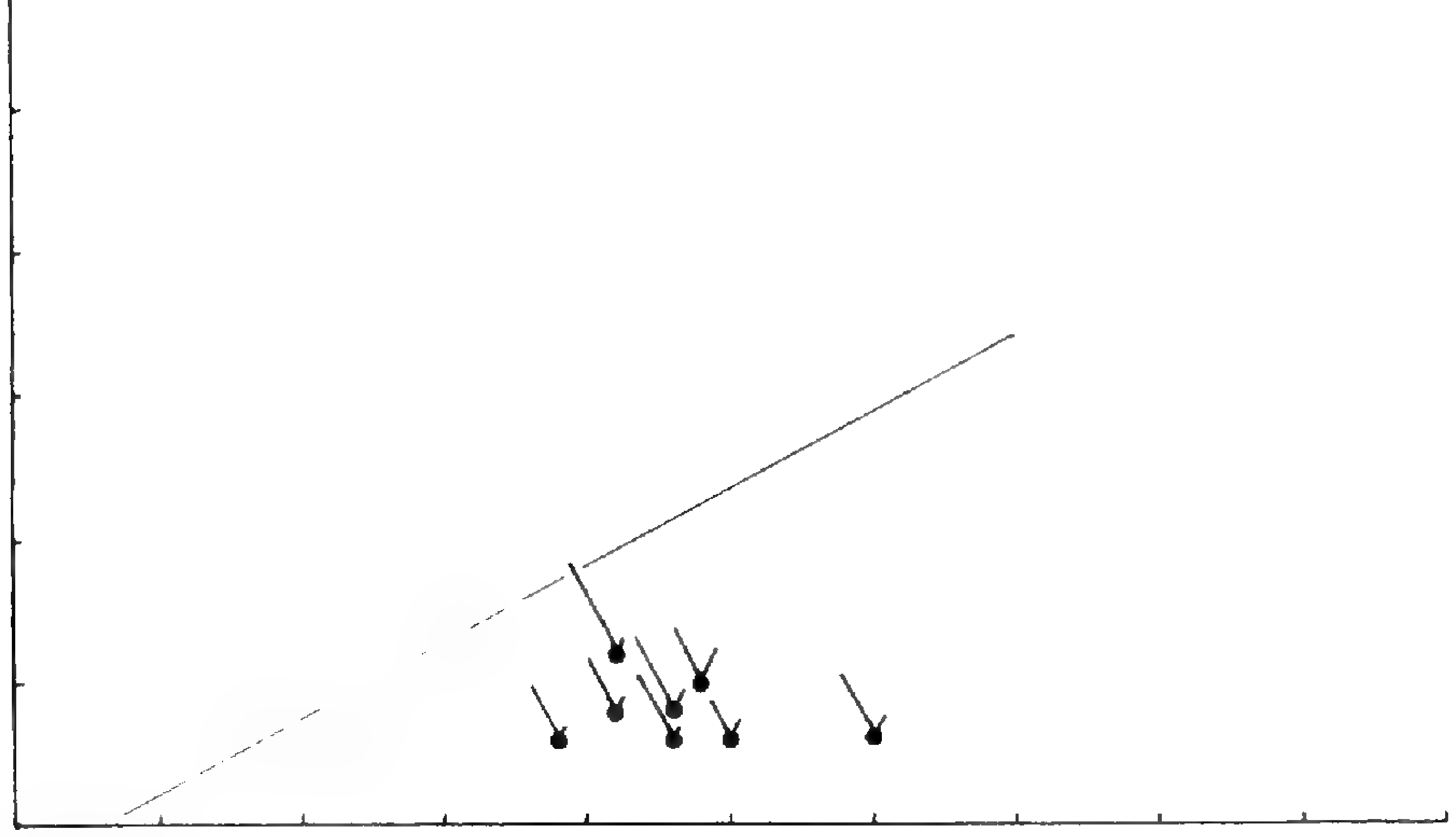


FIG. 8. CRINITA & PROCERA in Wisconsin.

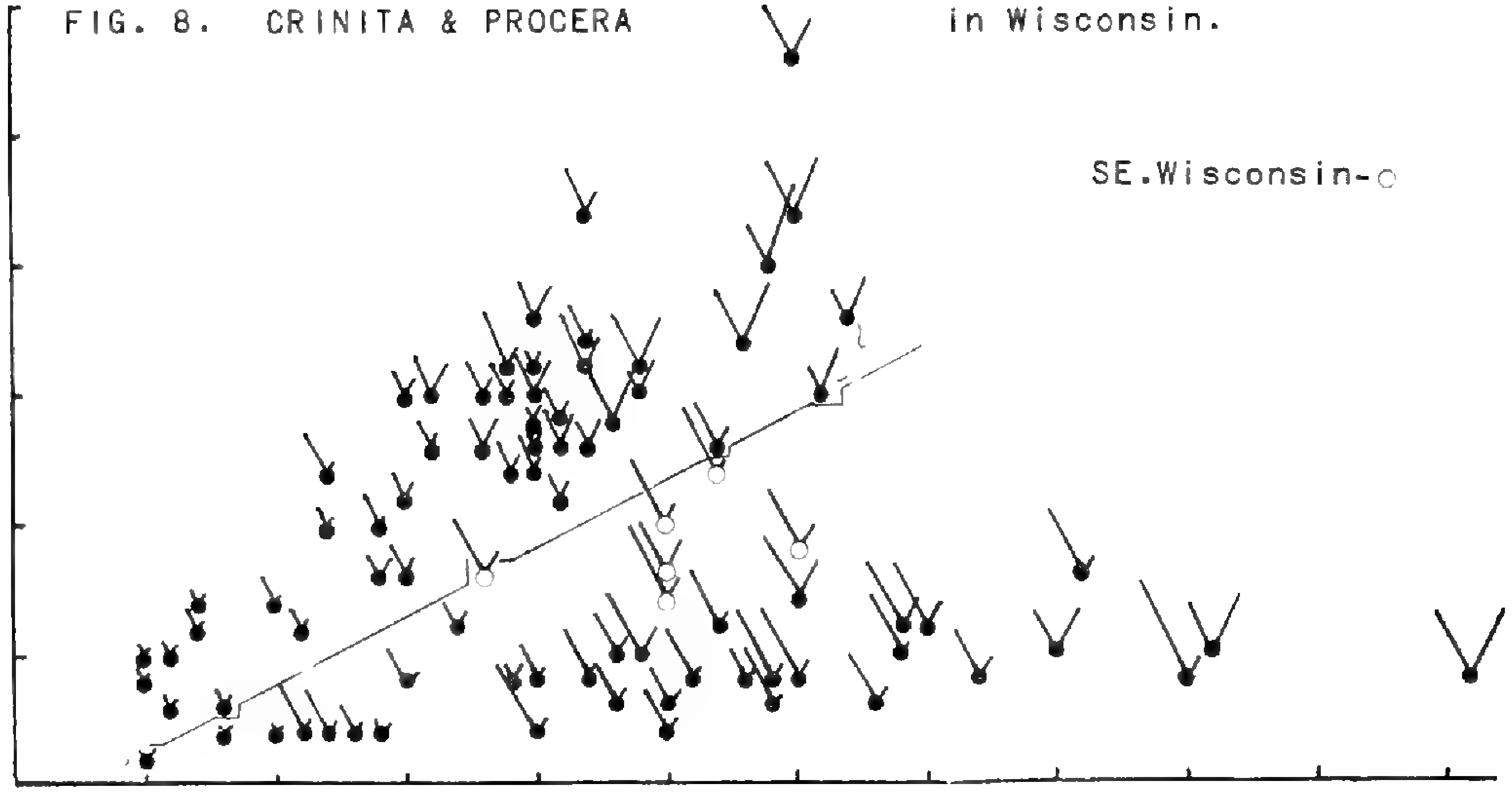


FIG.9. MASS COLLECTIONS FROM WISCONSIN.

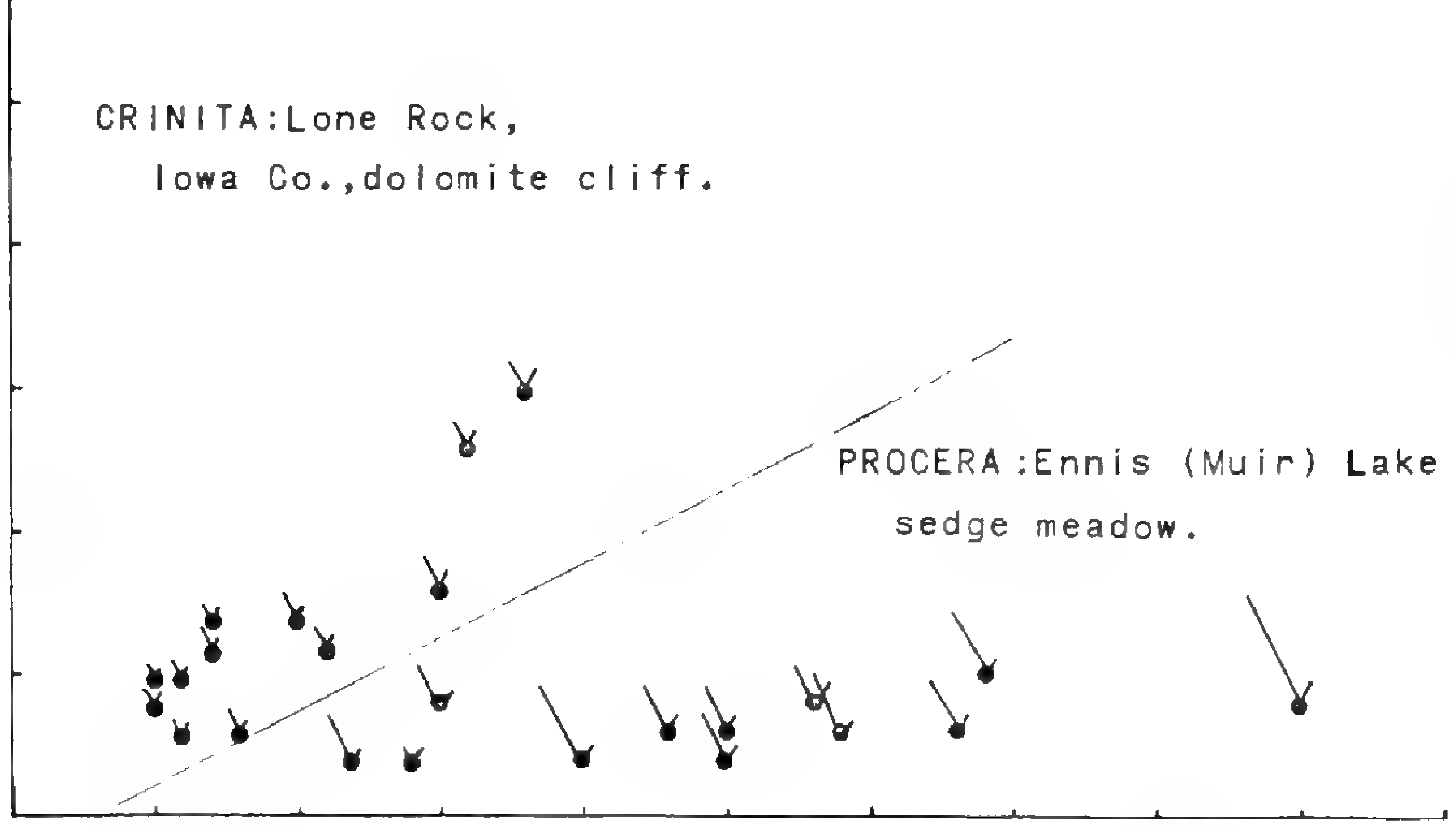
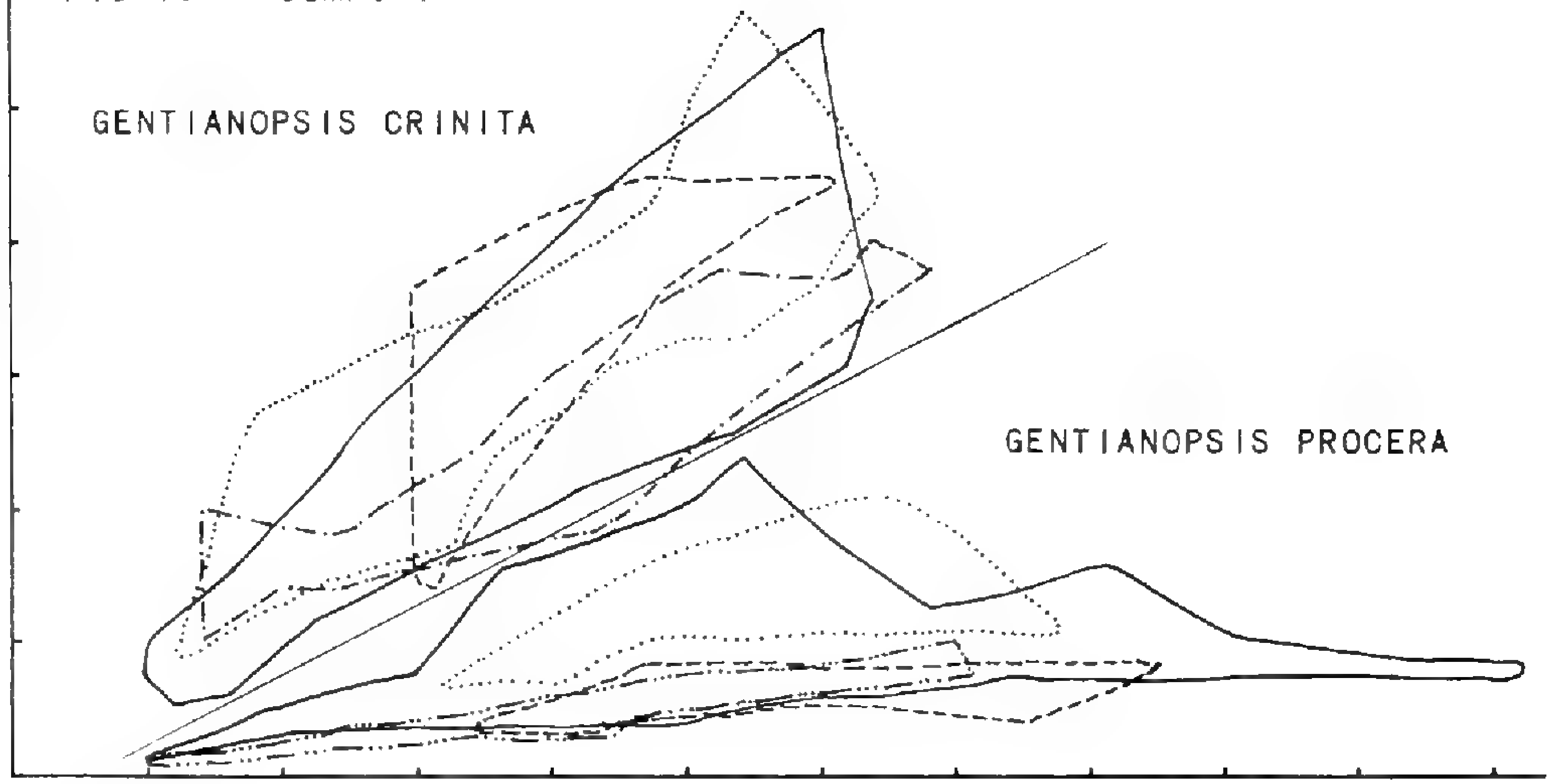


FIG.10. COMPOSITE DIAGRAM.



from the moist, spring-submerged calcareous sedge meadows of the Kenosha Prairie in Southeastern Wisconsin, which, very shallowly underlain by Niagara Dolomite in places covered with Fringed Gentians in the fall, represents one of the most interesting Middle-western habitats and now is threatened with total extinction.

The apparent uniformity of both the *G. victorinii* and *G. gaspensis* populations, which must have played its part in their being described to begin with, as well as their specialized habitat and great local restriction can be explained by either considering them 1) "Founder populations" (Mayr 1963; Goodhart 1963), founded, as it were, by one or few accidentally dispersed seeds which then expanded into rather small, relatively homogenic populations, remarkably uniform in ecological tolerance and morphology and therefore distinctive in aspect (hence the temptation to call them species) or, less likely, 2) by considering, in addition, their specialized and rather uniform calcareous habitats which would result in selection of uniform types. The small size of these populations, which would permit random genetic drift to operate, may also be significant. It is doubtful, however, whether these micro-neoendemics should be accorded any taxonomic status beyond the informal "*victorinii* population" or "*gaspensis* population." In this connection, Gillett's comment (1957:228) that "subspecies *victorinii* is morphologically somewhat intermediate between ssp. *procera* and ssp. *macounii* . . ." is to the point, and suggests that all these should simply be considered as but one species.

Fig. 5b. *G. crinita* from New England. Some of the Massachusetts *G. crinita* collections, which presumably are free of introgression from *G. procera* (which doesn't grow here), are similar in leaf shape to wide-leaved forms of *G. procera,* indicating perhaps that though overall modes of growth of the two taxa differ, occasional genotypes under certain environmental conditions may copy and approach the phenotype of the other species.

Fig. 6a. *G. procera* from Indiana, Illinois (black glyphs) and Ohio (hollow circle glyphs). Note the often larger leaf-width of the *G. procera* collections as compared with those from further west (Figs. 3 and 4). The Ohio specimens, especially, are very robust (collections of C. W. Short, "Columbus" 1835, "Prairies of Ohio" 1836). The glyph position on the diagram should be related to the robustness of these plants (flowers to 8 cm long! pedicel to 19 cm long!).

Fig. 6b. *G. crinita* from the south end of Lake Michigan (mostly Northern Indiana collections of L. M. Umbach). The distribution of glyphs is nearly identical to those from Wisconsin or New England.

Fig. 7. *G. procera* from Michigan and adjoining Ontario. A very small sample of 3 collections.

Fig. 8b. *G. crinita* in Wisconsin follows exactly the same distribution as in other parts of Eastern North America (see Fig. 10). In short, there appears to be no great influence of either climate or of genetic introgression from *G. procera* on phenotypic expression in *G. crinita*. The fact that the glyphs go to the far left-hand corner is explainable by the particular depauperate cliff population ("Lone Rock"), plotted separately in Fig. 9.

Fig. 8a. *G. procera* in Wisconsin is more complex. First of all, there are many plants that are as narrow-leaved and few-flowered as some of the *G. macounii*-*G. victorinii* specimens plotted in Figs. 3, 4, and 5. Most plants, however, have much wider leaves than those of *G. Macounii* or *G. procera* in Figs. 3 and 4, and are similar to those shown in Figs. 6 and 7. The question arises, whether this increase in leaf-width is related to the moister Wisconsin climate, or to introgression from *G. crinita*. Nearly identical broad-leaved types, again all very robust plants, are shown in Fig. 6 from Ohio. Were we to remove from Fig. 8 the generally robust plants from Racine, Kenosha and Milwaukee County (marked by hollow circles) the separation of the two taxa would be much clearer. Again, these few plants grow close to the Lake Michigan shore in Southeastern Wisconsin in a relatively mild climatic regime. At the same time, it is also a region where *G. crinita* overlaps the range of *G. procera!* Perhaps the broad-leaved phenotypes in this region represent in part phenotypic responses of the narrow-leaved genotype to climatic factors and in part introgression from *G. crinita*.

Fig. 9. *G. crinita* and *G. procera* in Wisconsin: Mass collections to show variability within single populations. Fig. 9a. The *G. crinita* collection from Iowa Co., across the Wisconsin River from Lone Rock, Wisc., is peculiar in that these mostly depauperate plants grow on a vertical North-facing dolomitic sandstone cliff. Collections made there in 1925 by N. C. Fassett and again in 1958 by Brian McNab show precisely the same morphological distribution.

Fig. 9b. *G. procera* population from an alkaline sedge meadow ("fen") on Muir (Ennis) Lake, Marquette County: note large spread of glyphs within this local population.

Fig. 10. Composite of all graphs of *G. crinita* and *G. procera*. See discussion especially of Figure 6. *G. victorinii* not shown since its limits are essentially congruent with those of the western plants of *G. procera* (dashes).

In summarizing these 8 graphs it can be said that 1) *G. procera*, *G. macounii*, *G. victorinii* and *G. gaspensis* must be considered as synonymous, the latter two evidently representing nearly homogenic small populations, originally established by long-range dispersed single or few seeds, hence low in variability as well as probably strongly selected by local conditions; 2) of these taxa, *G. procera* is the widest-leaved, intergrading gradually and completely into the more narrow-leaved western *macounii.* In Wisconsin and Idiana, *only very robust plants* resemble plants of *G. crinita.* Since there is a West to East clinal increase in leaf-width and robustness in the *macounii-procera* complex, but not a corresponding decrease in leaf width from East to West in *G. crinita,* it would seem that *G. procera-macounii* has shown itself sensitive to increase in moisture relations eastward by an increase in leaf width, this trait possibly becoming stabilized by selection in Southeastern Wisconsin or Northern Indiana. The alternative hypothesis, namely introgression with *G. crinita* as a cause for increase in leaf width, may also play a part, yet *G. crinita* does not approach *G. procera;* 3) Though local populations tend to be variable, the *scatter diagrams show clearly the presence of two modes of variation in this complex,* with few if any intermediates. It would seem best, therefore, to recognize as species only *G. crinita* and *G. procera,* the latter with some variable and isolated populations perhaps deserving names for purposes of discussion, but whose close biological interrelationships need be clearly recognized.

III. PROBABLE HISTORY OF GENTIANOPSIS IN THE EASTERN UNITED STATES

Since the modern distributions of *G. crinita* and *G. procera (sensu lato)* must be related to Pleistocene glaciation, we can visualize their post-glacial emigrations from glacial survival centers (Hulten 1937) or *"survivia,"* and attempt to reconstruct their post-glacial history (Map 3). All factors of distribution, ecology, phenology and even morphology, suggest that these two taxa are the result of separation by the Pleistocene glaciers of a once widespread ancestral species into two populations—one surviving in the longer growing season of the moister, more acidic Appalachian region in the East, and evolving into a broad-leaved, many flowered, late-blooming *G. crinita;* and one in the shorter growing season of the drier, more alkaline upper Great Plains (and Northern Rocky Mountains?) in the West, and evolving into a narrow-leaved early- and few-flowered heliophilic, calcophilic *G. procera.* Post-glacially, the eastern *G. crinita* spread into the glaciated region of the "White Pine-Hemlock-Northern Hardwoods" and beyond, while the western taxon (or were there several, morphologically slightly differentiated, geographically isolated surviving populations?), which, in its more depauperate, xeromorphic, Northern Great Plains phase is known as *G. macounii,* migrated eastward, especially on damp, but physiologically dry (?), alkaline (calcareous) habitats, to overlap the range of *G. crinita.* In Wisconsin and Michigan the higher precipitation (?) resulted through selection or phenotypic response in generally larger, bigger-leaved plants which have been formally distinguished from *G. macounii* as *G. procera.* Some of these resemble *G. crinita,* suggesting the possibility of introgression from *G. crinita.* While the scatter diagrams reflect this similarity, it seems more reasonable to suppose that increased leaf size may be a phenotypic response to moister habitat, less alkaline soil and/or longer growing season.

The Wisconsin and Indiana *G. procera* populations are rather variable, suggesting broad dispersal, "en masse" migration and many genotypes. The Eastern Canadian populations in contrast, are very uniform. As is characteristic of many other Western elements, *G. procera-G. macounii* spread as far east as the Gaspé Peninsula and Hudson Bay, probably by sporadic long range dispersal. The resultant isolated and highly local, ecologically specialized, genetically evidently impoverished and homogenic populations have been taxonomically recognized as *G. gaspensis* and *G. victorinii*, two neo-endemics perhaps best considered as weak varieties or just populations of *G. procera* (cf. Mason and Iltis, 1965).

There are, of course, examples of quite distinctive species or subspecies evolving in as short a time as 10,000 years or less in the Northeastern United States. One need only examine some of the Great Lakes endemics, e.g. *Iris lacustris, Hypericum kalmianum, Cirsium pitcheri* (cf. Johnson and Iltis 1963:290-292), *Calamovilfa longifolia* var. *magna* (Thieret 1960), or *Agropyron psammophilum* (Senn and Gillett 1961). However, in comparison especially to the beach and dune species, the Fringed Gentian populations in question are not nearly as markedly differentiated. Thus, in the formation of these Post-glacial neo-endemics, evolutionary rates appear to have differed greatly, depending on the nature of the plants themselves, the type of habitat, the kind of selection and the original variability and size of the population.

It is of interest, that when Raymond (1951) described the habitats of these gentians, he listed *G. procera* together with other taxa he considers Cordilleran [i.e. western] elements, which in a sense *G. procera* is. To Marie-Victorin (1938:528) *G. victorinii* and *G. gaspensis* are a ". . . fascinating groups of plants, . . . simultaneous endemics and relics, their Cordilleran affinity being evident in all cases." Gillett likewise emphasizes the complete intergradation of *G. macounii* into *G. procera*; and well he might! However, his other conclusion, that this cline continues to the Appalachians to include *G. crinita* has not been substantiated by the present study. That hybridization may occasionally occur seems, in view of their obvious relationship, probable. An interspecific "cline," however, represents a very different situation.

Subsequent to post-glacial dispersal and migration some 8000 or less years ago the forces of selection may have produced the cline from small-leaved forms in the drier West *(macounii)* to broad-leaved more robust forms *(procera)* in the moister Middle West and East. The processes of sporadic long range dispersal, however, may still continue to this day, and would explain narrow-leaved *macounii* extremes among otherwise typical *procera* as far east as Minneapolis *(Rosendahl 4756,* SW of Nichols, Dakota Co. Minn. WIS!). The presence of narrow-leaved "*macounii*" plants in Gaspé, on the other hand, may simply be a reflection of the Atlantic Ocean's proximity and consequent halophytic conditions of the habitat, a habitat resembling saline marshes such as are found in Manitoba or Montana.

The fact needs be considered also that these are small-seeded, easily dispersed, "open habitat" annuals (or biennials), probably self-compatible, with rapidly fluctuating populations, a fact that would have bearing on evolutionary rates. Their population size during and immediately following the glacial retreat may have been locally enormous. Since then, through competition with forest or perennial communities, their numbers may have dwindled into the modern, localized populations in the East, many of which apparently became extinct in the last 100 years (e.g. New York stations of *G. procera* on Lake Ontario near Rochester; the sole West Virginia station of *G. crinita*, cf. Strausbaugh and Core 1958:732).

The ideas presented here no doubt represent great simplification. Thus there remains no clarity in the relationship of *G. procera* to the mostly Western *G. detonsa* complex. While the chromosome number is said to differ, no published counts of any of its American members are available. For example is *G. procera* an old taxon that evolved in pre-Wisconsin times on the upper Great Plains, as its ecology and morphology suggest, surviving the Pleistocene in small populations on the ice's edge? Or was *G. thermalis*, a common species in the Central Rocky Mountains, or *G. detonsa* to the north, or both, involved in its ancestry? Did the *G. detonsa (nesophila)* population of Northern Quebec and Newfoundland play a role in the ancestry of *G. victorinii?*

The great taxonomic-phytogeographic difficulties which the *G. macounii-procera* pheno-cline seems to have engendered, and its relationship to the Gaspé endemics and to *G. crinita*, can thus be resolved by realizing that *the two taxa fall into the standard pattern of Eastern North America-Western North America vicarious species pairs* with the post-glacially produced modern ranges overlapping in glaciated Northeastern North America. This pattern, or especially that of the western member of each pair, was originally discussed in Fernald's (1925) celebrated "Nunatak Hypothesis," documented as to its prevalence by Hultén (1937), and more recently discussed and documented by many excellent, ecologically and genetically sophisticated papers of Anderson (1936), Wynne-Edwards (1937, 1939), Griggs (1940), Cain (1940), Fassett (1941), Stebbins (1935, 1942), Rousseau (1953), Butters and Abbe (1953), and others. *This pattern is much more prevalent than is generally appreciated*, and is exemplified by the ranges of many of our commonest as well as rarest species in the Northeastern United States. There are many Western taxa, which, in a general way much like *Gentianopsis* *procera*, arrived sometime post-glacially in the Eastern United States, where they were able to invade and survive in ecologically equivalent habitats in a great variety of plant communities (but not necessarily the same as out West!) These include not only the many species listed by Fernald (1925, 1935) and Fassett (1941), or such great Eastern rarities as *Pterospora andromedea, Aconitum columbianum (A. noveboracense), Dodecatheon pulchellum* and *D. amethystinum* (Iltis 1965), or *Illiamna rivularis (I. corei, I. remota)*, but also more common, often locally ubiquitous species, such as *Salix candida, S. pyrifolia, Potentilla fruticosa (P. floribunda), P. arguta, Geum triflorum, Carex flava, Schizachne purpurascens, Oryzopsis asperifolia, Corydalis aurea, Valeriana edulis* (incl. *V. ciliata), V. sitchensis* (incl. *uliginosa)* (Meyer 1951), *Anemone multifida, Geranium bicknellii*, and literally many hundreds more. Most, if not all, of these do not have a closely related sibling in the East.

Of somewhat greater interest are the cases where a pair of species, one of which is Western (Cordilleran, Great Plains, Pacific Northwest, etc.), and the other Eastern (Appalachian, Alleghenian), have been able to migrate far enough from their respective regions of survival to overlap the range of their sibling, *this overlap in almost all cases sharply restricted to the glaciated regions of the Northeastern United States.* With the Western taxon listed first, such vicarious species pairs, in addition to *G. procera* — *G. crinita*, include: *Populus tremuloides* — *P. grandidentata; Viola rugulosa* — *V. canadensis* (treated as varieties of *V. canadensis* by Russell 1965); *Viola adunca* — *V. conspersa* (Russell 1965); *Actaea rubra* (incl. *A. arguta)* — *A. alba* (Kane, Iltis, & Kawano, in ms.); *Cynoglossum boreale* — *C. virginianum; Cypripedium, parviflorum* — *C. pubescens*, and many other species pairs in Orchidaceae; *Juniperus horizontalis* — *J. virginiana* (Fassett 1945); *Senecio pauperculus* — *S. plattensis* (Barkley 1962, 1963, cf. footnote 5, p. 349); *Salix serrissima* — *S. lucida* (Argus 1964) and other species pairs of willows; *Parnassia glauca* — *P. caroliniana* (which relate to each other much like the two *Gentianopsis* species with which they may grow); *Chimaphila umbellata occidentalis* — *C. u. cisatlantica; Cinna latifolia* — *C. arundinacea; Rhus radicans rydbergii*—*R. radicans radicans; Steptopus amplexifolius americanus* — *S. roseus* (Fassett 1935; cf. Löve & Harries 1963); East-West subspecies within *Solidago spathulata* and *S. speciosa* (cf. Cronquist, in Gleason 1962); *Muhlenbergia racemosa* — *M. glomerata:* and many others. The taxa in these pairs may be as distinctive as *Actaea alba* and *A. rubra* or *Streptopus amplexifolius* and *S. roseus*, or as similar as the varieties of *Rubus strigosus* or the species of *Amelanchier*. In many, if not nearly all of the above examples, hybridizations between the two taxa in the region of sympatry has been demonstrated or suspected. The great difficulties that one encounters in distinguishing these poorly differentiated, post-glacially confluent species pairs was well stated by Hultén (1937) who was among the first moderns to appreciate the dynamics of such a situation: . . . "As long as those races are separated from one another geographically, they may be distinguishable, but when migration has proceeded so far that the radiants from two elementary areas meet, hybridization and thereby an intergradation of the differences must be expected to occur."

The recognition of this large western floristic element in the flora of Northeastern North America is a very important key to the resolution of many taxonomic, phytogeographic, and evolutionary problems in this region, especially in the floristic region of the "White Pine-Hemlock Northern Hardwoods," a region recently glaciated, recently ecologically "open" and receptive, and therefore recently easily invadable. *The restriction of the Western taxa to glaciated lands in their Eastern North American ranges* has far-reaching historical phytogeographic implications, especially regarding the amount of (or lack of) disturbance and vegetational shifting in the Southeastern United States during the Pleistocene. These questions will be discussed in a paper now in preparation. This evidence, however, strongly supports the views of E. Lucy Braun (1950) that the effect of the Pleistocene ice sheet on the Southeastern vegetation was minimal, and that the present ranges south of the glacial maximum of species of the Southeastern forest flora are essentially the same today as they were during the glaciation.

ACKNOWLEDGMENTS

The present study was aided by the University of Wisconsin Research Committee on funds from the Wisconsin Alumni Research Foundation and by travel support from the Botanical Society of America to the Xth International Botanical Congress, where at the Edinburgh Botanical Garden Library Ma's (1951) paper was examined and the first draft written. Publication of illustrations was supported in part by the Norman C. Fassett Memorial Fund. I wish to thank John W. Thomson, Lloyd Shinners and James Pringle for critical reading of the manuscript and stimulating argument, Mrs. R. Snell for careful work on the manuscript, Drs. J. M. Gillett and J. Rousseau for their kind permission to reproduce illustrations of *Gentianopsis* from their studies, and Dr. John Moore for maps of the Minnesota ranges.

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RELATIONSHIPS OF PHLOX CAESPITOSA, PULVINATA, AND DOUGLASII (POLEMONIACEAE)

EDGAR T. WHERRY

University of Pennsylvania, Philadelphia

In the course of his journey eastward in the spring of 1833, Nathaniel Wyeth collected a *Phlox* which was assigned the epithet *caespitosa* by Thomas Nuttall the following year. When the writer was compiling his monograph on the genus, published in 1955, no data were at hand to enable more than a guess as to its type locality to be made. Shortly afterward, however, there appeared McKelvey's monumental Botanical Exploration of the Trans-Mississippi West, which included in Chapter 25 extracts from Wyeth's journal of that trip.

The taxon concerned was recorded to have been collected along "Flathead River, high side of a dry hill." The writer presumed this to have been near the mouth of the river presently so named, but it is now manifest that Wyeth applied this name to what is designated on modern maps as Clarks Fork River. Where, then, along this stream did the plant grow? The label accompanying the type specimen bears the date April 22, 1833; but the journal records that on this day the party was leaving Flathead House to continue their eastward journey. At such a time an expedition-leader would surely not have had leisure to climb the high side of a hill to obtain botanical specimens. On April 30, however, he recorded that he "went out to collect some flowers for friend Nuttall," so this was most likely the real date of discovery of the taxon.

The location of Flathead House, from which the party started a week before, has seemingly never been establishd; McKelvey gives the opinion of one historian on page 513 and of another on page 514, and the two differ considerably. One can infer, however, that when Wyeth found his opportunity to botanize for friend Nuttall he was in the general vicinity of the present Superior, Montana, at an altitude of around 3000 feet. It may be noted that in herbaria there is represented a modern collection of the same taxon from 4 miles east of Thompson Falls, which is farther down Clarks Fork River at about 2500 feet.

Wyeth collected ample material, and beside the type clump in Nuttall's herbarium in the British Museum, there are clastotypes in the Gray Herbarium. The features of the taxon can therefore be checked in this country by anyone interested. It grows 6 to 10 cm. [misprinted mm. in the Monograph] high, with spaced nodes; the leaves are linear-subulate, thickish and not at all needle-like, with conspicuous coarse cilia; the inflorescence-herbage is glandular-pubescent; and the pedicels are up to 6 and styles to 8 mm. long. Field and herbarium study show material of this sort to occur at moderate altitudes in Idaho-Montana and increas-

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ingly higher down to Utah-Colorado. At really high altitudes, however, it is replaced by relatives.

The commonest of these relatives, and the only one meriting discussion here, is taxon *pulvinata* (Wherry, 1941). This differs from taxon *caespitosa* in the clumps being under 5 cm. high with close-set nodes, the pedicels only up to 3 and the styles to 5 mm. long. Except in sizes of parts the two are identical in all significant features, representing little more than ecotypes of respectively moderate and high altitudes. Because of their distinctive geography, the writer classed taxon *pulvinata* as a subspecies. In the recent work, Vascular Plants of the Pacific Northwest, however, this was raised to species status, without any new data being given to justify such an assignment.

Another proposal made in the work just cited calls for fuller discussion; this concerns the interpretation of *Phlox douglasii* Hooker, 1838. Although Hooker showed some confusion in his writings on cushion Phloxes, he had no difficulty in recognizing that one of these collected by Douglas in the mountains of Washington or Oregon was wholly distinct from Wyeth's plant, and named it after its collector. Bentham, the first monographer of the genus, agreed. Asa Gray, while finding Phloxes of this type "almost inextricable," had no hesitation as to keeping these two separate.

After studying in detail the scores of specimens which have accumulated in herbaria, the writer found the two to be so distinct in morphology that they could serve as the basis of independent subsections, *Caespitosae* and *Douglasianae*. In the key these were separated by having, as had been noted by the earlier workers, respectively "Leaf-cilia coarse, conspicuous," *vs.* "Leaf-cilia fine or obsolete." In the text it was added that in the former subsection the leaves are relatively broad and flat, in the latter narrow and acicular. In the genus *Phlox* such leaf differences, correlating as they do with less readily observable inflorescence characters, are very useful in tracing the relationships between superficially similar taxa and grouping them in a meaningful way. There is every indication that "broad-leaved" and "needle-leaved" cushion Phloxes belong to independent phylogenetic groups.

In the Vascular Plants of the Pacific Northwest, page 129, *Phlox douglasii* is placed, along with a couple of only remotely related taxa, in a table of subjective ("taxonomic") synonymy under *P. caespitosa*. This seems like a rather shabby treatment of a taxon, the epithet of which has in the past been so popular that it has been applied in one way or another to a considerable number of cushion Phloxes, becoming indeed a sort of catch-all for material requiring closer study than most workers were willing to give. Had new research demonstrated the validity of such an assignment, the principle of priority would of course come into play.

The only basis for this proposal, however, is stated on page 135: "The type of *P. caespitosa* . . . proves to be a compact plant of the taxon usually known as *P. douglasii.*" Actually the genus *Phlox* is far too complex to justify basing fundamental conclusions as to its systematics on mere superficial observation, without the presentation of pertinent qualitative and quantitative data. Until the relations between these two taxa are fully studied by workers of greater eminence or diligence than those listed above, a change from long-established usage is deemed inacceptable. All evidence at present available indicates *Phlox douglasii* and *P. caespitosa* to be just as distinct at species level as any pair of unrelated taxa which through parallel evolution have attained similar habit.

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PUBLISHED ILLUSTRATIONS OF PENSTEMON HIRSUTUS (SCROPHULARIACEAE): MAGNIFICENCE, MALFORMATION AND MISIDENTIFICATION

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Authors illustrating well-known plant species would do well to notice what has gone before them. As in the case of the various editions of Britton and Brown's *Illustrated Flora,* the accuracy of the illustrations has generally improved with time, but many authors persist in the presentation of imaginative drawings. The worst are probably in the popular wild flower guides and possibly have caused the frustration and disinterest of many prospective amateur botanists. *Penstemon hirsutus* (L.) Willd. has been pictured very often in both taxonomic and popular literature, and may be used to analyse the effectiveness of our attempts to illustrate nature.

The color plates of *P. hirsutus* by M. E. Eaton in the National Geographic Magazine (42:44, pl. 8, 1922) and in Addisonia (Pennell, Francis W., 1919, Addisonia 4:49, pl. 145) are excellent, although in the latter the staminode is a little too lightly bearded and the anther sacs are somewhat small. Excellent color plates are also found in Homer D. House's *Wild Flowers of New York* (72nd. Ann. Rept., Append. 2, New York State Museum, 1918) and in O. E. Jennings' *Wild Flowers of Western Pennsylvania and the Upper Ohio Basin* (vol. 2, pl. 140, University of Pittsburgh Press, Pittsburgh, 1953). The plate in Curtis's Botanical Magazine (t. 1424) is artistically pleasing and remarkably resembles the specimen in the Linnaean Herbarium, but is most atypical for the species as a whole.

Two photographs of the species taken by McFarland (Babb, Grace, 1951, Introducing the Penstemons, Nat. Hort. Mag. 30: 1-7) very beautifully show the habit of the plant as well as inflorescence detail. A photograph by Michael Carron (Nat. Hort. Mag. 15:149) is also excellent. A photograph of an inflorescence in George H. Hamilton's *Plants of the Niagara Park System* (Ryerson Press, Toronto, 1943) shows one flower very well, but all of the other flowers are poorly focused. Very excellent is the photograph of *P. hirsutus* in Herbert Durand's wild flower book (*Taming the Wildings.* G. P. Putnam's Sons, New York, 1923).

A very good illustration is presented by Edgar T. Wherry in his *Wild Flower Guide* (pl. 80, Doubleday & Co., Inc., 1948). The drawing of *Penstemon hirsutus* flowers in Norman C. Fassett's *Spring Flora of Wisconsin* (fig. 350, University of Wisconsin Press, ed. 3, 1959) shows

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the upcurving of the lower lip and is generally good. *The MacMillan Wild Flower Book* (Hylander, Clarence J., 1954, The MacMillan Co., New York) gives an acceptable likeness of *P. hirsutus* as "hairy beardtongue." The drawing of this species in George Lincoln Walton's *Flower Finder* (opp. page 242, J. B. Lippincott Co., Philadelphia, 1914) is good, but the calyx and leaf-toothing are wrong. The line drawing in Strausbaugh and Core's *Flora of West Virginia* (pt. 3:831, West Virginia University Bulletin, Morgantown, 1958) is not badly done. The general shape of the anther sacs is adequately portrayed, at least for comparative purposes.

The worst drawing I have seen is in the first and second editions of Britton and Brown's *Illustrated Flora of the Northern United States, Canada and the British Possessions* (Charles Scribner's Sons, New York, 1898, 1913). *The New Britton and Brown Illustrated Flora* (Gleason, H. A., 1952, The New York Botanical Garden, New York) replaced it with a somewhat better drawing, which, however, shows no hairs on the orifice of the dissected corolla of *P. hirsutus*, though these are shown in the similarly dissected corolla of *P. tenuiflorus* Pennell, its closest relative. In fact, *this erroneous difference is the only notable difference between the two drawings.*

Fair line drawings are present in Ethel Hausman's *Illustrated Encyclopedia of American Wild Flowers* (Garden City Publ. Co., Garden City, N. Y., 1947) and Harold L. Madison's *Wild Flowers of Ohio* (Cleveland Museum of Natural History, Cleveland, 1938). The line drawing in Arthur Craig Quick's *Wild Flowers of the Northern States and Canada* (M. A. Donohue & Co., Chicago, 1939) is very poor; the leaves are entire and sheathing rather than serrate and sessile; the flowers are open, rather than closed by the upcurving of the lower lip. The Illinois Natural History Survey, in its *Field Book of Illinois Wild Flowers* (p. 305, Urbana, 1936) presents a most unsatisfactory drawing of *P. hirsutus.* The flowers are the wrong shape, being more like those of *Penstemon digitalis* Nutt.

George T. Stevens' *Illustrated Guide to the Flowering Plants* (Dodd, Mead & Co., 1910) contains an atrocious drawing of *P. hirsutus,* with flowers aborted and cauline leaves wrongly petiolate and improperly toothed. Norman Taylor's *Guide to the Wild Flowers* (Greenberg Publ., New York) purports to illustrate *P. hirsutus* (Fig. 795), but its illustration of "*Penstemon penstemon*" (Fig. 796) is much more like *P. hirsutus.* The illustration in F. Schuyler Mathews' *Field Book of American Wild Flowers* (G. P. Putnam's Sons, New York) is certainly drawn from a plant of *P. laevigatus.* The illustration in George T. Aiken's *Pioneering With Wildflowers* (publ. by author, 1935) is the scarlet-flowered *P. barbatus!*

In summary, it seems that some illustrations of *P. hirsutus* are magnificent, some malformed, and some misidentified. It is interesting to note the large number of illustrations of this species, particularly in wild flower books. Although 9 other species of *Penstemon* in the eastern United States are closely related to *P. hirsutus,* and many are much more colorful, authors of wild flower books invariably choose the already over-illustrated Gray's Manual range species. A notable exception is Eula Whitehouse's *Texas Plants in Natural Color* (publ. by author, Dallas, 1948), which illustrates the native *Penstemon laxiflorus* Pennell.

I wish to thank the Research Committee of the University of Wisconsin for supplying funds for this study from the Wisconsin Alumni Research Foundation. Thanks are also due Dr. H. H. Iltis for critical comments regarding the first draft.

SUBDIVISIONS OF PENSTEMON SECTION PENSTEMON

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The completion of a revision of *Penstemon* (sect. *Penstemon*) series *Graciles*, to be published soon, and a step-by-step revision of the remaining series now underway, requires the validation of the series names below. The previously described taxa in section *Penstemon* between species and section do not adequately express the relationships involved. Several of the series correspond to subsections in Keck (1945), however. The series may be distinguished by the following key:

KEY TO SERIES OF PENSTEMON SECTION PENSTEMON

A. Leaves linear, revolute . . . . series 1. *Gairdnerani*
AA. At least some leaves not linear and revolute
  B. Corollas glandular within and without, sticky when fresh
    C. Plants shrubby; west of the Rocky Mountains . series 2. *Deusti*
    CC. Plants herbaceous; east of the Rocky Mountains . . . . series 3. *Tubaeflori*
  BB. Corollas not glandular within, not sticky when fresh
    D. Plants with buried caudex and creeping fibrous rootstocks
      E. Corollas glandular without; plants of alpine regions . . . . series 4. *Harbouriani*
      EE. Corollas eglandular without; plants of desert regions . . . . series 5. *Arenarii*
    DD. Plants with aerial caudex
      F. Corolla strongly marked with guide-lines of a deeper color, or if guide-lines absent, then the lower lip of the corolla upcurved to close the orifice; corolla floor pleated
        G. Caudex herbaceous . . . . series 6. *Graciles*
        GG. Caudex suffrutescent
          H. Leaves entire
            I. Staminode uniformly densely pubescent for half its length . . . . series 6. *Graciles*
            II. Staminode bearded more densely at the tip or only there . . . . series 8. *Humiles*
          HH. Leaves toothed
            J. Plants caespitose; leaves only obscurely toothed . . . . series 8. *Humiles*
            JJ. Plants erect; leaves usually well-toothed.
              K. Calyx 2-5 mm high; staminode included . . . . series 7. *Ovati*

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KK. Calyx 5-11 mm high; staminode well-exserted. . . . . . . series 9. *Whippleani*

FF. Corolla not strongly marked with guide-lines of a deeper color; corolla floor not strongly pleated

L. Plants usually suffrutescent at base; inflorescence often capitate; Rocky Mountains and westward

M. Delicate diploids and tetraploids . . . . . . series 10. *Proceri*

MM. Robust hexaploids . series 11. *Attenuati*

LL. Plants wholly herbaceous; inflorescence never capitate; east of Rocky Mountains . . . . . . series 12. *Penstemon*

Series 1. **Gairdnerani** (Keck) Crosswhite, stat. nov. (subsection *Gairdneranae* Keck, Amer. Midl. Nat. 23: 595. 1940). Type: *P. gairdneri* Hook., Fl. Bor. Am. 2: 99. 1838.

Series 2. **Deusti** (Keck) Crosswhite, stat. nov. (subsection *Deusti* Keck, Amer. Midl. Nat. 23: 599. 1940). Type: *P. deustus* Dougl. ex Lindl., Bot. Reg. 16: t. 1318. 1830.

Series 3. **Tubaeflori** Pennell ex Crosswhite, series nova. Caudex aerius non suffrutescens: folia lanceolata; corolla non 2-plicata, intus et extus dense glanduloso-pubescens; 2n = 32. Type: *P. tubaeflorus* Nutt., Trans. Amer. Phil. Soc. II. 5: 181. 1837.

Series 4. **Harbouriani** Rydberg ex Crosswhite, series nova. Plantae alpinae; caudex subterraneus; corolla prominenter ventre 2-plicata, extus solum glanduloso-pubescens; 2n = 16. Type: *P. harbourii* A. Gray, Proc. Amer. Acad. 6: 71. 1862.

Series 5. **Arenarii** (Keck) Crosswhite, stat. nov. (subsection *Arenarii* Keck, Amer. Midl. Nat. 23: 605. 1940). Type: *P. arenarius* Greene, Pittonia 1: 282. 1889.

Series 6. **Graciles** Crosswhite, series nova. Caudex aerius, non suffrutescens; folia lanceolata; corolla ventre 2-plicata, extus solum glanduloso-pubescens; staminodium a basi ad apicem dense auro-barbatum; 2n = 16. Type: *P. gracilis* Nutt., Gen. N. Amer. Pl. 2: 52. 1818.

Series 7. **Ovati** Crosswhite, series nova. Caudex aerius, suffrutescens; folia triangularia ovatave; calyx 2—5 mm. altus; corolla ventre 2-plicata, intus glabra; 2n = 16, 32. Type: *P. ovatus* Dougl. ex Hook., Bot. Mag. 56: t. 2903. 1829.

Series 8. **Humiles** (Keck) Crosswhite, stat. nov. (subsection *Humiles* Keck, Amer. Midl. Nat. 33: 179. 1945). Type: *P. humilis* Nutt. ex Gray, Proc. Amer. Acad. 6: 69. 1862.

Series 9. **Whippleani**, series nova. Caudex aerius, suffrutescens; folia oblonga vel lanceolato-acuminata; calyx 5—11 mm. altus; corolla ventre

2-plicata, intus glabra; 2n = 16. Type: *P. whippleanus* A. Gray, Proc. Amer. Acad. 6: 73. 1862.

Series 10. **Proceri** (Keck) Crosswhite, stat. nov. (subsection *Proceri* Keck, Amer. Midl. Nat. 33: 141—142. 1945). Type: *P. procerus* Dougl. ex R. Grah., Edinb. N. Phil. Jour. 7: 348. 1829.

Series 11. **Attenuati** Crosswhite, series nova. Plantae robustae; caudex aerius, suffrutescens; folia lanceolato-ovata vel oblonga amplexicaulia attenuata; corolla ventre non prominenter 2-plicata, intus non glanduloso-pubescens; 2n = 48. Type: *P. attenuatus* Dougl. ex Lindl., Bot. Reg. 15: t. 1295. 1829.

Series 12. **Penstemon**. Type that of the genus and section: *P. laevigatus* Ait., Hort. Kew. 2: 361. 1789.

I wish to thank the Research Committee of the University of Wisconsin for granting funds from the Wisconsin Alumni Research Foundation for this study. Special thanks are due to Dr. H. H. Iltis, who has critically read the manuscript.

REFERENCE

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POST SCRIPT

After this manuscript was in page proof, it was found that the subsectional names published by Keck are invalid since they were published after 1 January, 1935 without Latin diagnoses. These are supplied as follows:

Series 1. Folia linearia, revoluta.

Series 2. Folia nunc linearia nunc revoluta, plantae fruticosae, corolla intus et extus glanduloso-pubescens.

Series 5. Caudex suffrutescens, folia nunc revoluta nunc linearia, corolla intus et extus glabra.

Series 8. Caudex aerius, suffrutescens, corolla, ventre 2-plicata, staminodium apice solum aurato-barbatum.

Series 10. Caudex plus minusve suffrutescens, caulis gracilis, inflorescentia verticillata et compacta.

DOCUMENTED PLANT CHROMOSOME NUMBERS.—Following are the first in a continuing series of reports of chromosome counts accompanied by illustrations and backed by voucher herbarium specimens. The initiator of the series and advisor for it is Dr. C. R. Bell, Department of Botany, University of North Carolina, Chapel Hill, North Carolina 27515. Further contributions are invited. They may be sent either to Dr. Bell or to the editor of SIDA at the Herbarium, Southern Methodist University, Dallas, Texas 75222.

DOCUMENTED PLANT CHROMOSOME NUMBERS 65: 1

J. L. ROGERS

Department of Biology, Bemidji State Teachers College, Bemidji, Minn.

The work here reported was done under the direction of Dr. C. Ritchie Bell at the University of North Carolina during the summer of 1961, under the National Science Foundation Undergraduate Research Participation Program.

APIACEAE (UMBELLIFERAE)

PASTINACA SATIVA L.[a] (Fig. 1.) $n=11$. N.C., Watauga Co.: *C. R. Bell 17126* (NCU).

ASTERACEAE (COMPOSITAE)

LIATRIS ASPERA (Michx.) Greene.[a] (Fig .2.) $n=10$. N.C., Ashe Co.: *Bell 17186* (NCU).

SOLIDAGO PATULA Muhl.[a] (Fig. 3.) $n=9$. N.C., Alleghany Co.: *Bell 17212* (NCU).

SOLIDAGO PATULA Muhl.[b] (Fig. 4.) $n=18$. N.C., Ashe Co.: *Bell 17187* (NCU). This is the first tetraploid plant reported for this species.

CAMPANULACEAE

CAMPANULA AMERICANA L.[b] (Fig. 5.) $n=17$. N.C., Alleghany Co.: *Bell 17158* (NCU).

DROSERACEAE

DROSERA INTERMEDIA Hayne.[b] (Fig. 6.) $n=20$. N.C., Craven Co.: *Bell 17158* (NCU). This is the first report of a tetraploid plant for this species.

HYPERICACEAE (GUTTIFERAE)

HYPERICUM DENTICULATUM Walt. (Fig. 7.) $n=24$. N.C., Carteret Co.: *Bell 17167* (NCU). This is the first reported tetraploid plant in the n 12 series of the genus.

HYDROPHYLLACEAE

PHACELIA MACULATA Wood.[a] (Fig. 8.) $n=5$. S.C., Lancaster Co.: *Bell 17031* (NCU).

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[a] Species for which a similar chromosome count has been published previously.

[b] Species for which a chromosome count differing from this one has been published previously.

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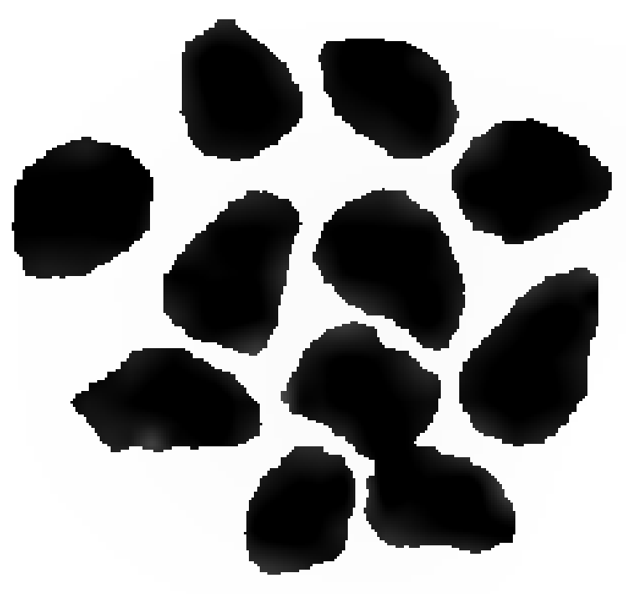

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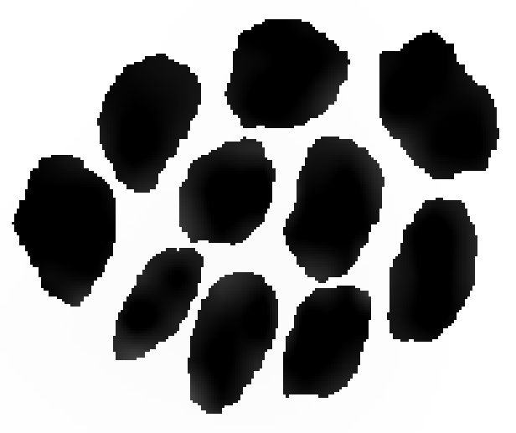

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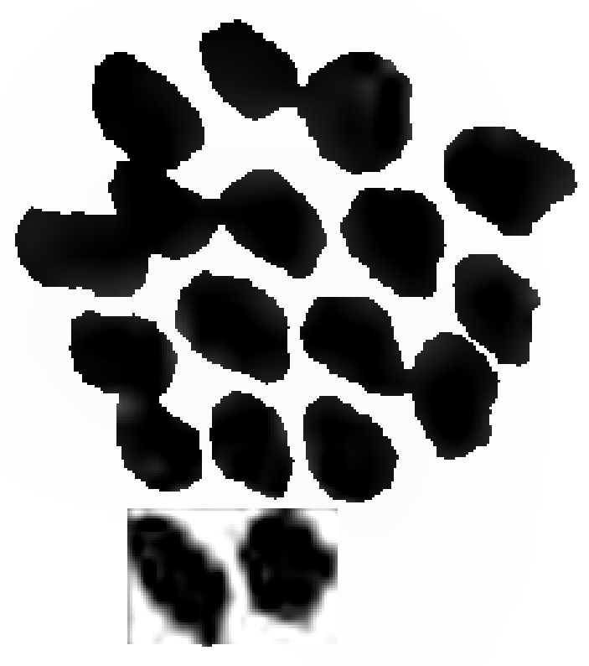

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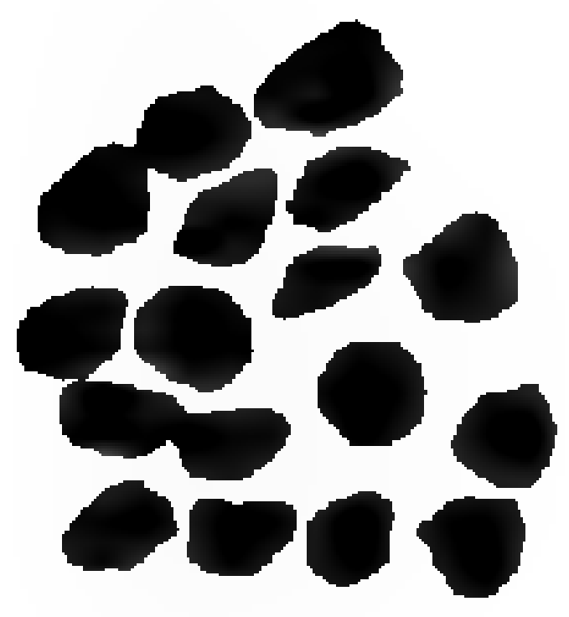

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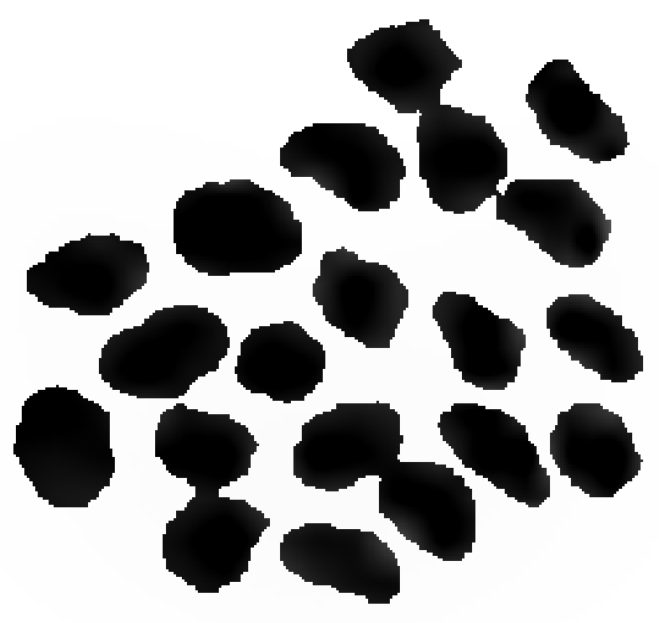

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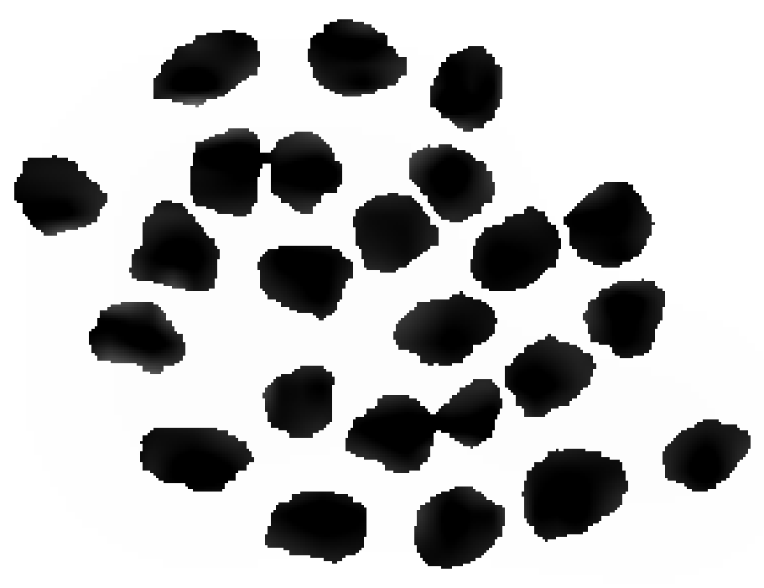

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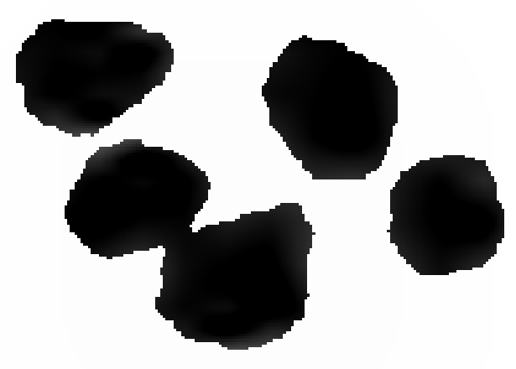

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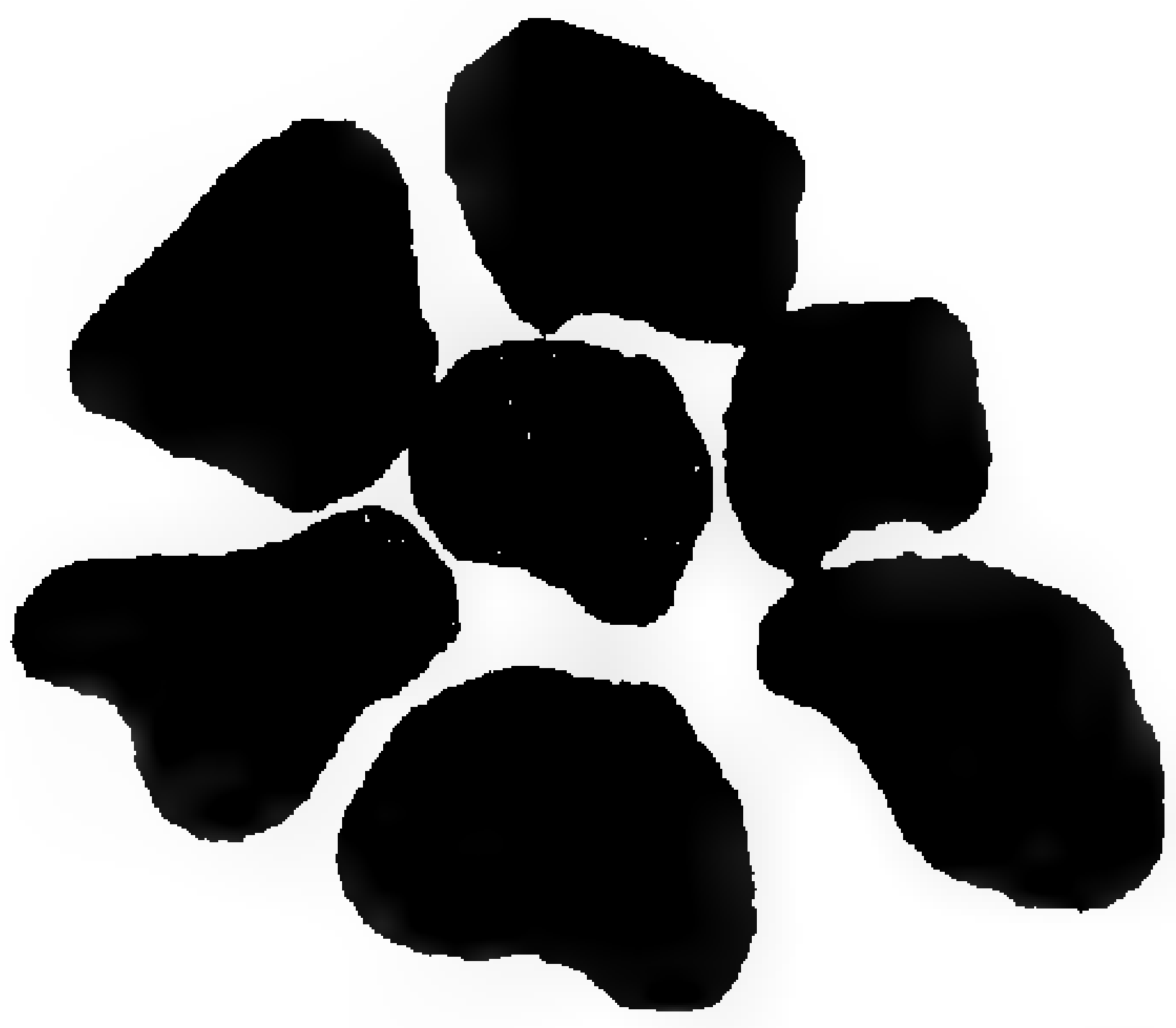

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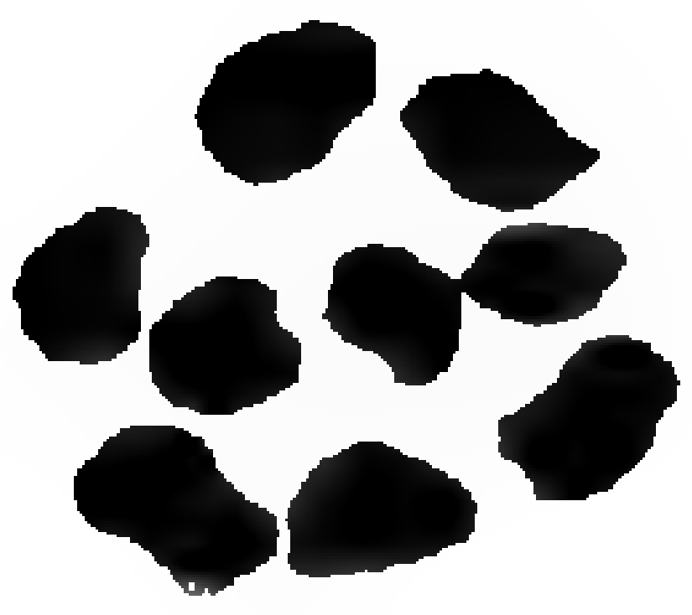

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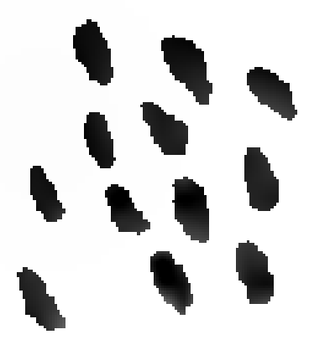

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all approx. x1450

LILIACEAE

ALLIUM ALLEGHANIENSE Small.[a] (Fig. 9.) n=7. N.C., Ashe Co.: *Bell 17190* (NCU).

POLEMONIACEAE

PHLOX MACULATA L.[a] (Fig. 10.) n=7. N.C., Alleghany Co.: *Bell 17190* (NCU).

RUBIACEAE

HOUSTONIA PURPUREA L.[a] (Fig. 11.) n=9. N.C., Ashe Co.: *Bell 17140* (NCU). Meiosis is highly irregular. Plantes of 8—11 chromosomes were observed.

SCROPHULARIACEAE

PENSTEMON SMALLII Heller. (Fig. 12.) n=8. N.C., Watauga Co.: *Bell 17121* (NCU).

SOLANACEAE

SOLANUM CAROLINENSE L.[a] (Fig. 13.) n=12. N.C., Chatham Co.: *Bell 17147* (NCU).

DOCUMENTED PLANT CHROMOSOME NUMBERS 65: 2

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The work here reported was done under the direction of Dr. C. Ritchie Bell at the University of North Carolina during the summer of 1960, under the National Science Foundation Undergraduate Research Participation Program.

APIACEAE (UMBELLIFERAE)

DAUCUS CAROTA L.[a] (Fig. 1.) n=9. N.C., Chatham Co.: *P. E. Bostick 1* (NCU).

ASTERACEAE (COMPOSITAE)

ASTER PILOSUS Willd.[b] (Fig. 2.) n=12. N.C., Orange Co.: *Bostick IV* (NCU).

CHRYSANTHEMUM LEUCANTHEMUM L.[a] (Fig. 3.) n=9. N.C., Orange Co.: *Bostick 72—7* (NCU).

ERIGERON PHILADELPHICUS L.[a] (Fig. 4.) n=9. N.C., Orange Co.: *Bostick 61—1* (NCU).

GAILLARDIA AESTIVALIS (Walt.) H. Rock var. LANCEOLATA (Michx.) Ahles. (Fig. 5.) n=17. N.C., Richmond Co.: *C. R. Bell 17048* (NCU).

HIERACIUM VENOSUM L.[a] (Fig. 6.) n=9. N.C., Orange Co.: *Bostick 47—3* (NCU).

POLYMNIA UVEDALIA L. (Fig. 7.) n=14. N.C., Orange Co.: *Bostick 7* (NCU).

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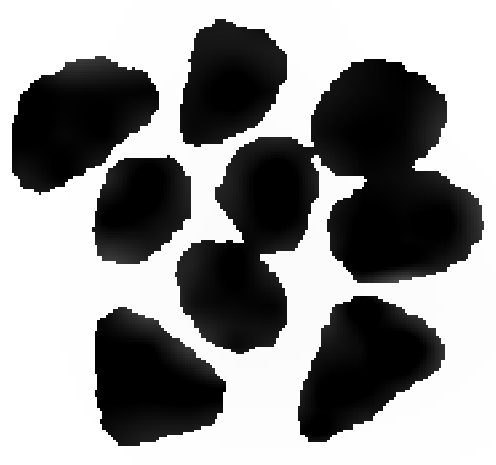
[a] Species for which a similar chromosome count has been published previously.

[b] Species for which a chromosome count differing from this one has been published previously.

[c] No chromosome numbers reported previously for any member of this genus.

SIDA 2 (2): 165—168. 1965.



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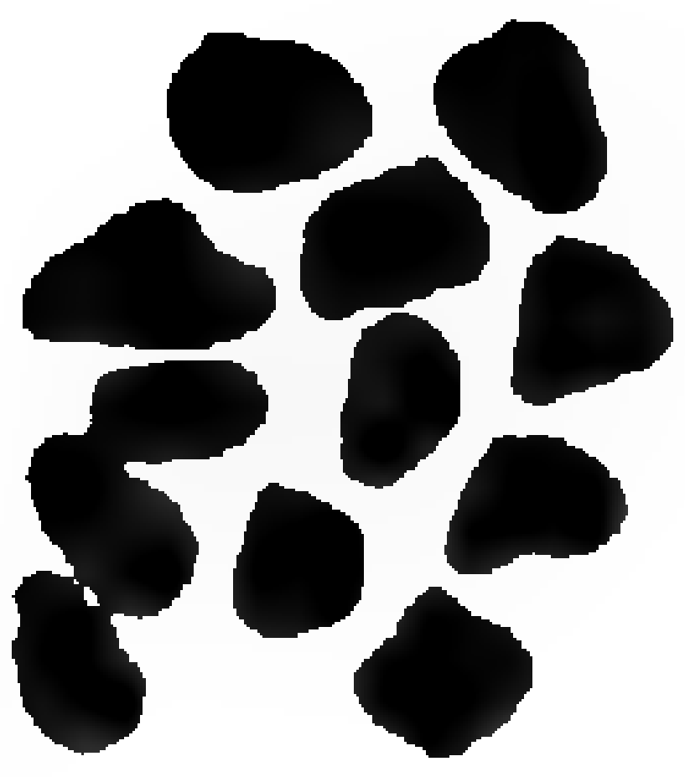

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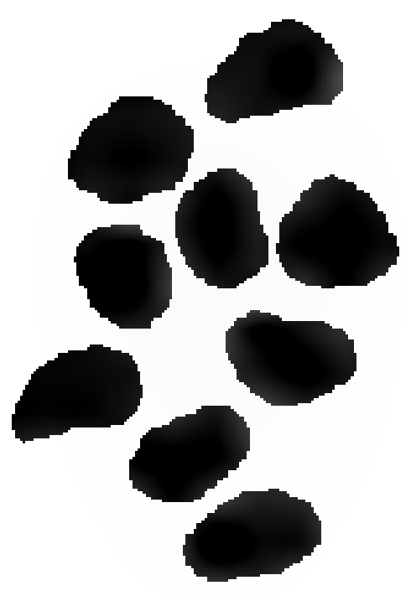

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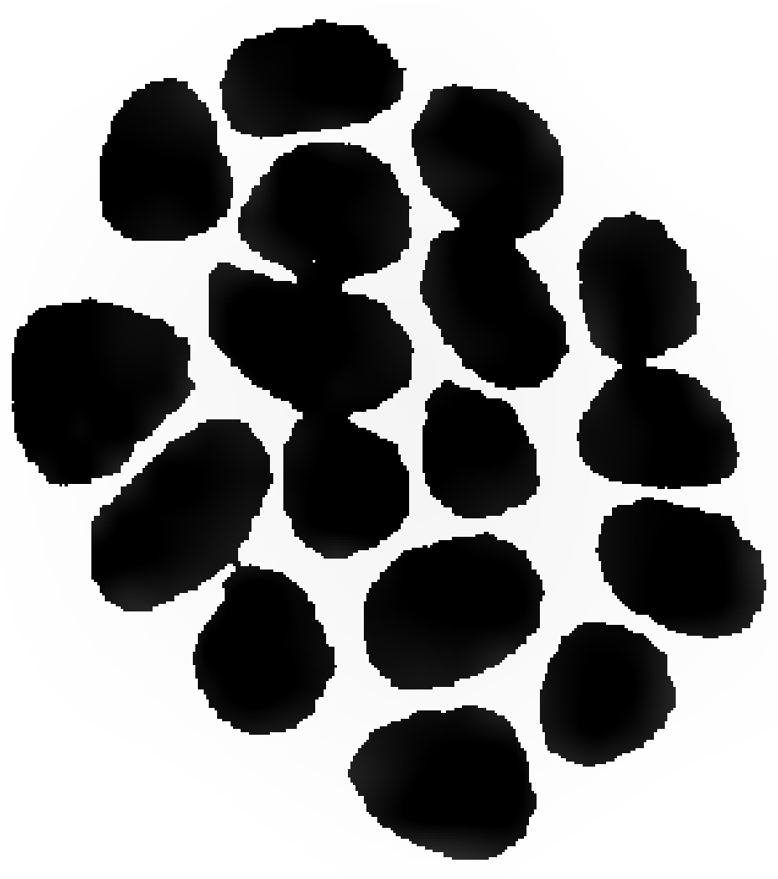

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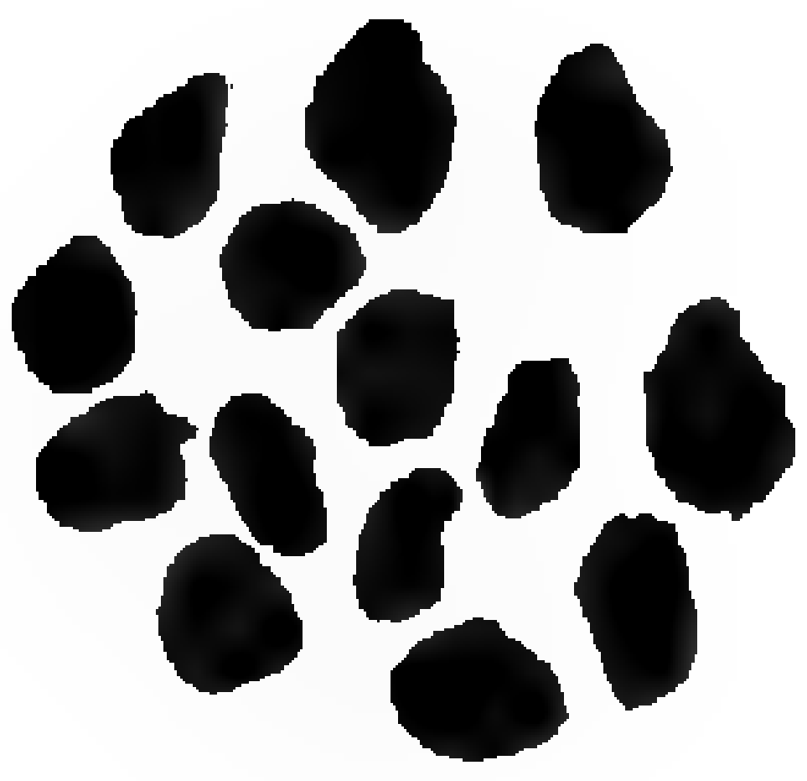

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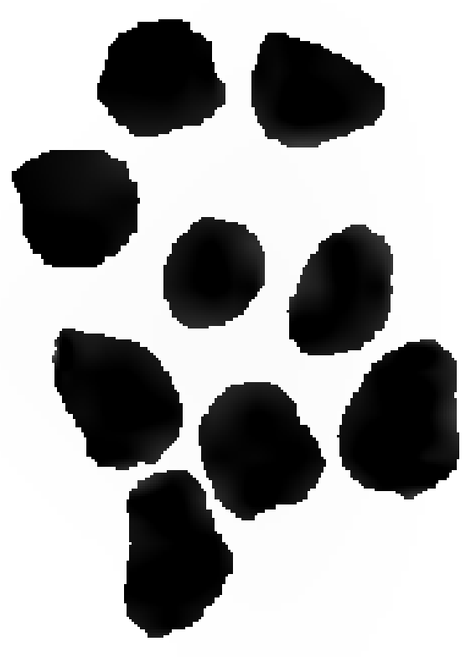

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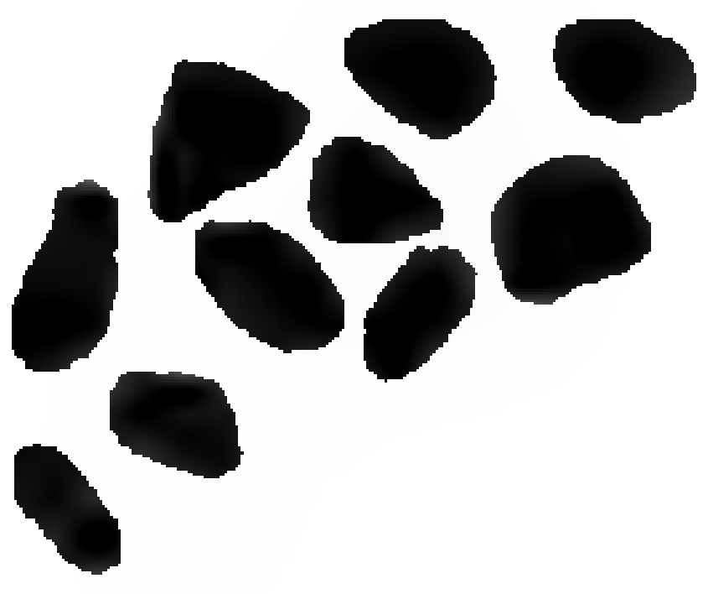

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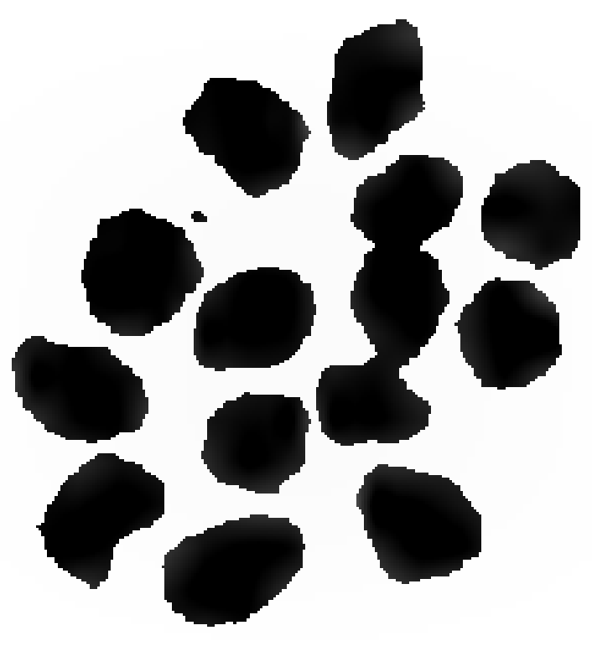

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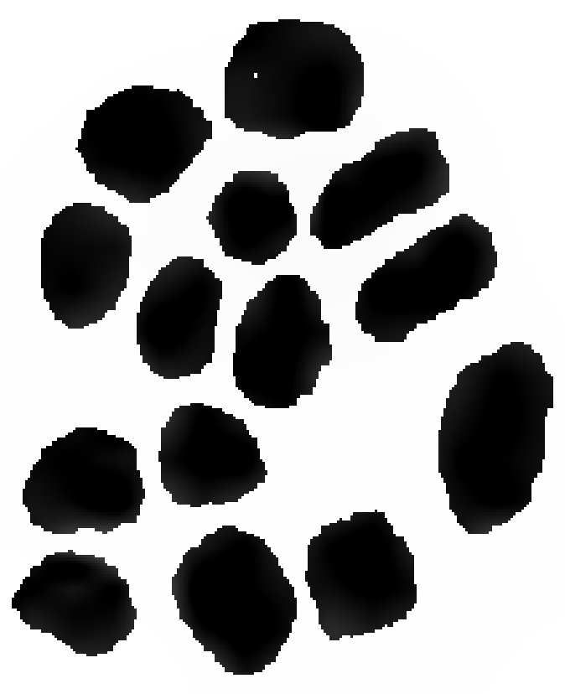

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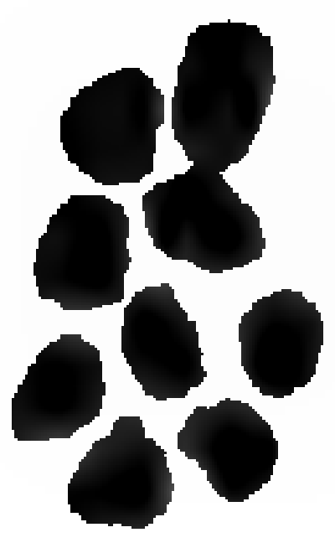

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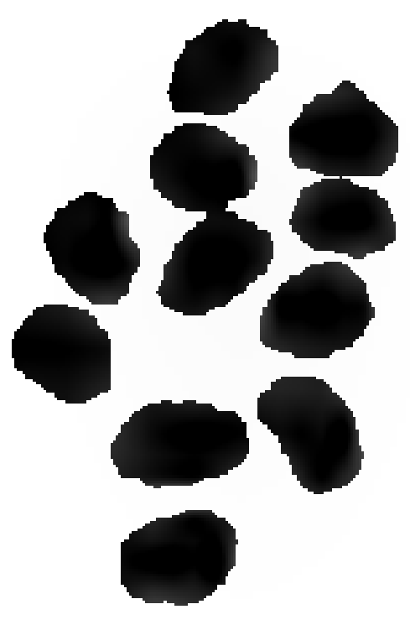

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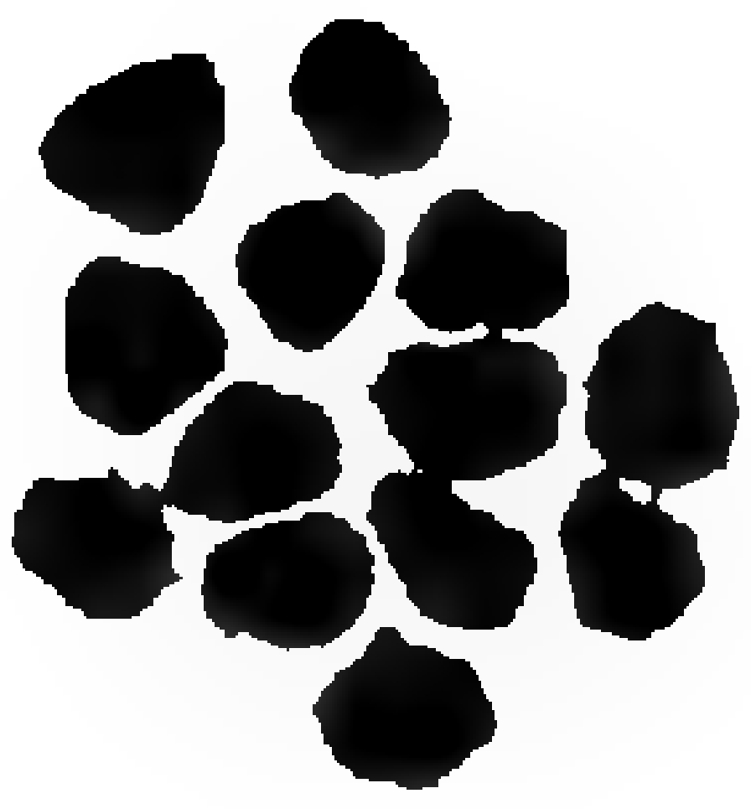

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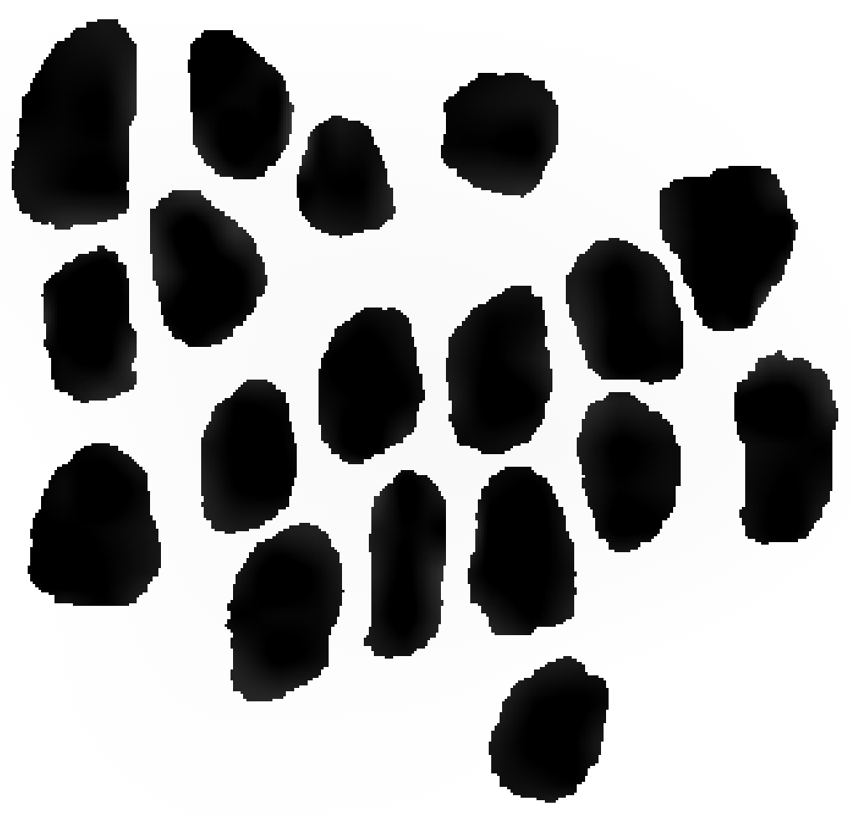

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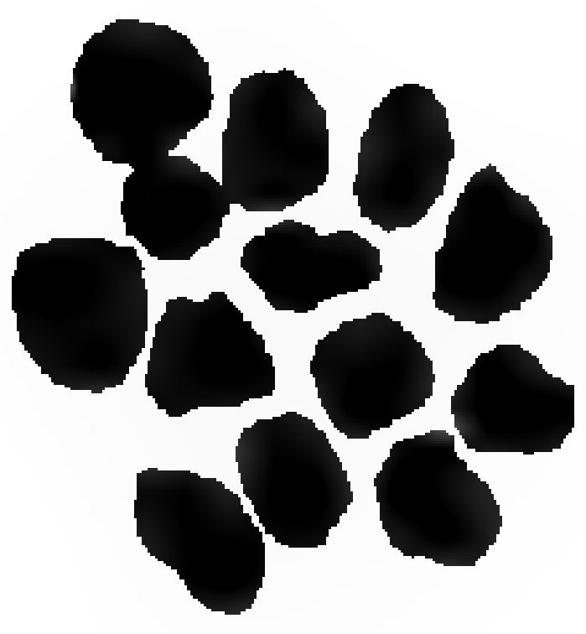

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SOLIDAGO PINETORUM Small. (Fig. 8.) n=9. N.C., Orange Co.: *Bostick 17* (NCU).

BALSAMINACEAE

IMPATIENS CAPENSIS Meerb. (Fig. 9.) n=10. N.C., Orange Co.: *Bostick* 4 (NCU).

CAMPANULACEAE

LOBELIA PUBERULA Michx.[b] (Fig. 10.) n=14. N.C., Jackson Co.: *Bostick 23* (NCU).

GENTIANACEAE

SABATIA BRACHIATA Ell. (Fig. 11.) n=14. N.C., Pender Co.: *Bell 17081* (NCU).

HYPERICAEAE (GUTTIFERAE)

HYPERICUM ADPRESSUM Barton. (Fig. 12.) n=9. N.C., Richmond Co.: *Bell 17055* (NCU).

MELASTOMATACEAE

RHEXIA ALIFANUS Walt.[c] (Fig. 13.) n=11. N.C., Pender Co.: *Bell 17078* (NCU).

RHEXIA MARIANA L. (Fig. 14.) n=22. N.C., Orange Co.: *Bostick 13* (NCU).

ORCHIDACEAE

GOODYERA PUBESCENS (Willd.) R. Br. (Fig. 15.) n=13. N.C., Richmond Co.: *Bell 17057* (NCU).

PHYTOLACCACEAE

PHYTOLACCA AMERICANA L. (Fig. 16.) n=18. N.C., Orange Co.: *Bostick 3* (NCU).

RANUNCULACEAE

CLEMATIS VIRGINIANA L.[a] (Fig. 17.) n=8. N.C., Macon Co.: *Bostick 18* (NCU).

SCHIZANDRACEAE

SCHIZANDRA COCCINEA Michx.[c] (Fig. 18.) n=13. N.C., Richmond Co.: *Bell 17050* (NCU).

SCROPHULARIACEAE

AUREOLARIA VIRGINICA (L.) Pennell.[c] (Fig. 19.) n=13. N.C., Orange Co.: *Bell 17060* (NCU).

MIMULUS RINGENS L.[b] (Fig. 20). n=8. N.C., McDowell Co.: *Bell 17079.* (NCU).

SOLANACEAE

PHYSALIS HETEROPHYLLA Nees. (Fig. 21.) n= 12. N.C., Orange Co.: *Bell 17059* (NCU).

THEACEAE

GORDONIA LASIANTHUS (L.) Ell. (Fig. 22.) n=18. N.C., Pender Co.: *Bell 17070* (NCU).

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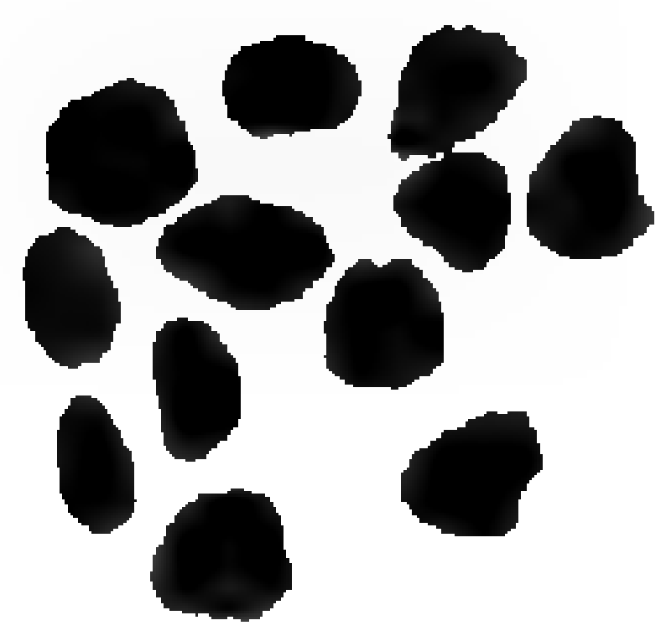

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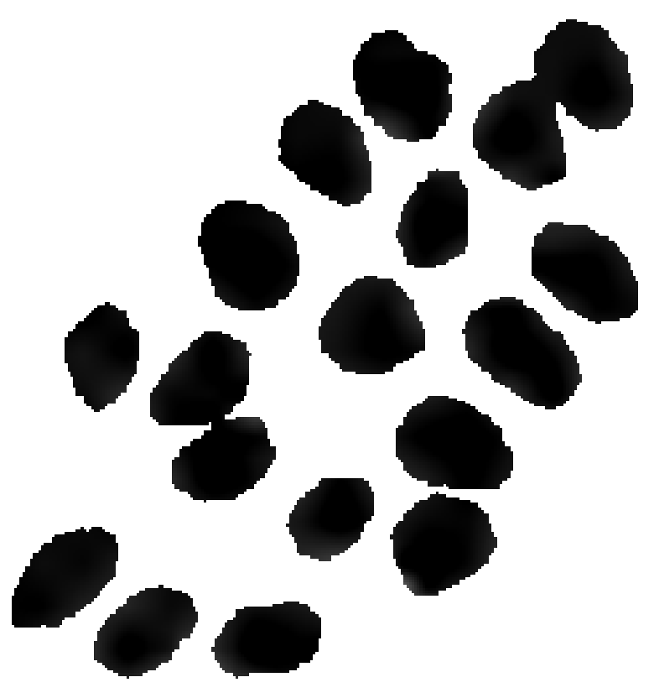

22

DOCUMENTED PLANT CHROMOSOME NUMBERS 65: 3

C. RITCHIE BELL

Department of Botany, University of North Carolina, Chapel Hill

Figures 1—26 are camera lucida drawings, all approximately 725×.

ASTERACEAE (COMPOSITAE)

BLENNOSPERMA NANUM var. ROBUSTUM J. T. Howell.[a] (Fig. 1.) n=7. Calif., Marin Co.: *Bell 17485* (NCU).

CHAENACTIS STEVIOIDES H. & A. *(C. latifolia* Stockw.) (Fig. 2.) n=5. Ariz., Maricopa Co.: *Bell 17557* (NCU).

PALAFOXIA LINEARIS (Cav.) Lag.[c] (Fig. 3.) n=10. Mexico, Sonora, Puerto Penasco: *Bell 17545* (NCU).

BORAGINACEAE

AMSINCKIA TESSELLATA Gray.[a] (Fig. 4.) n=12. Ariz., Maricopa Co.: *Bell 17555* (NCU).

HELIOTROPIUM CURASSAVICUM L.[b] (Fig. 5.) n=26. Mexico, Sonora, Puerto Penasco: *Bell 17537* (NCU).

BRASSICACEAE (CRUCIFERAE)

CAKILE MARITIMA Scop.[a] (Fig. 6.) n=9. Calif., San Luis Obispo Co.: *Bell 17619* (NCU).

CARDAMINE PARVIFLORA var. ARENICOLA (Britton) O. E. Schulz. (Fig. 7.) n=8. Ill., Vermilion Co.: *H. E. Ahles s.n.* (NCU).

CARDAMINE CORDIFOLIA Gray. (Fig. 8.) n=12. Utah, Cache Co.: *Bell s.n.* (NCU.)

CARDAMINE HIRSUTA L. (Fig. 9.) n=8. N.C., Orange Co.: *Ahles 9957* (NCU).

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[a] Species for which a similar chromosome count has been published previously.

[b] Species for which a chromosome count differing from this one has been published previously.

[c] No chromosome numbers reported previously for any member of this genus.

SIDA 2 (2): 168—170. 1965.

CAPPARACEAE

WISLIZENIA REFRACTA Engelm.[c] (Fig. 10.) n=20. Mexico, Sonora, Sonoita: *Bell 17520* (NCU).

CUCURBITACEAE

MARAH FABACEUS (Naud.) Greene.[a] *Echinocystis fabacea Naud.)* (Fig. 11.) n=16. Calif., San Mateo Co.: *Bell 17411* (NCU).

EUPHORBIACEAE

CROTON PUNCTATUS Jacq. (Fig. 12.) n=14. N.C., Onslow Co.: *Bell 17063* (NCU).

SAPIUM BILOCULARE (Wats.) Pax.[c] (Fig. 13.) n=11. Ariz., Pima Co.: *Bell 17519* (NCU).

FABACEAE (LEGUMINOSAE)

HOFFMANNSEGGIA MICROPHYLLA Torr. (Fig. 14.) n=12. Calif., Riverside Co.: *Bell 17595* (NCU).

HYDROPHYLLACEAE

PHACELIA CRENULATA Torr.[a] (Fig. 15.) n=11. Ariz., Pima Co.: *Bell 17509* (NCU).

PHACELIA CRENULATA Torr.[a] (Fig. 16.) n=11. Ariz., Maricopa Co.: *Bell 17560* (NCU).

PHACELIA MACULATA Wood.[a] (Fig. 17.) n=5. S.C., Lancaster Co.: *Bell 17032* (NCU).

HYPERICACEAE (GUTTIFERAE)

HYPERICUM MUTILUM L. (Fig. 18.) n=8. N.C., Pender Co.: *Bell 17075* (NCU).

HYPERICUM PUNCTATUM Lam. (Fig. 19.) n=7. N.C., Pender Co.: *Bell 17073* (NCU)

LENNOACEAE

PHOLISMA PANICULATUM Templt. (Fig. 20.) n=18. Calif., San Luis Obispo Co.: *Bell 17618* (NCU).

ONAGRACEAE

OENOTHERA CLAVAEFORMIS var. AURANTIACA (Wats.) Munz.[b] (Fig. 21.) n=6. Ariz., Maricopa Co.: *Bell 17558* (NCU).

PORTULACACEAE

CLAYTONIA VIRGINICA L.[a] (Fig. 22.) n=8. (Counts of n=14, 15, 16, and 17 were also obtained.) Ill., Vermilion Co.: *Bell 1441* (NCU).

PRIMULACEAE

HOTTONIA INFLATA Ell. (Fig. 23.) n=10. N.C., Northampton Co.: *Ahles 38439* (NCU).

SCROPHULARIACEAE

BELLARDIA TRIXAGO (L.) All.[c] (Fig. 24.) n=12. Calif., Contra Costa Co.: *Bell 17679* (NCU).

VERONICA CAMPYLOPODA Boiss. (Fig. 25.) n=ca. 18. Utah, Cache Co.: *Bell 17628* (NCU).

SOLANACEAE

SOLANUM MAMMOSUM L. (Fig. 26.) n=12. Grown in greenhouse from seed from Hawaii, *Bell s.n.* (NCU).


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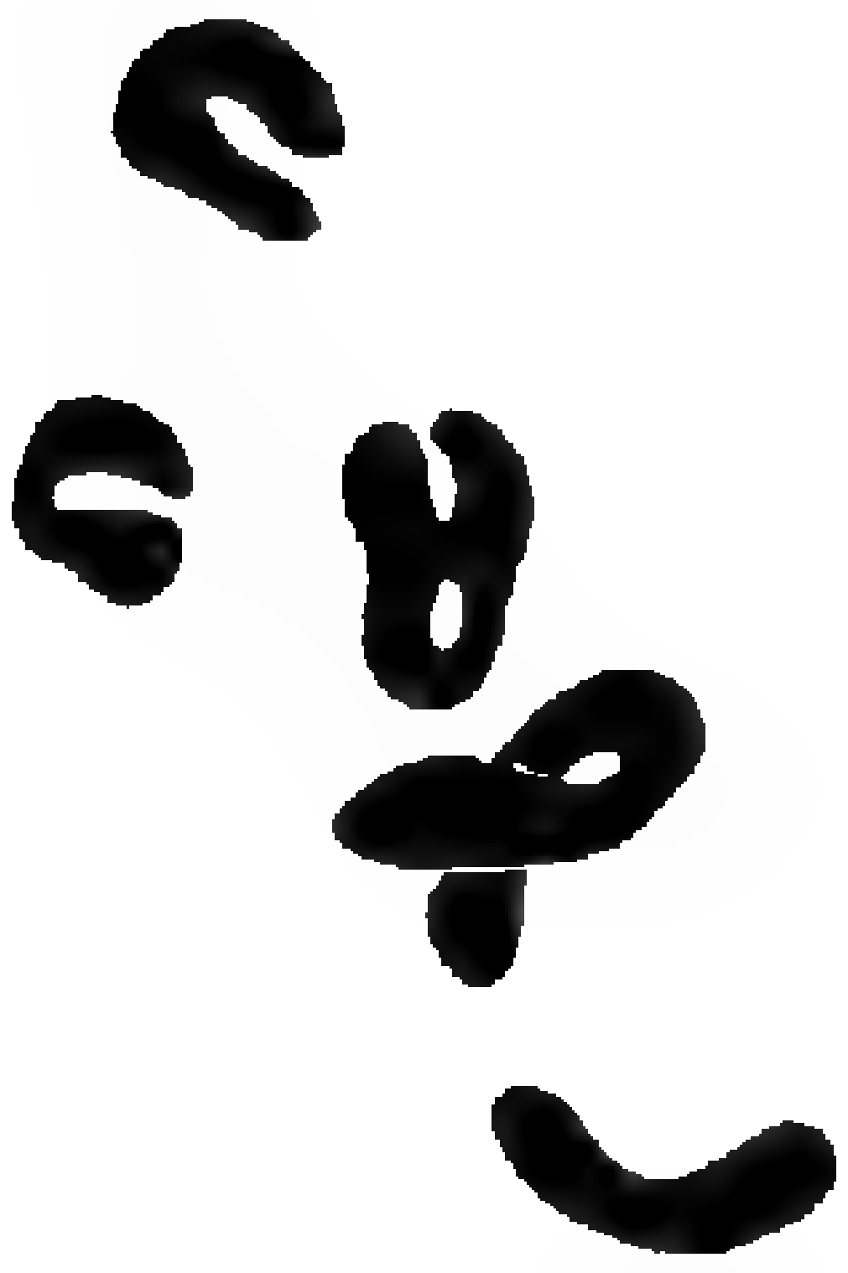
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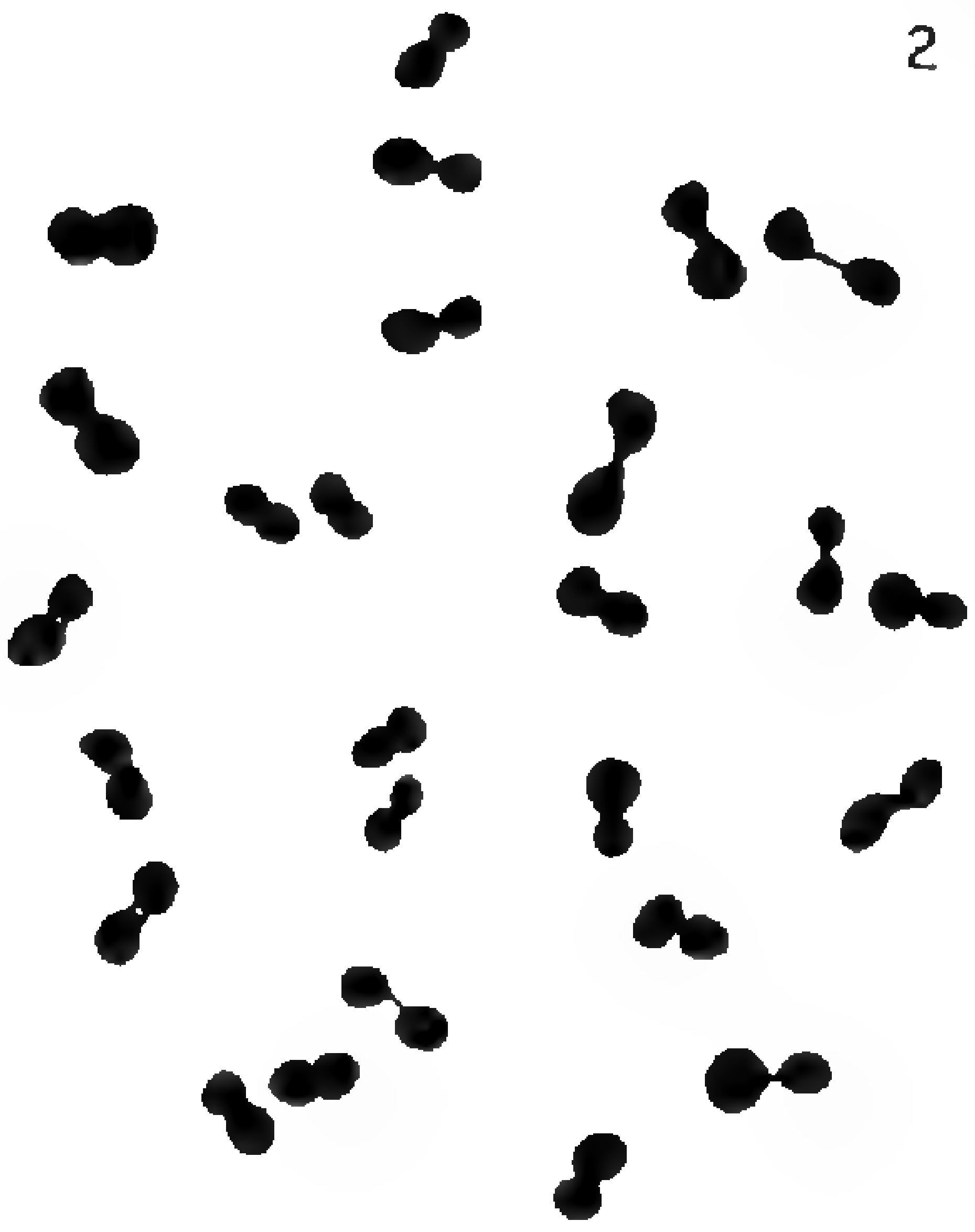
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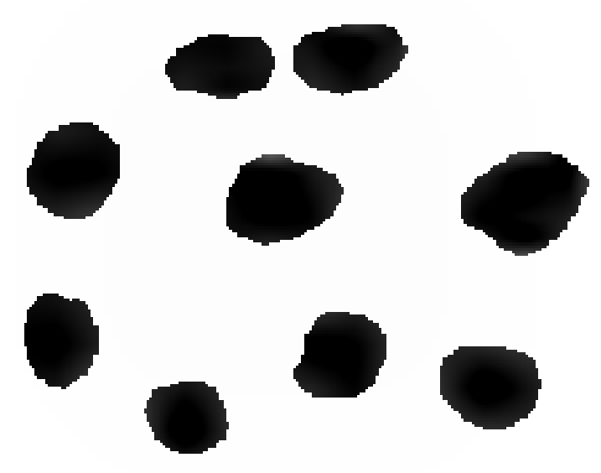
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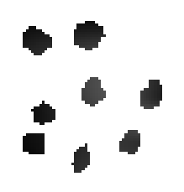
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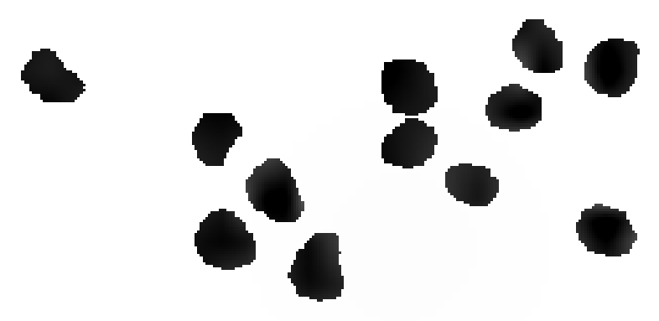
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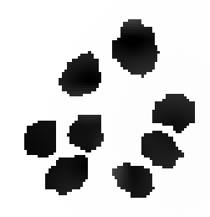
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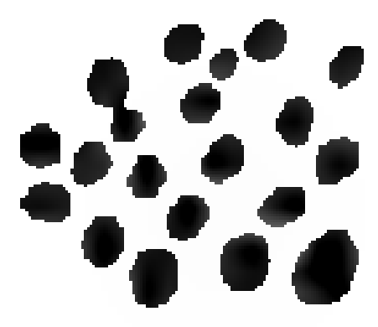
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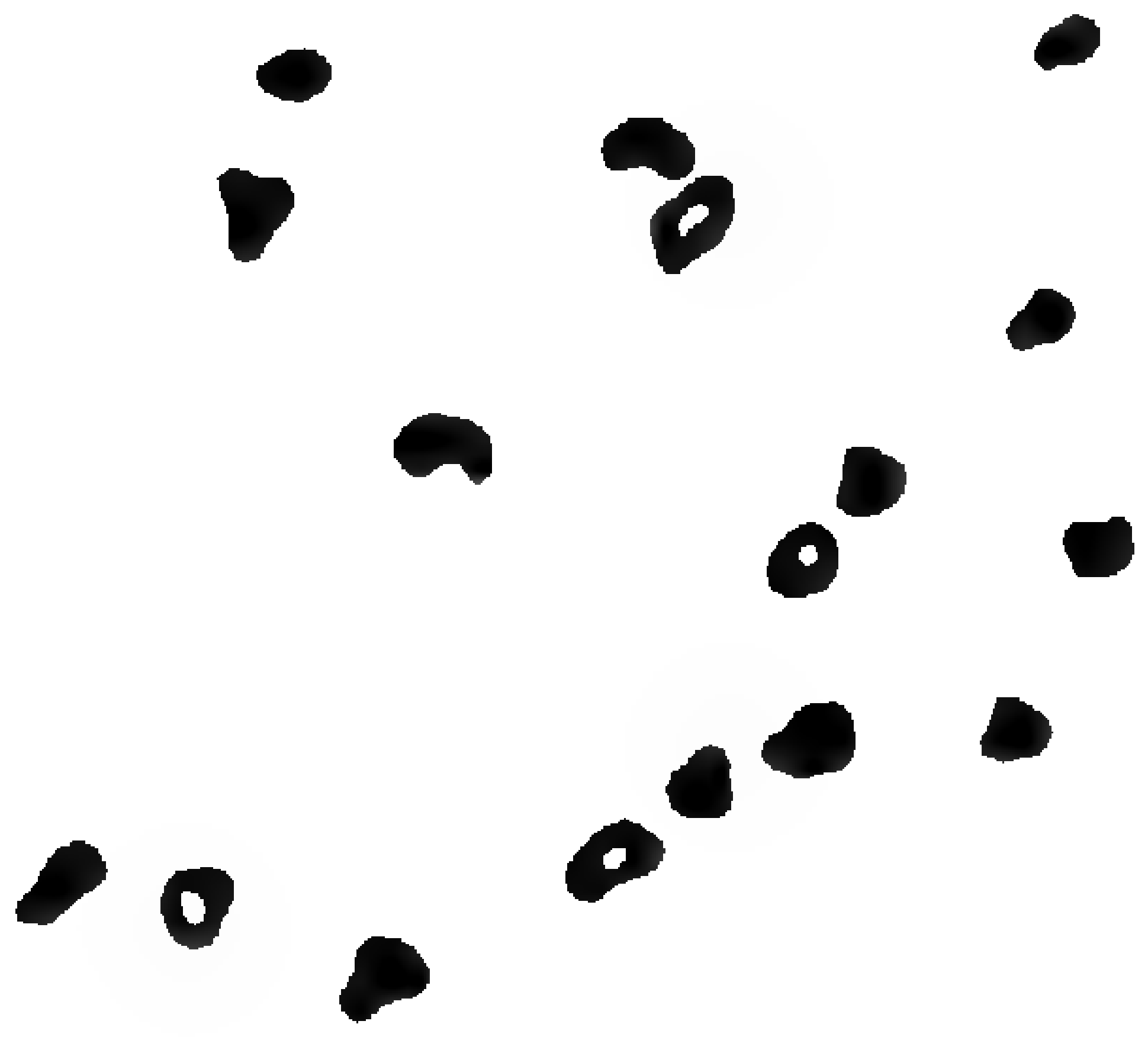
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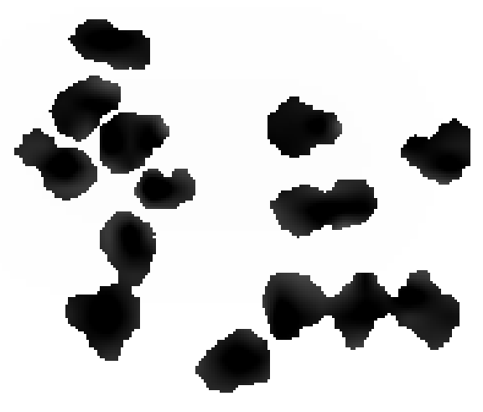
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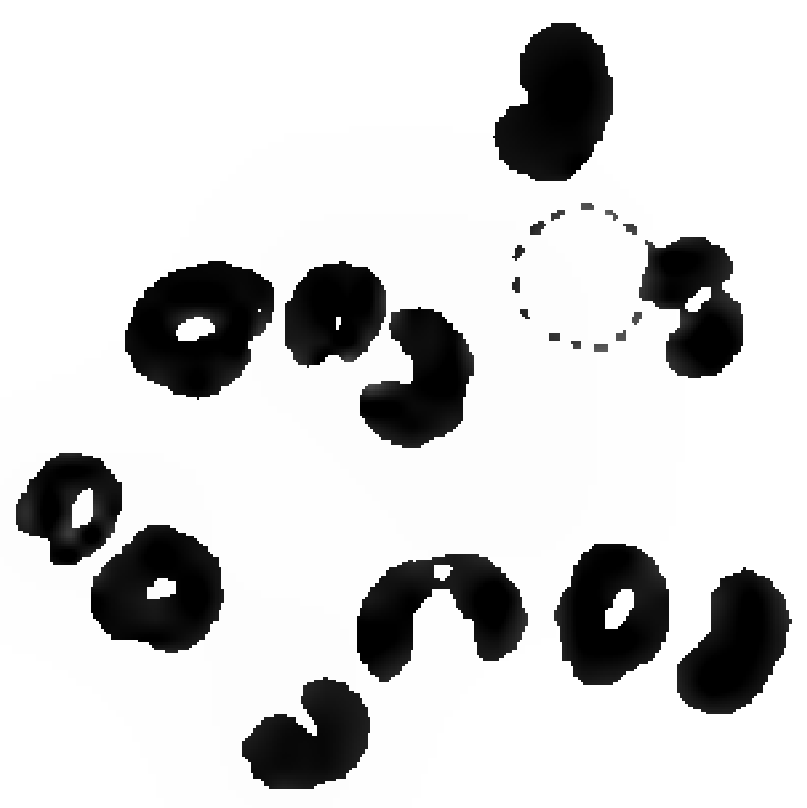
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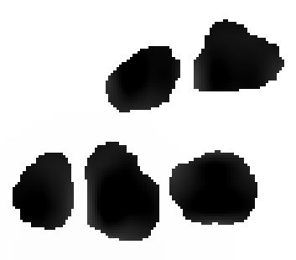
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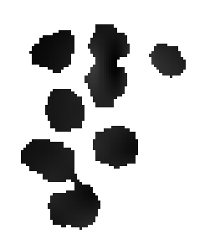
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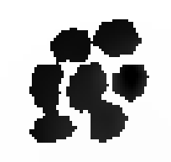
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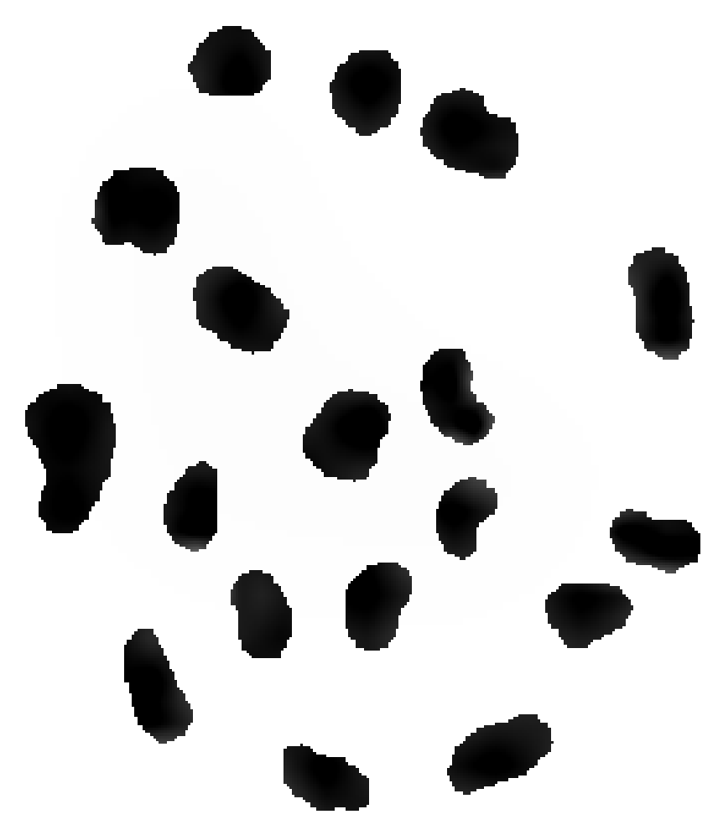
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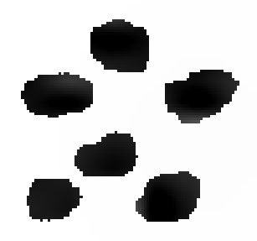
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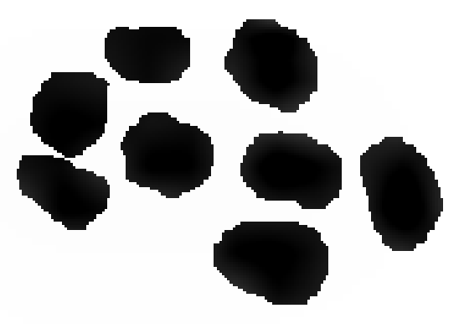
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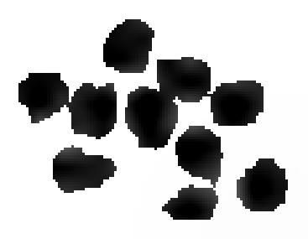
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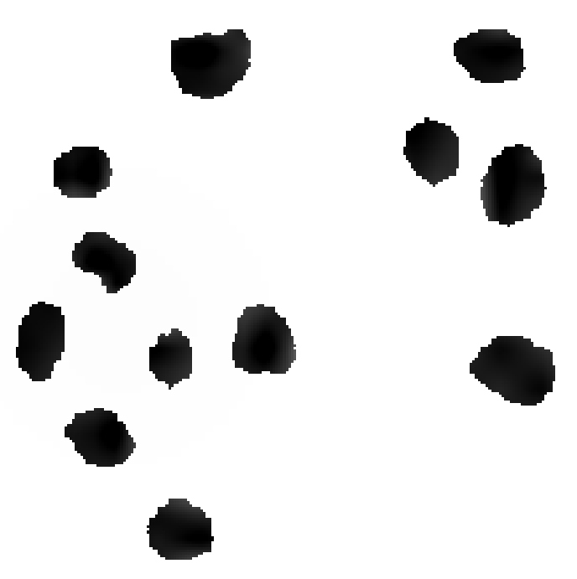
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NOTES

SOME PLANTS NEW TO THE PANHANDLE OF TEXAS.—Among plants collected in Hutchinson County, Texas, in May, 1964, were three species not known previously from the Panhandle and one heretofore unknown from Texas.

Astragalus wootonii Sheldon. North of Plemons bridge across the Canadian River, roadside in sandy soil, *Mrs. Cliff Drake 2,* 6 May 1964.

Hedysarum boreale Nutt. Canadian River breaks north of Phillips, *Drake 1,* 26 May 1964. First report for Texas.

Trifolium repens L. Backyard in Phillips, *Drake* 5, 15 May 1964.

Linum aristatum Engelm. var. *aristatum.* Canadian River breaks north of Phillips, *Drake 7,* 14 May 1964.

Specimens are deposited in the Herbarium of the University of Texas, Austin.—*Mrs. Cliff Drake, 7 North Koopman Street, Phillips, Texas 79071.*

IDENTITY OF XYRIS CAROLINIANA WALTER (XYRIDACEAE).—The name *Xyris caroliniana* has long been a source of trouble. In his *Flora Caroliniana* (1788, p. 69), Walter treated but one species, described as follows:

> *caroliniana* 1. fol. gladiatis, scapo longo, floribus
> luteis, *filamentis latis barbatis.* Stylo
> trifido patulo, longitudine staminum.
> Stigmatibus *capitatis.*

Sixteen or more entities of *Xyris* are to be found in the Carolinas alone, and the description is too inconclusive to circumscribe any particular species. For this reason the epithet *caroliniana* has been assigned in various ways or has been ignored altogether. Rendle (Notes on *Xyris,* Journ. Bot. 37: 397—399, 1899) declared that no specimens of *Xyris* exist in the Walter Herbarium at the British Museum.

No subsequent worker (myself included) appears to have taken the trouble to check the whereabouts of any possible duplicate specimen which might provide evidence as to the identity of Walter's species. Thus it was at the suggestion of Dr. Lloyd Shinners, whose capacity for doubting categorical statements is well known, that I wrote to the Paris Museum regarding the Fraser specimen mentioned by Lamarck under *Xyris caroliniana* (Tabl. Encycl.-Ill. 1: 133, 1797). I also sent a series of specimens for comparison. Dr. Alicia Lourteig replied that a specimen did exist in the Lamarck Herbarium (Fraser, "de la Caroline Meridionale," "Xyris caroliniana Lam. Gen."), and that it matched perfectly a specimen sent to her under the name *X. flexuosa (Demaree 32511).* A phototype kindly sent me by Dr. Lourteig clearly shows the slender, twisted scape and acute, lance-ovoid spike so characteristic of the species.

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Thus it is clear that the plant heretofore known as X. *flexuosa* Muhl. ex Ell. is actually X. *caroliniana* Walter, and what a type or at least an authentic specimen has at last been located. It should be mentioned that *Xyris flexuosa* Muhl. ex Ell., Sketch Bot. S.C. & Ga. 1: 51, 1816, is an illegitimate name, since both X. *caroliniana* and X. *jupicai* are cited as synonyms without qualification. I am indebted to Dr. Shinners for bringing this point to my attention. Thus any proposal to treat X. *caroliniana* as a *nomen confusum* could not permit the continued use of the name X. *flexuosa*.

The investigation of Xyris which led to this note is being supported by a research grant (GB-159) from the National Science Foundation. An account of *Xyris* in North America north of Mexico has been completed and is awaiting publication.—*Robert Kral, Department of General Biology, Vanderbilt University, Nashville, Tennessee 37203.*

POLYGAMODIOECIOUS LEITNERIA FLORIDANA (LEITNERIACEAE).—*Leitneria floridana*, composing the monotypic family Leitneriaceae, is, to our knowledge, known as a dioecious plant. Its floral structures are specialized (reduced) and its possible relationships have been variously interpreted. One may refer to a recent treatment (Channell, R. B. and C. E. Wood, Jr., The Leitneriaceae in the southeastern United States, Jour. Arn. Arb. 43: 435-438, 1962) for pertinent references and well illustrated structural details of staminate and carpellate catkins.

Here we wish simply to report on a population of *Leitneria floridana* in which, besides the usual dioecious condition, there are plants having catkins some cymules of which are bisexual. We have not analyzed the populaton for relative numbers of individuals and/or clones exhibiting each sexual condition. Neither have we attempted to obtain a statistical measure of the number of bisexual cymules in catkins on the monoecious plants.

This population is near North River in the St. Marks Wildlife Refuge, Wakulla County, Florida. At the time of our visit, March 1, 1964, most plants were at anthesis. The relatively large, rather lax, brownish-yellow, conspicuous staminate catkins are in marked contrast, even from some distance, to the smaller, stiffly erect, dark red carpellate catkins. While meandering around (wading), we came to realize that the catkins of some plants had an appearance unlike that which we had come to recognize as typical of either sex. Such catkins much resembled the usual males but were for the most part shorter, more stiffly erect, plumper and more congested. Close examination revealed that although they were conspicuously stamen-bearing, in some catkins (not all, by any means) from 1 to 10 or more red styles were protruding. Dissection

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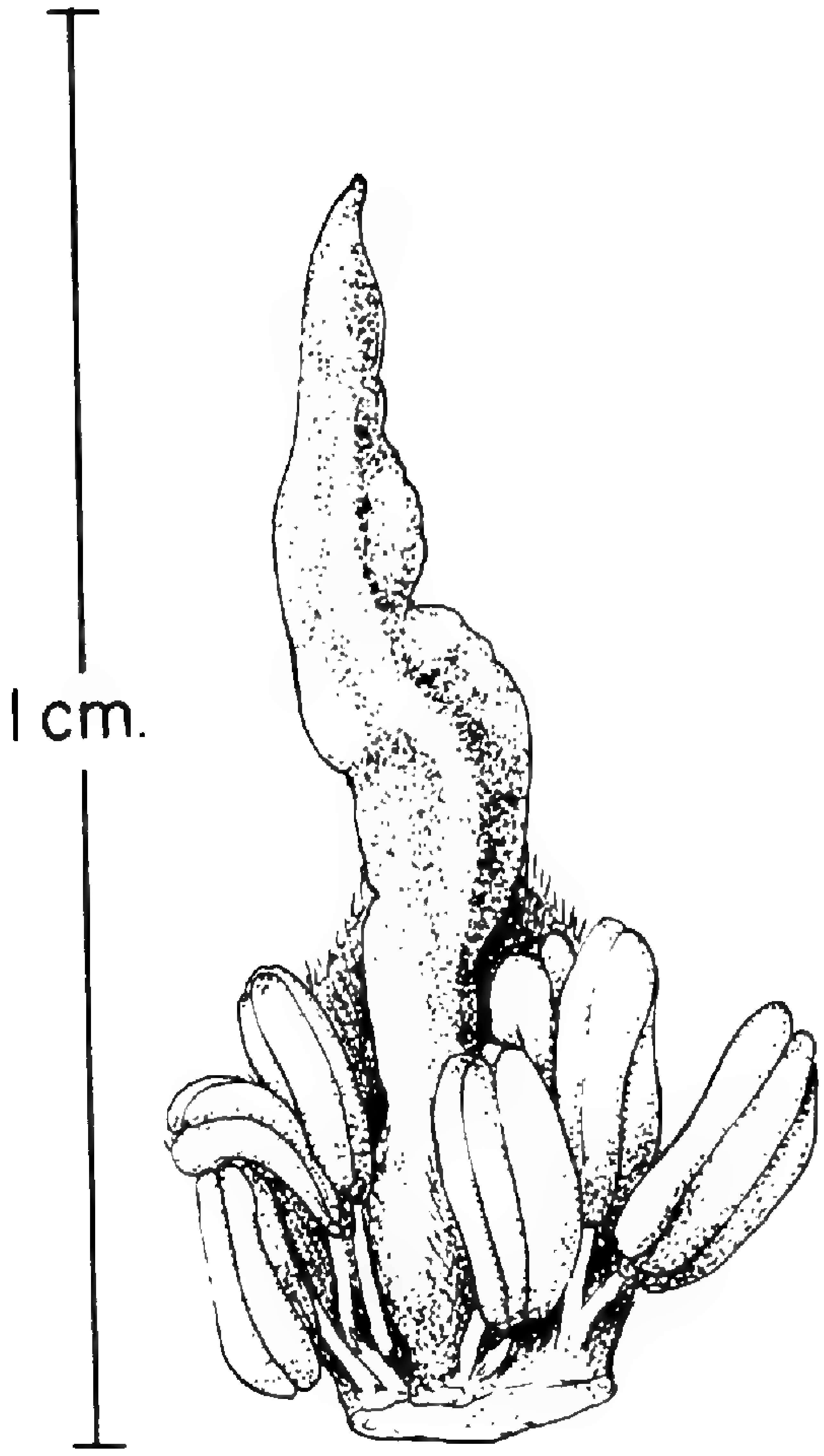
SIDA 2 (2): 172—173. 1965.



Bisexual cymule of Leitneria floridana

of numerous bisexual cymules revealed that each is comprised of a single carpel and from 1 to at least 8 stamens. On the lower portion of the catkin a bisexual cymule frequently consists of 2 groups of 3 stamens with 1 carpel between. Near the tips of the catkin, the carpel is often to one side, a cluster of 2-4 stamens to the other.

Voucher specimen: Godfrey 63248 and Clewell (FSU).

If there be someone who wishes to make a comprehensive study of this population, we offer our services to the extent of escorting him to the locality.—*R. K. Godfrey and Andre F. Clewell, The Florida State University, Tallahassee.*

CYNANCHUM AUGUSTIFOLIUM PERSOON INSTEAD OF C. PALUSTRE (ASCLEPIADACEAE.—In my recent paper "Texas Asclepiadaceae other than *Asclepias*" (SIDA 1: 358-367, 1964), the name *Cynanchum palustre* (Pursh) Heller was used for a species found along the coast from Texas to the Carolinas. The binomial is based on *Ceropegia palustris* Pursh, Fl. Am. Sept. 1: 184, 1813 ("1814"), described from "salt marshes . . . Carolina." *Cynanchum angustifolium* Persoon, Syn. Pl. 1: 274, 1805, from "ad littora maris in Carolina," is an older name for the same plant, and the one which should be used. This was pointed out in 1949 by E. D. Merrill and Shiu-Ying Hu in the introductory portion of their paper "Work and publications of Henry Muhlenberg, with special attention to unrecorded or incorrectly recorded binomials" (BARTONIA 25: 1-66; see especially pp. 13-14), but I had failed to note it.—*Lloyd H. Shinners.*

CHROMOSOME NUMBER OF CHELONE GLABRA (SCROPHULARIACEAE).—To my knowledge, this is the first report of a chromosome number in the genus *Chelone*. It establishes the new base number 7 in the tribe Cheloneae of the Scrophulariaceae. Previous base numbers in the tribe have been X=8 in *Penstemon sens. str.* and in *Chionophila*, but apparently X=5 in *Penstemon frutescens* Lamb. (=*Leiostemon* Raf., the only *Penstemon*-like species not on the North American continent) as well as in *Penstemon nemorosus* (Dougl.) Trautv. (=*Nothochelone* A. Gray, long thought to be a connecting link between *Penstemon* and *Chelone*). This latter species has the chromosome number n=15 or 2n=30; that such a number could arise by amphidiploidy between *Chelone* and *Penstemon* has not escaped my attention.

Chromosome counts of *Chelone glabra* L. were made by a new orcein technique (Shoichi Kawano, unpublished) using root-tips. Voucher specimens (2n=28): WISCONSIN: FLORENCE CO.: Seepage Bog, *Thuja* woods at the south end of Pickerell Lake (R17E, T40N, sect. 7), *H. H. Iltis s.n.* (WIS). Popple River, damp open aspen woods (R17E, T39N, sect. 26), *H. H. Iltis s.n.* (WIS).

I wish to thank the Research Committee of the University of Wisconsin for supplying funds from the Wisconsin Alumni Research Foundation, and Dr. H. H. Iltis for supplying the living plants.—*Frank S. Crosswhite, Department of Botany, University of Wisconsin, Madison.*

LIMNOPHILA INDICA (R.BR.) DRUCE (SCROPHULARIACEAE) IN LOUISIANA. *Limnophila indica* was first collected by writer in 1961 during a preliminary survey of the aquatic flora of Lake Chicot near Ville Platte in Evangeline Parish. The specimen was placed at that time in the herbarium waiting for identification, labeled *planta incognita.*

In April, 1963, during the survey of Mountain Bayou Lake near St. Landry in Evangeline Parish, heavy mats of the same plant were discovered and were tentatively identified as *Limnophila indica* (R.Br.) Druce. Exsiccatae were sent to the Herbarium of the Royal Botanic Gardens, Kew. The specimen were studied by Mr. A. R. Smith, who reported the following: "Of all the tropical Asian spp., these specimens do come nearest to *L. indica,* but there is a more marked tendency to lobing of what are presumably the aerial leaves (near the growing point) in the Louisiana specimens than is typical. Of course, the specimens were obviously quite young when gathered — and the ± entire leaves of the upper parts of the stem which one finds in *L. indica* may yet have developed.

In addition, the pedicels of these specimens are somewhat shorter than is typical of *L. indica.*"

Further studies *loco natale* showed that the entire leaves mentioned by Mr. Smith developed on the plants and the length of the pedicals proved to be very variable.

Both lakes are typical for the area with *Taxodium distichum, Nyssa aquatica, Fraxinus, caroliniana, Cephalanthus occidentalis.*

Lake Chicot and Mountain Bayou Lake cover an area respectively of 2000 and 700 acres. Average water depth 8 feet. *Limnophila* was found in shallow water—not deeper than 3 feet.

Specimens have been deposited in the USL Herbarium, USL Ornamental Horticulture Herbarium (both of the University of Southwestern Louisiana, Lafayette, Louisiana); Herbarium of the Royal Botanic Garden, Kew, England; Herbarium of the Southern Methodist University, Dallas, Texas; Indian National Herbarium, Silbpur, India; and in the Herbarium of the University of Delhi.—*Sigmond L. Solymosy, University of Southwestern Louisiana, Lafayette, Louisiana.*

SIDA 2 (2): 175. 1965.

SIDA CONTRIBUTIONS TO BOTANY

VOLUME 2 NUMBER 3 APRIL 1966

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SIDA is privately published by Lloyd H. Shinners, SMU Box 473, Dallas, Texas 75222, U.S.A. Subscription price $6 (U.S.) per volume of about 360—400 pages, parts issued at irregular intervals.

XYRIS (XYRIDACEAE) OF THE CONTINENTAL UNITED STATES AND CANADA

ROBERT KRAL

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The family Xyridaceae comprises two genera of rushlike perennial or annual herbs, primarily aquatic or of high hydroperiod soils. One genus *(Abolboda,* 10 supp.) is tropical American. The other genus, called *Xyris,* has approximately 190 species of which a majority is pantropical. Little economic importance attaches to the family; a few are used as aquarium subjects (Lawrence, 1951) and the seed of a few are used by game birds such as turkey.

This treatment is of 22 entities, all occurring naturally within the area comprising the United States and Canada, all within the section *Xyris (Euxyris,* Endl.) which is distinguished primarily on the basis of a one-celled, 3-parietal ovulary. Some argument (unpublished) presently exists as to whether *X. elliottii* rightfully belongs within this section in that it has been observed to have free-central placentation. However, my own observations of this species have been that the placentae are attached to the ovary wall at the base of the ovulary, departing from it above the midpoint to intrude into the cell. It is also true that the placentae of other *Xyris* will on drying, separate from the upper wall of a ripe capsule; therefore this treatment is of only the one section.

Several studies of North American *Xyris* have been made, the most comprehensive being done by Malme (1913 et al.), with several helpful, though more local, ones being done by Elliott (1824), Chapman (1860 et al.), Ries (1892), Harper (1903 et al.), Small (1903 et al.), Fernald (1950), Gleason (1952), Blomquist (1955) and others. To a reader who has had considerable field experience with species of *Xyris* it quickly becomes apparent that the writings of A. W. Chapman on the subject are best, in that they are based upon the most first hand observation. In fact it becomes evident that field observations of North American Xyrids are more the exception than the rule in published treatments, including those of Malme.

The present work began with a treatment of the Florida *Xyris* (1960), which was to serve as a partial base for this somewhat more comprehensive approach. Since then, many hundreds more specimens have been collected by the writer within an area extending from New Jersey south to the tip of Florida and west in the Coastal Plain into Texas; many more, including type specimens and photographs of types, were obligingly made available by the curatorial staffs of the following institutions (whose symbols are those suggested by Lanjouw and Stafleu, 1964): BM, British Museum of Natural History, London; CHARL, the Charles-

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SIDA 2 (3): 177—260. 1966.

ton Museum, Charleston, S.C.; FLAS, the Herbarium, Agricultural Experiment Station, Gainesville, Florida; FSU, the Herbarium, Florida State University, Tallahassee, Florida; GH, Gray Herbarium of Harvard University, Cambridge, Mass.; K, the Herbarium, Royal Botanic Gardens, Kew, Great Britain; NY, the New York Botanical Garden, New York, N.Y.; P, Museum National d'Histoire Naturelle, Laboratoire de Phanerogamie, Paris, France; PH, Academy of Natural Sciences, Philadelphia, Pa.; SMU, Herbarium of Southern Methodist University, Dallas, Texas; US, the U.S. National Museum, Smithsonian Institution, Washington, D.C.; VDB, Vanderbilt University, Nashville, Tenn.; WIS, Herbarium of the University of Wisconsin, Madison, Wisc. The fine private collections of Mr. F. H. Sargent and of Mr. S. McDaniel were also examined.

It is a pleasure to acknowledge the assistance of the following people: Dr. L. H. Shinners, Southern Methodist University, who has made available to me not only working space and herbarium facilities but a wealth of competent criticisms and suggestions; Professor Joseph Ewan of Tulane University and Professor Samuel W. Geiser of Southern Methodist University, for their kindnesses in suggesting the whereabouts of type specimens and the possible itineraries of some of this country's nineteenth century naturalists; Dr. Alicia Lourteig, Museum National d'Histoire Naturelle, Laboratoire de Phanerogamie, for her kindness in making comparisons of recently collected specimens of *Xyris* with type specimens. Latin diagnoses of new taxa have been provided by Dr. Shinners.

Thanks are extended also to the directors and curators of the institutions mentioned above for their cooperation in lending specimens or providing photographs of type specimens.

This investigation was supported in large part by a research grant GB-159 to the author from the National Science Foundation.

HISTORICAL ACCOUNT

The genus *Xyris* was proposed by Linnaeus (Sp. Pl. I: 42. 1753), and is based upon the name *X. indica*. Unfortunately the specific epithet is based upon discordant elements, one North American and represented by a species collected by Clayton (at BM) and by Kalm (at LINN), the other East Indian (Fl. Zeyl. 35). The first person clearly to state the problem was Sir J. E. Smith(in Rees' Cycl. 39, 1818) who designated the East Indian entity as the Linnaean type while assigning the name *X. torta* to the material collected by Clayton and Kalm. Argument as to the validity of this solution exists today (Keepers' correspondence of 7 May, 1963, from Mr. John Lewis, British Museum, in regard to specimen *Clayton 219)* and therefore a more detailed explanation will follow the treatment of *X. torta* in this work.

The first post-Linnaean addition to nomenclature of North American *Xyris* was that of Walter (1788:69) and the only species described in "Flora Caroliniana" is *X. caroliniana:*

caroliniana 1. Fol. gladiatis, scapo longo, floribus
luteis, *filamentis latis barbatis,* Stylo
trifido patulo, longitudine stamin-
um. Stigmatibus *capitatis.*

According to Rendle (1899), the specimen upon which the above description was based is not among the Walter specimens at BM. Rendle strongly implies that such a specimen is no longer extant. It is certainly true that the brief description written by Walter could well be applied to very many species within the range of this treatment. However, there is deposited in the Lamarck Herbarium at P a specimen sent by Fraser to Lamark, presumably the very same plant examined by Walter. According to Dr. Lourteig, this specimen matches perfectly with a specimen of *X. flexuosa (Demaree 32511)* sent to her for comparison. Therefore, however brief and inconclusive the description of Walter, the name *Xyris caroliniana* appears to be adequately typified in the form of a specimen of what most North American authors currently call *X. flexuosa.*

The next pertinent work was that of L. C. Richard (Act. Soc. Hist. Nat. Paris I: 106. 1792), which contains a description of *X. jupicai.* While the type is from South America (Cayenne), the species is well represented in the southern United States as a weed of wetlands.

In 1803, two species of *Xyris* were treated by Michaux in his "Flora." The first was *X. brevifolia* Michx., a photograph of the type of which is before me; the second was *X. jupicae,* which appears from the description to be the same as *X. jupicai* Richard, the type for which is at the Paris Museum.

Two species, *X. brevifolia* Michx., *X. anceps* Pers., are cited and one, *X. flexuosa* proposed in Muehlenberg's "Catalogus Plantarum" (1813). *X. anceps* is here considered in the synonymy of *X. jupicai, X. flexuosa,* it develops, is a superfluous name for the Walterian *X. caroliniana.*

The work of Elliott (1816) is significant in that it contains descriptions of two new species, *X. fimbriata* Ell. and *X. juncea* Baldw. Original material of both still exists in the Elliott Herbarium at Charleston. However the latter name was found by Schultes (1822) to be a later homonymn, thus the species is presently known as *X. baldwiniana* Schultes.

When Smith (l.c.) described one of the discordant Linnaean elements of *X. indica as X. torta,* he designated two specimens as examples, both of which are of the same species which rarely ranges into the southeastern Coastal Plain east of the Mississippi River. Subsequent authors were to confuse it with an exclusively Coastal Plain species, here treated as *X. caroliniana.*

The study of *Xyris* by Kunth (1843) includes several detailed descriptions of North American Xyrids together with a detailed diagnosis of a new species, *X. ambigua,* written by its discoverer, Beyrich.

1860 marks the date of publication of the first edition of Dr. Chapman's "Flora of the Southern United States," by far the greatest contribution to our existing knowledge of North American *Xyris*. Chapman, residing at Apalachicola, Florida, which is in one of the finest regions of the U.S.A. for the genus, submitted descriptions of nine new species. Prior to this time no workers had had quite the wealth of field experience with *Xyris* in the United States; thus it is unfortunate that some of Chapman's acute comments, particularly in regard to habitat and flowering, were ignored later by less experienced workers. It is also unfortunate that some of Chapman's concepts were expressed only as label names in that these, inadmissible under the Code, add somewhat to the task of designating types.

A diminutive, coldwater bog species of the northern United States and southern Canada *(X. montana)* was described by H. Ries in 1892. Shortly thereafter (1895) G. V. Nash described the southern *X. smalliana* and R. Harper (1903) discovered the endemic *X. scabrifolia*. The most current comprehensive treatments were those of Malme (l.c.) who described an additional species, *X. drummondii*, together with some varieties of previously recognized species. Malme's final revision of North American *Xyris* (North American Flora 19: 1937) was based strictly on herbarium specimens; the difficulty of applying it to living specimens or to the now much vaster reservoir of collections of *Xyris* is actually the provocation leading to this paper.

MORPHOLOGY

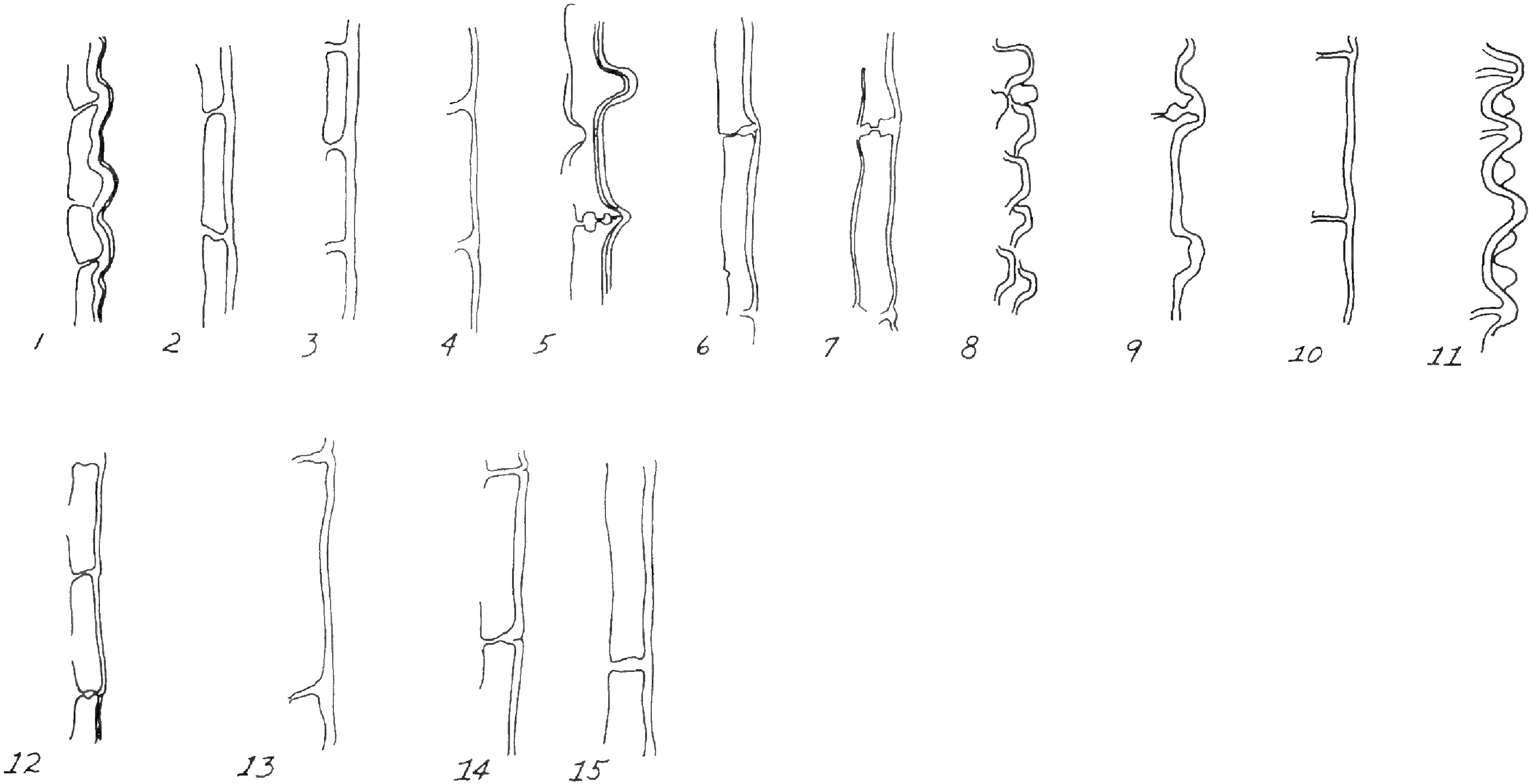
All remarks on the morphology of *Xyris* are based solely on a study of living material of the species treated below, and thus are not intended to be general.

Habit. Barring drought or drainage of the wetlands which *Xyris* frequents, all of the entities treated below are at least short-lived perennials. However a considerable number of species increase prodigiously on disturbed habitats which are, of course, the most likely to drastic fluctuations in soil water. Drying out of the habitat, unless severe and long lasting, usually does not keep a current crop of *Xyris* from setting seed, but the otherwise perennial plants will die in that no overwintering buds are produced; hence the reason for assignment of an annual habit to some soft-based species by some authors. Species such as *X. jupicai*, whose latitudinal range in the United States is from Florida to at least New Jersey may be annual to the north, perennial in the south (Blomquist 1955). Perennation is by means of lateral, overwintering buds. These are most often produced in pairs, one axillary bud, from each of two approximate nodes, and are generally concealed by the dead and living leaf bases of the parent plant; often they are large enough to be called "bulbs." A rhizomatous habit has been attributed to at least one entity, *X. montana* Ries. However, I have observed specimens of *X. baldwiniana*, *X. drummondii*, and *X. elliottii* whose caespitose bases, having been buried in wash or peat, have responded by an elongation of internodes to produce ascending, rhizome-like structures. It would therefore appear that anything like a rhizome in this complex is actually a habitat reaction!

Roots. The root system of *Xyris* is not extensive, being shallow and unbranched. An individual root is somewhat similar to that of some orchids, being fleshy. When the plant bases are buried, some species will respond by developing roots on the buried nodes.

Leaves. The leaves of *Xyris* are equitant, distichous, even on the seedlings. The two margins of the equitant portion are usually very thin, or hyaline; these converge to form one margin of the linear blade, the midrib forming the other margin. Such is not uncommon in the monocots (i.e. many Iridaceae, such as *Iris, Gladiolus).* Inasmuch as the blade margins themselves may be thin, or thickened-cartilaginous, smooth, papillose, or scabrid, this portion of the leaf provides a taxonomic character of use (see Fig. 1). Surfaces of the leaves vary from smooth to papillose or scabrid. In some of the species (e.g. *X. platylepis)* the stomata are raised, and the oblong guard and subsidiary cells therefore could be confused with papillae. However, genuine cellular protuberances do exist, usually appearing in short, transverse or diagonal lines (see Fig. 2), which appears to be most concentrated along the endwalls and cell-corners. Such deposits take the form of tubercles, or domes; they are clear and quite hard, and account for the roughened or "glazed" appearance of foliage of such species as *X. scabrifolia, X. difformis* (vars.), *X. serotina.* The bulk of the epidermis of the *Xyris* leaf is made up of chains of cells whose long axis parallels the leaf blade, interspersed with shorter guard and subsidiary cell-pairs. My own, still limited, studies of epidermal peels of *Xyris* may be an indication that further work with epidermal peel characters of the species might be of taxonomic value in that size of cells, thickness of cell walls, and shape and frequency of guard and subsidiary cells do differ between complexes of species. Detailed internal analyses of *Xyris* leaves have been done by Malme (1913), Carlquist (1960), Smith and Downs (1960) and have thus become much a part of the taxonomy of South American Xyrids.

Bases of leaves of *Xyris* are often specifically different. In one group containing such species as *X. flabelliformis, X. jupicai, X. smalliana, X. fimbriata, X. difformis,* and *X. longisepala,* the leaf bases are dilated, but are thin and soft, also definitely keeled; the scale-like overwintering bud leaves are elongate. In another group containing such species as *X. ambigua, X. stricta, X. scabrifolia, X. platylepis, X. caroliniana* and *X. torta,* the leaf bases are not only dilated but considerably thickened, in the aggregate, the overwintering bud leaves are shorter, fleshier. Still another group of species including *X. baldwiniana, X. elliottii, X. drummondii, X. brevifolia* and *X. isoetifolia,* have hard, somewhat thickened or leathery, but definitely not bulblike aggregations of leaf bases; the overwintering bud leaves are elongate. The backs of the leaf-bases of both these latter categories are rounded. Especially longlived species



LEAF MARGINS OF XYRIS, AT MID-LEAF. From fresh material. 1. *X. stricta.* 2. *X. caroliniana.* 3. *X. smalliana.* 4. *X. platylepis.* 5. *X. difformis* var. *curtissii.* 6. *X. difformis* var. *difformis.* 7. *X. jupicai.* 8. *X. ambigua.* 9. *X. fimbriata.* 10. *X. elliottii.* 11. *X. serotina.* 12. *X. baldwiniana.* 13. *X. iridifolia.* 14. *X. scabrifolia.* 15. *X. torta.*

such as *X. elliottii, X. baldwiniana, X. isoetifolia,* may produce enormous clumps of plants whose flowering scapes may total in the hundreds.

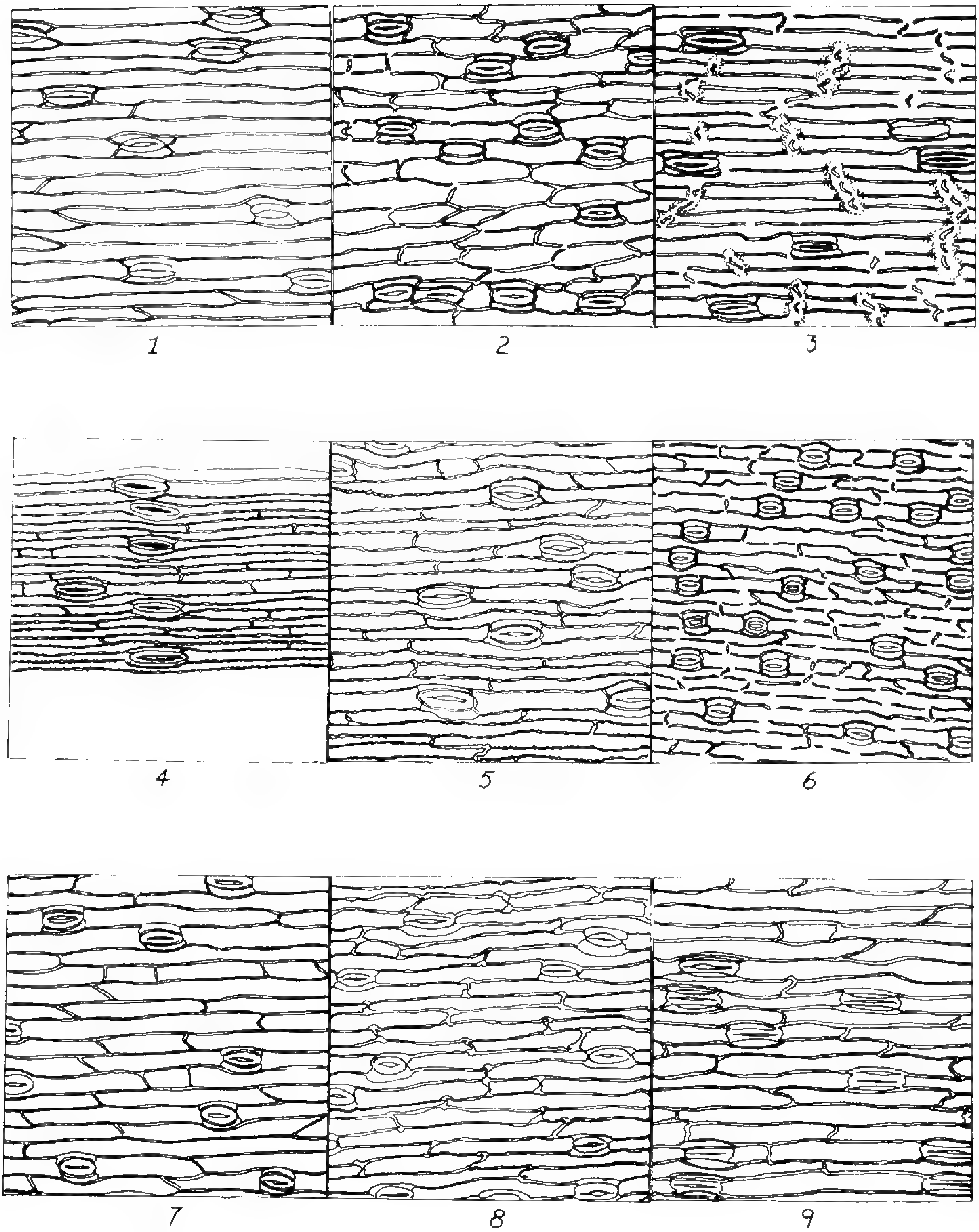
The seedling leaves of all *Xyris* could be useful in distinguishing between species complexes, sometimes even species (see p. 198). The leaves are, in most, flabellately arranged, but there are surprising differences in shapes, length, and pigmentation.

Pigmentation of leaves may be of inestimable taxonomic value in *Xyris*. This character may differ between otherwise very similar species and it fortunately does persist for a fairly long time on herbarium specimens. The most conspicuous pigment is in the red range and when present appears to be concentrated in short chains of elongate cells which are liberally deposited longitudinally throughout the leaves. Such pigments are also present in the scapes. Where present in association with chlorphyllous tissue they tend to darken the green of the foliage; however, they are most noticeable in the lower parts of leaves where the masking chlorophyll is less (i.e. *X. difformis & vars., X. platylepis, X. smalliana, X. flabelliformis, X. iridifolia).*

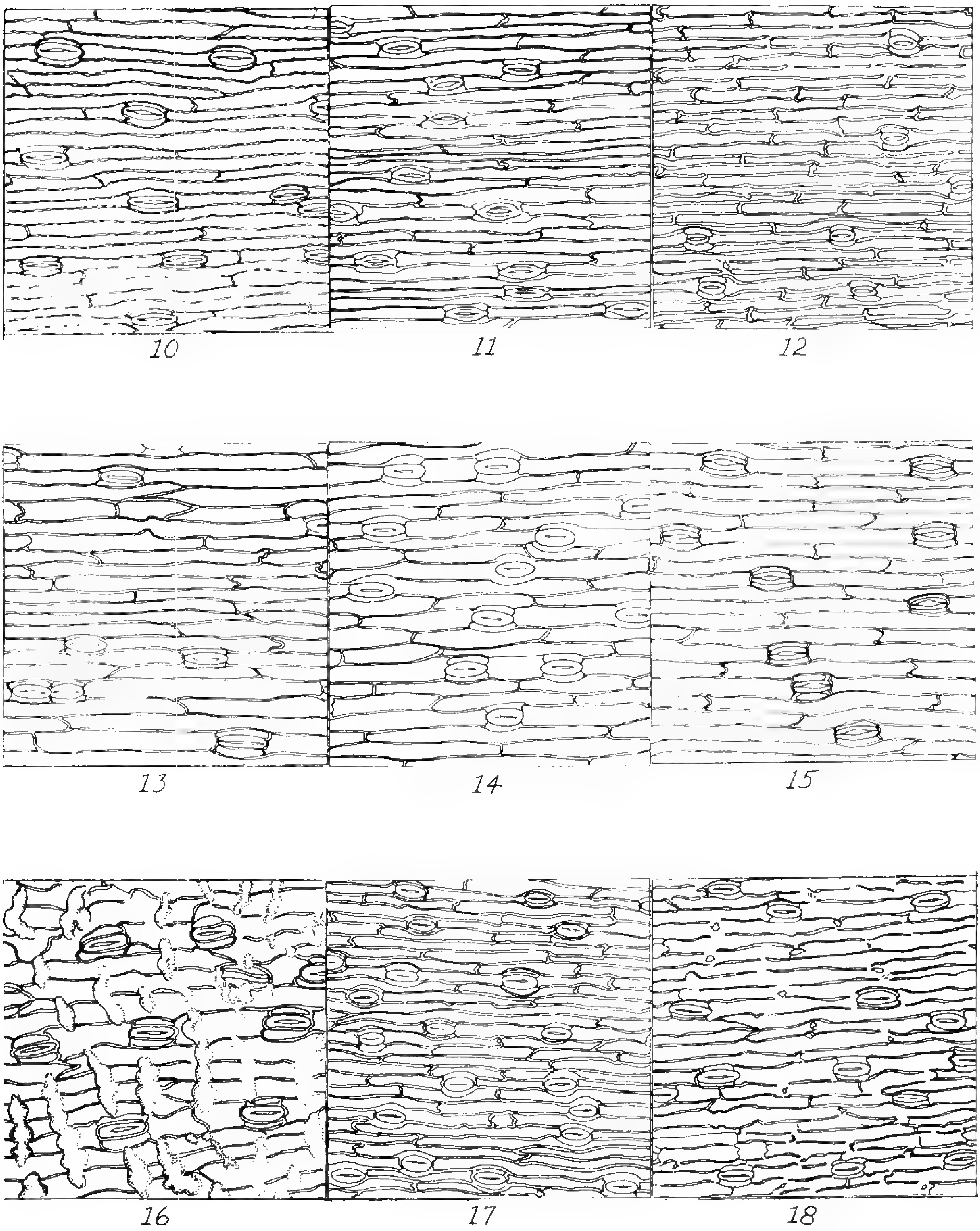
Scape. The scape of *Xyris* is characteristically longer than the leaves, its lower portion sleeved by an inner leaf. The lower portion of a scape is twisted, usually subterete, with many low, longitudinal, (siliceous?) clear, hard ridges but the uppert part in most species (save *X. baldwiniana, X. flabelliformis, X. brevifolia, X. torta,* some *X. difformis)* tends to flatten and have less, but more conspicuous, ridges. The epidermis and pigmentation of the scape will be similar to that of the foliage leaves, except that the lines of cells comprising the scape-ridges will generally have thicker end-walls, often produced outward into tubercles or papillae. In some species (e.g. *X. fimbriata)* these projections are large enough to make the scape edges harsh to the touch.

Inflorescence. The inflorescence of *Xyris* is a cone-like spike comprised of spirally arranged, imbricate, tough, bracts, all but the lowermost subtending a flower. I have found that shape of spike is a fine field characteristic but that it must be used with care in herbarium studies. Drying and pressing tend to distort spike shapes and to change the colour of the bracts.

Bracts. Bracts of *Xyris* are characteristically broad, thickest toward the midrib, thinnest at the margin. Bract apices may be entire or lacerate. The concave inner surface is usually brown and very lustrous; the outer surface shows two zones consisting of a subapical, elliptic, rectangular, ovate or triangular "dorsal area" which is green at flowering time in contrast to the rest of the surface of the bract which ranges in colour from tan to dull-brown or reddish-brown. However, any comment on colour character of outer surfaces of bracts ought to be accompanied by a statement about age of the bract. It is of interest that the dorsal area is most prominent on the lowermost, barren bracts. Here it may protrude *(X. drummondii)* from the bract apex as a cusp or mucro,



EPIDERMAL PATTERNS OF XYRIS, AT MID-LEAF. From fresh material. 1. *X. torta.* 2. *X. difformis* var. *curtissii.* 3. *X. serotina.* 4. *X. elliottii.* 5. *X. caroliniana.* 6. *X. brevifolia.* 7. *X. iridifolia.* 8. *X. smalliana.* 9. *X. baldwiniana.*



EPIDERMAL PATTERNS OF XYRIS, AT MID-LEAF. From fresh material. 10. *X. equisetifolia.* 11. *X. jupicai.* 12. *X. stricta.* 13. *X. difformis* var. *difformis.* 14. *X. platylepis.* 15. *X. fimbriata.* 16. *X. scabrifolia.* 17. *X. ambigua.* 18. *X. flabelliformis.*

or it may even assume a somewhat foliar character.

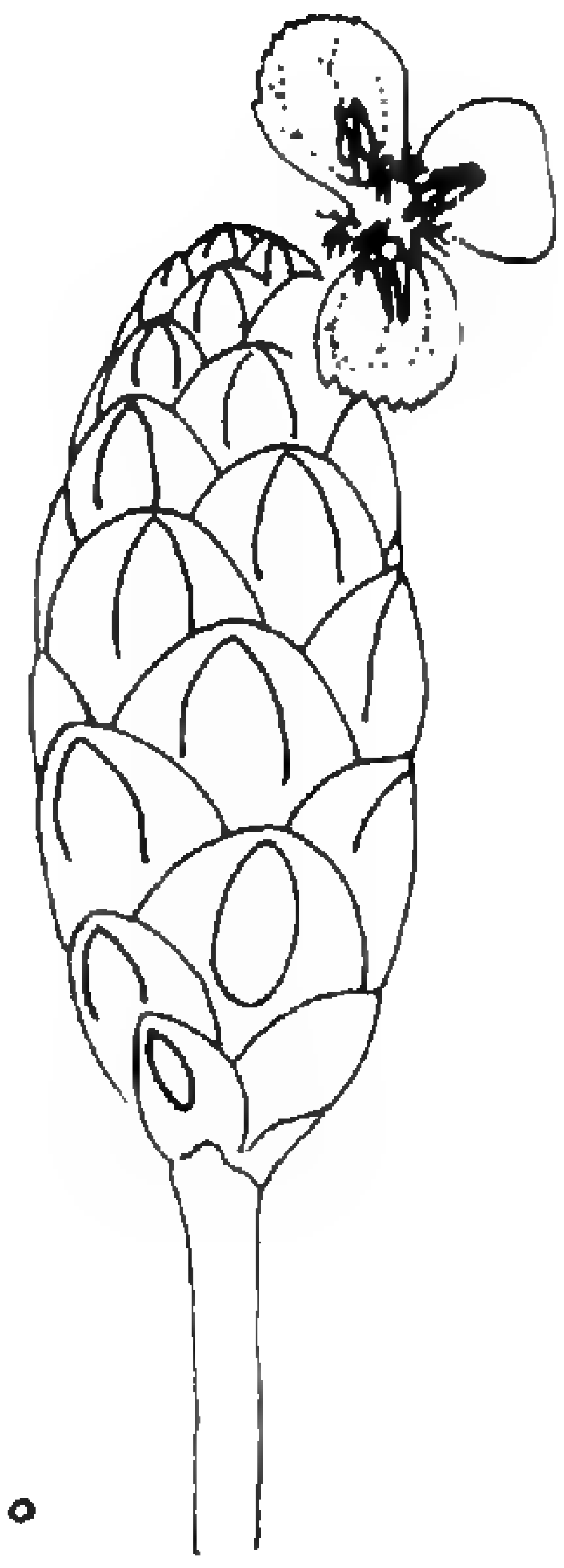
Flower. The flower of *Xyris* is zygomorphic, perfect, trimerous (see p. 187). The corolla itself is actinomorphic, ephemeral in that it lasts but for a part of a day. The commonest flower colour is yellow, but there are white-flowered forms of *X. caroliniana, X. platylepis.*

Sepals. Xyris flowers have 3 sepals, of which the outer is almost membranaceous, forming a transluscent covering for the rest of the flower in the bud, disarticulating at anthesis. The inner two, called "lateral sepals" oppose each other, finally clasping the ripened capsule. The character of the lateral sepals has long been considered of paramount taxonomic importance. Each sepal is boat-like (see pp. 189-193), with thin or membranaceous sides and a thicker, narrow or relatively broad, keel. However in some species (*X. difformis, X. jupicai, X. smalliana,* etc.) the margin of this keel is thin and the cells tend to fray irregularly. In others, more than one layer of cells is involved in the keel margin, from which individual cells or chains of cells may protrude or have narrow tuberculate or papillate protrusions *(X. torta, X. ambigua, X. flabelliformis, X. brevifolia)* which appear in 1, 2 or 3 rows along the keel margin. In other species relatively long chains of elongated cells may part from other cells of the keel, paricularly toward its apex, to give it a fimbriate appearance *(X. caroliniana, X. fimbriata).*

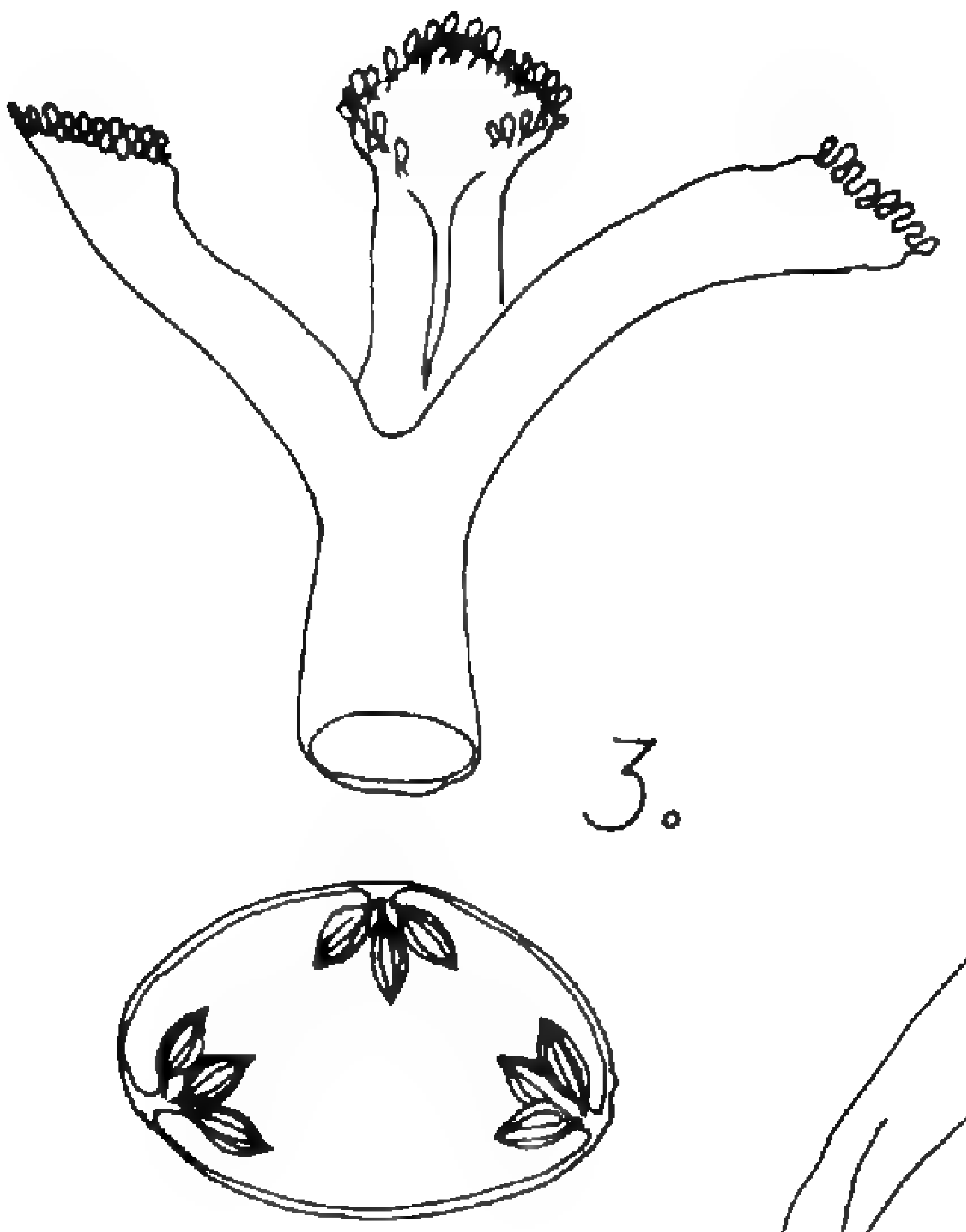
Petals. The petals of *Xyris* are 3, plane, subequal, and separate to the very base. At anthesis each petal consists of a clawed base (see p. 187) which is concealed by the subtending bract and a broad, yellow or white, usually jagged-margined, limb which is exposed. An individual corolla is expanded for but part of a day, as already mentioned, but the *time* of day during which it is full varies from species complex to species complex. The petals are supplied by 3 traces which are simple to their point of juncture with the departure of the stamens, anastomosing beyond this point.

Stamens. Each flat petal claw shows 3 prominent traces which lead to the base of a functional stamen which is attached and whose filament departs from the base of the petal blade. The central trace supplies the short filament. Each anther is comprised of two thin-walled thecae which are slightly convergent apically. Occasionally, at the point on the petal where the lateral traces join the margins of the filament base, there may be short, flat protuberances of cells or small tufts of moniliform trichomes similar to those found on staminodia.

(Opposite) XYRIS CAROLINIANA. 1. Spike with single flower at anthesis. 2. Flower: (A) petal, (B) lateral sepal, (C) staminodium, (D) gynoecium, (E) outer sepal. 3. (above) Upper portion of style showing three branches, stigmatic areas. (below) Cross section through ovulary.



1.



3.

2.

Staminodia. Alternating with the petals and just inside them on the receptacle is a cycle of 3 staminodia, the filaments of which are flattened and bear a single trace. At about the level of the anthers each staminodial filament branches into 2 blades, the trace likewise forking at this junction. Each blade is slightly folded and keeled, the concave side pointed outward; strands of cells comprising the blade separate from it along its edges to form long, usually moniliform, trichomes which are remarkably similar in character from species to species. The only exception to the above-described staminodia lies in *X. baldwiniana,* whose staminodia are reduced and beardless.

Carpels. Our *Xyris* have 3 carpels which comprise a single, unilocular ovary and a hollow style which branches above into 3 parts, each style-branch being conduplicately folded and cylindrical. Toward the very apex, the folded margins of a style branch are truncated to form a "U," the rim of which is lined with short, stigmatic, hairs. These are at approximately the same level in the flower at anthesis as are the anthers and the staminodial hairs. Placentation is 3-parietal, the placentae intruding and the funiculi of the abundant ovules variously elongate. Some question exists as to the mode of placentation in that placentae may intrude toward the summit of an ovulary (i.e. *X. elliottii, X. baldwiniana, X. difformis* var. *curtissii)* and in that the placentae themselves may separate from the ovary wall of the fruit.

Fruit. Fruit of *Xyris* is a thin walled capsule which may rupture irregularly or along placental lines. It is generally dorsiventrally compressed.

Seeds. The seeds of *Xyris* are minute, 1 mm. long or less, tending to be ovoid or narrower in outline. However, shape of seed is often dependent to a degree on crowding of seed within a capsule while length, relative width, and sculpturing of seed cost are independent of crowding. All *Xyris* seed have longitudinal lines whose character is diagnostic (see pp. 194-197). In some species the lines appear broad and flattened, under high magnification reminiscent of thick strips of tape (*X. caroliniana, X. fimbriata);* in others the lines are comprised of contiguous series of darker coloured, rod-shaped papillae or domelike processes of the testum (*X. ambigua, X. difformis,* etc.). Transverse lines, usually fainter than the longitudinal, are also evident in most species. Most *Xyris* seeds have transluscent, yellowish or amber contents save for an opaque region near the embryo. However a few *(X. serotina, X. difformis* var. *floridana, X. iridifolia, X. stricta)* are darker, opaque throughout, and have varying quantities of a powdery or mealy (farinose) substance on their coats.

(Opposite) LATERAL SEPALS OF XYRIS. 1. *X. flabelliformis.* 2. *X. brevifolia.* 3. *X. drummondii.* 4. *X. isoetifolia.* 5. *X. baldwiniana.* 6. *X. elliottii.* 7. *X. torta.*


7
6
5
4
3
2
1
0
mm
1.
2.
3.
4.
5.
6.
7.

Life History. Germination of seed seems to be independent of season, appearing to be triggered more by moist conditions, warm weather, and sunlight. I have gotten good germination of *Xyris* in February, April, June, as well as in the autumn months. In nature, seedlings in all stages of development may be found on a single locality, often forming a turf. The cotyledon is linear or strap-shaped, epigean, green, erect or flattened against the substratum. The husk of the seed usually remains on the tip of the seed-leaf for many weeks after germination (see p. 198). In about a month's time small rosettes, usually fan-shaped, of five or more leaves are visible. Most of the species will flower within a year of seed sowing, so that a fall planted crop will usually be in bloom by the following summer; a few (i.e. *X. brevifolia, X. flabelliformis, X. jupicai)* may go from seed to flower in four months. Stock of *X. brevifolia* and *X. flabelliformis* was moved to the greenhouse in January 1963. By March of the same year it was in bloom and a crop of seed was removed the following month which itself was developed into seed-producing plants by August 1963.

Xyris may overwinter in the seedling stage or perennate by means of pairs of lateral buds which develop in the upper axils of the contracted stem. In several species *(X. torta, X. platylepis, X. scabrifolia, X. caroliniana)* these buds are bulb-like and the outermost scales never become photosynthetic. The inner scales, which are also fleshy, produce cusp-like prolongations which are highly meristematic and which finally elongate, become green, and plane out to become leaf blades. The central or parent plant dies as the lateral buds gain size and strength, often being brown long before killing frosts arrive. In all cases the pattern of growth appears to be forking, usually two daughter plants arising from the parent stem.

FLOWERING TIMES, POLLINATING AGENTS, CHROMOSOMES

Flowering Times. A majority of species of *Xyris* flower in the morning. *X. ambigua X. elliottii, X. jupicai, X. difformis* and varieties, *X. baldwiniana, X. brevifolia, X. flabelliformis, X. drummondii, X. isoetifolia, X. iridifolia* and *X. torta* open their delicate flowers early in the morning and are usually closed toward midday. A few such as *X. fimbriata, X. stricta* and *X. serotina* open their flowers later in the morning and are usually closed toward early afternoon. However such species as *X. scabrifolia, X. caroliniana, X. smalliana, X. longisepala,* and *X. platylepis,* usually flower in the afternoon, with the exception of some forms of *X. caroliniana.*

(Opposite) LATERAL SEPALS OF XYRIS. 1. *X. caroliniana.* 2. *X. ambigua.* 3. *X. stricta.* 4. *iridifolia.* 5. *X. fimbriata.*


6
5
4
3
2
1
0
mm
1.
2.
3.
4.
5.
.2 mm

Season of Flowering. Short lived, weedy species such as *X. brevifolia, X. flabelliformis, X. jupicai* and *X. smalliana* may flower at any time of year if given adequate warmth and moisture. In fact, one species or another of *Xyris* is often in bloom throughout the year in southern peninsular Florida. However, there are definite *peaks* in quantity of blooms produced by a given species, and definite *sequences* of species coming into bloom on a given area. First to commence heavy flowering are *X. brevifolia, X. flabelliformis, X. baldwiniana, X. elliottii, X. torta;* this is usually in the spring, continuing to early summer. By early summer *X. caroliniana, X. isoetifolia, X. longisepala, X. smalliana, X. stricta, X. ambigua,* and *X. jupicai* are blooming and continue to bloom and set seed throughout the rest of the season. From mid summer until fall *X. drummondii, X. fimbriata, X. scabrifolia, X. difformis* (and *varieties*), *X. serotina, X. platylepis,* and *X. iridifolia* are in bloom.

Pollinating Agents. The only insects which I have observed visiting the flowers of *Xyris* are bees of the families Andrenidae, Bombidae. Their leisurely behavior (the smaller ones rolling around like little hogs in a wallow) would be an indication that the stops are for pollen. No nectaries are evident in the odourless flowers.

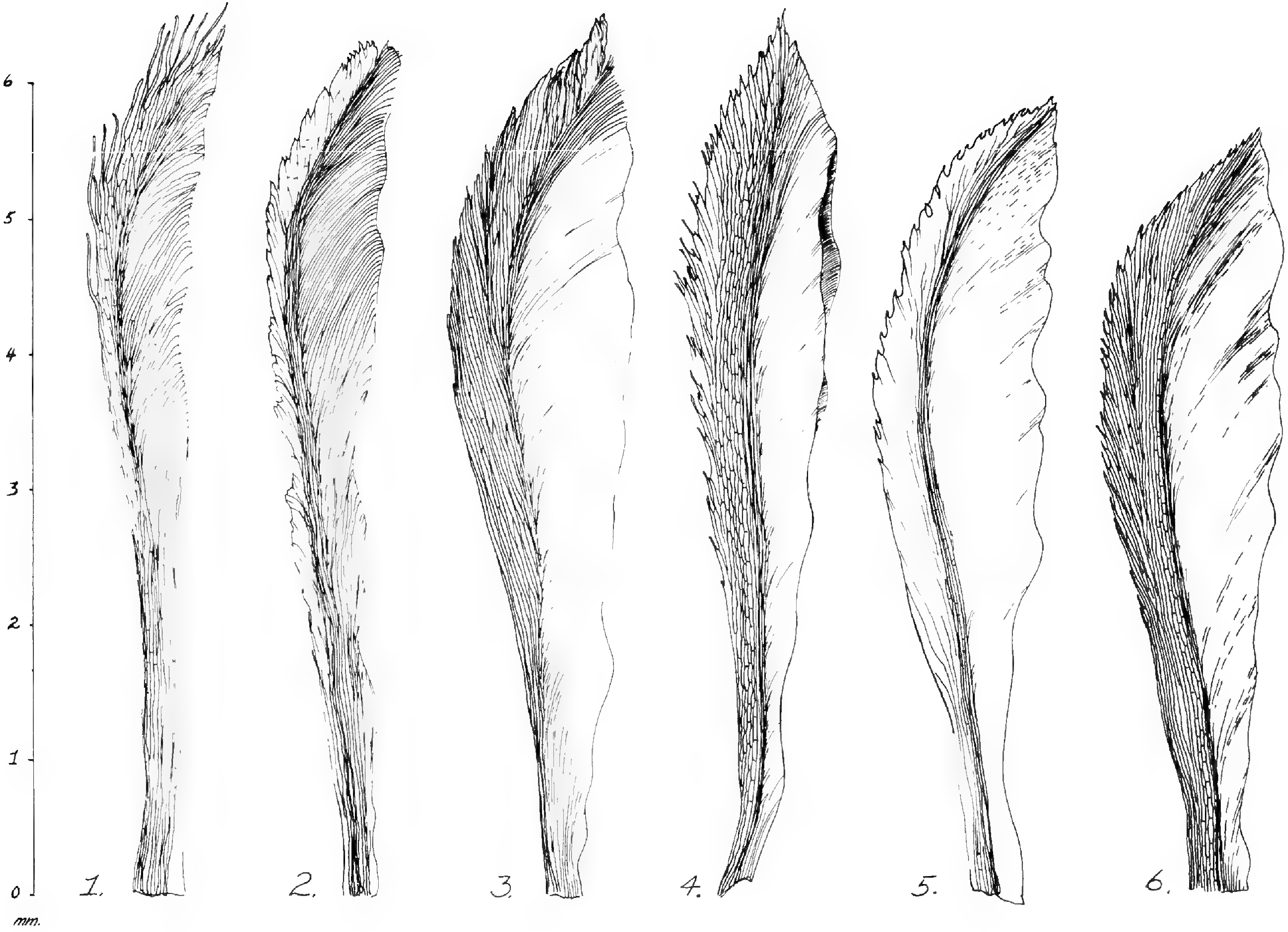
Chromosomes. Chromosome counts of all *Xyris* (save *X. longisepala, X. montana)* native to the United States have been done either by Lewis (1961) or myself. All of the samples thus far have shown a haploid count of 9, a diploid complement of 18, with no evidence of somatic doubling. My technique for making aceto-carmine smears permanent was that of Beeks (1955), which involves Hoyer's Solution. The handling of root tips was based on the double-staining technique first described by Snow (1963). Behavior of chromosomes in meiosis appears very similar from species to species, but there are differences in size of chromosomes, the smallest being found in short-lived, soft-based, species such as *X. brevifolia, X. flabelliformis, X. jupicai* (see pp. 199-203).

A list of specimens which serve as vouchers for my work is below:

Anther Smears: N equals 9

1. *Xyris ambigua* Beyr. *FLORIDA.* ESCAMBIA CO.: *Kral 17728;* WALTON CO.: *Kral 19376. GEORGIA.* MCINTOSH CO.: *Kral 18750. LOUISIANA.* OUACHITA PAR.: *Kral 8060. NORTH CAROLINA.* COLUMBUS CO.: *Kral 19050.*
2. *Xyris baldwiniana* Schultes. *FLORIDA.* ESCAMBIA CO.: Kral 17731; LIBERTY CO.: *Kral 19316B. LOUISIANA.* BEAUREGARD PAR.: *Kral 20206B;* VERNON PAR.: *Kral 20080. GEORGIA.* GRADY CO.: (from greenhouse stock of *Kral 15507).*

(Opposite) LATERAL SEPALS OF XYRIS. 1. *X. scabrifolia.* 2. *X. platylepis.* 3. *X. smalliana.* 4. *X. longifolia.* 5. *X. jupicai.* 6. *X. serotina.*


6
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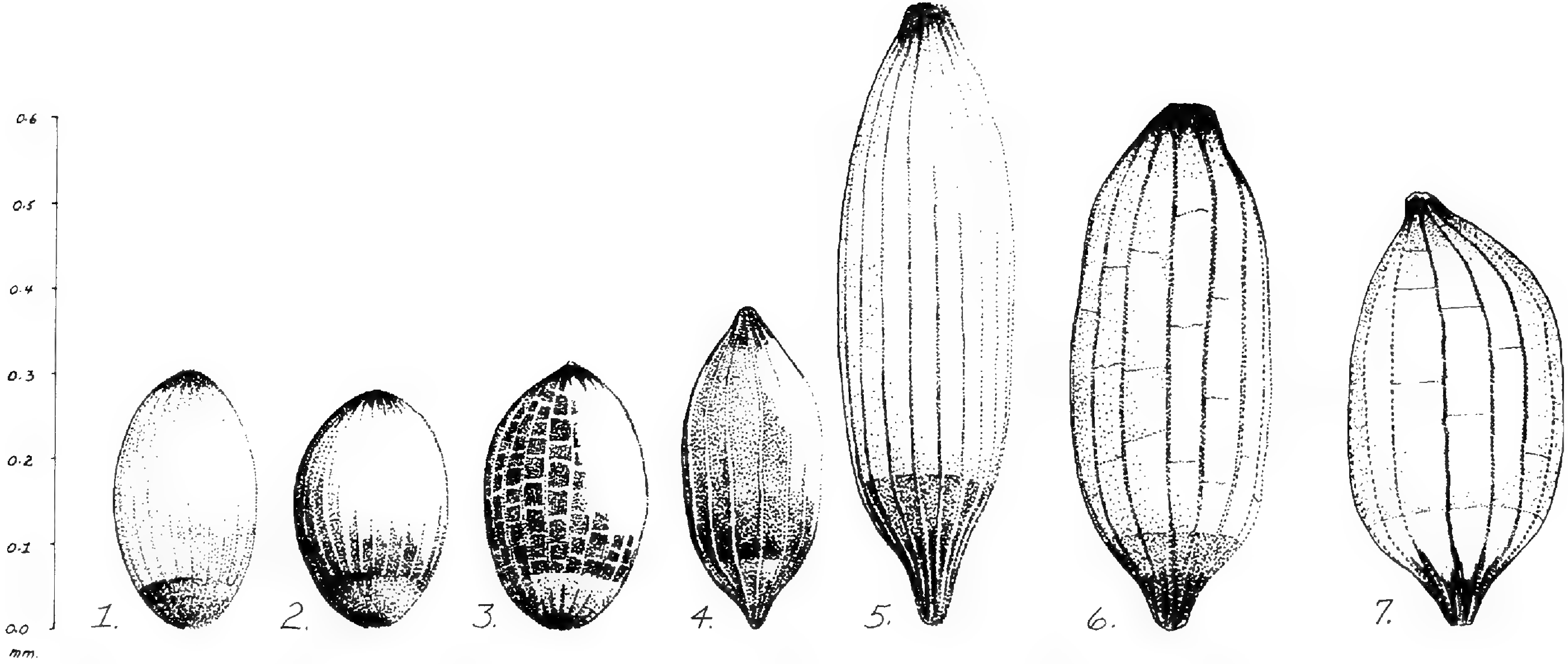
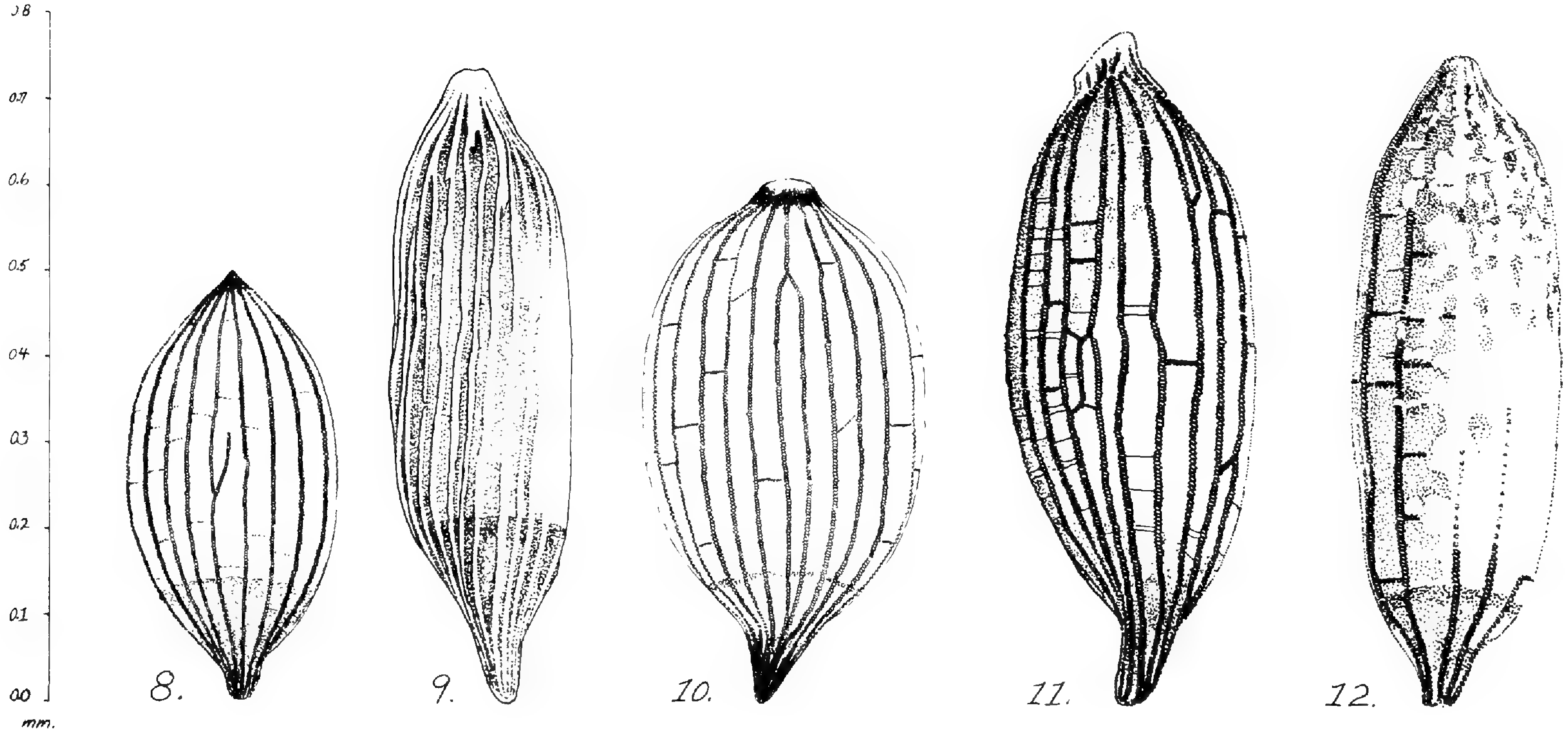
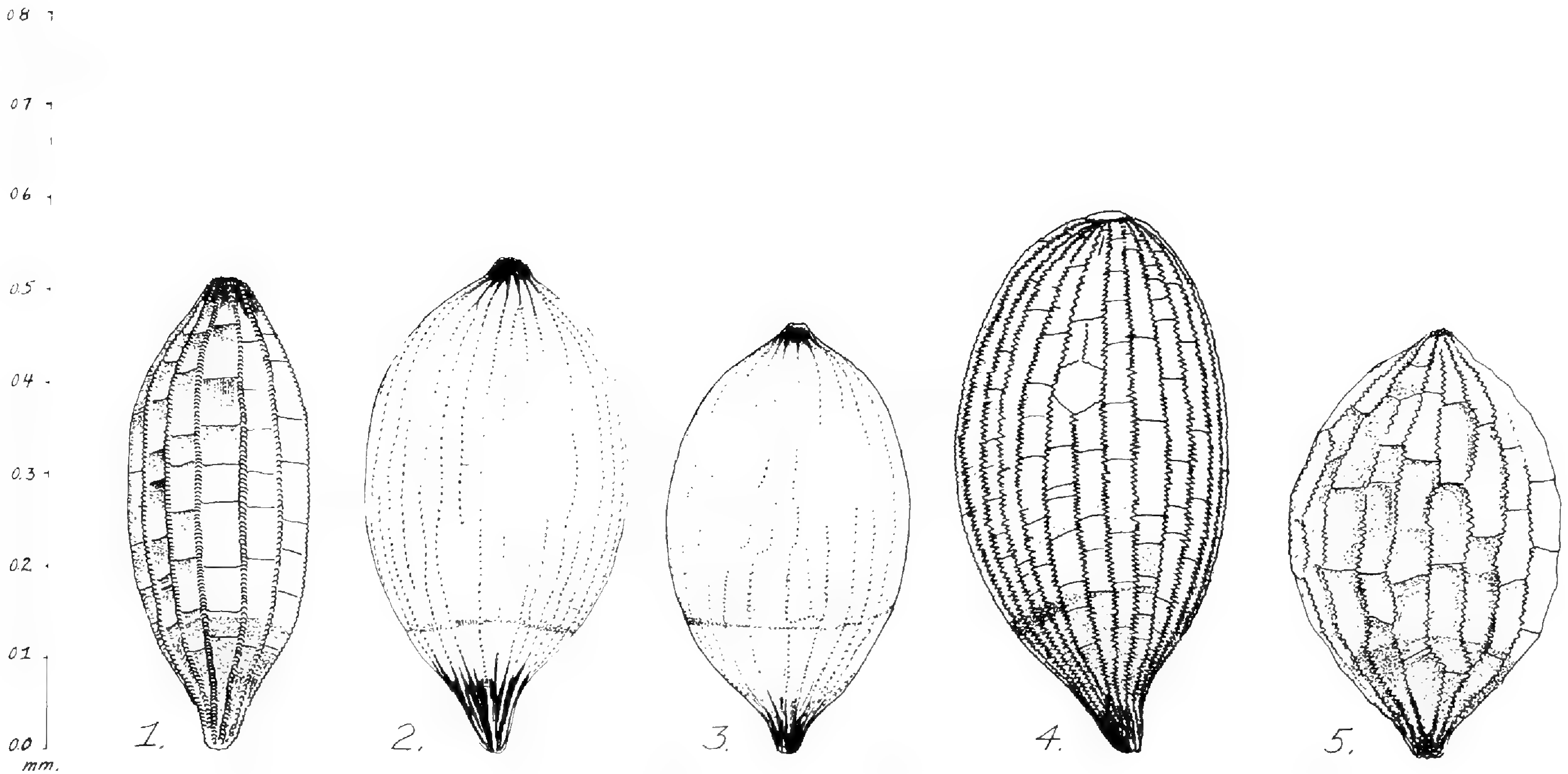


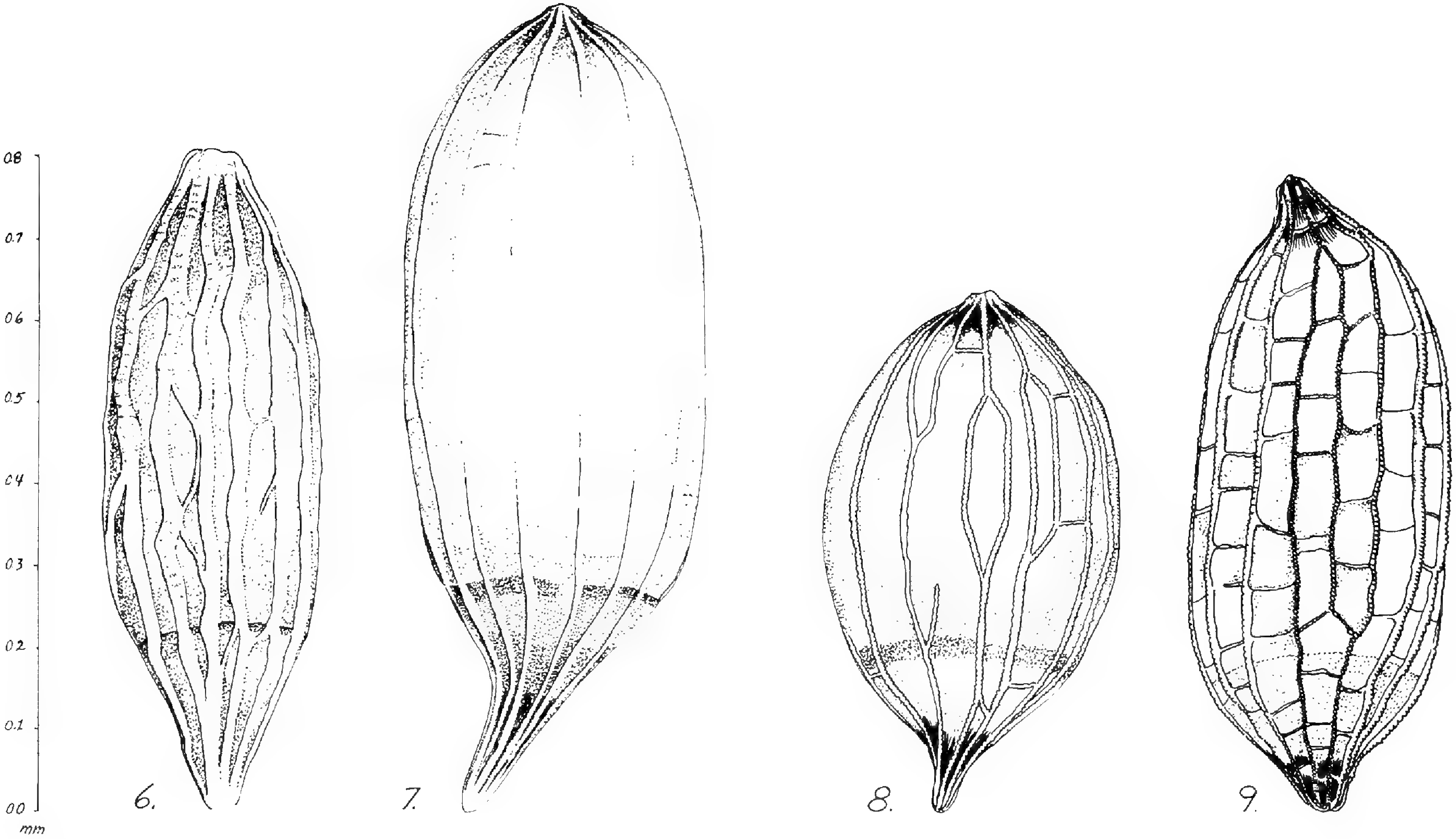
SEEDS OF XYRIS. 1. *X. flabelliformis.* 2. *X. brevifolia.* 3. *X. drummondii.* 4. *X. isoetifolia.* 5. *X. baldwiniana.* 6. *X. elliottii.* 7. *X. difformis* var. *curtissii.*



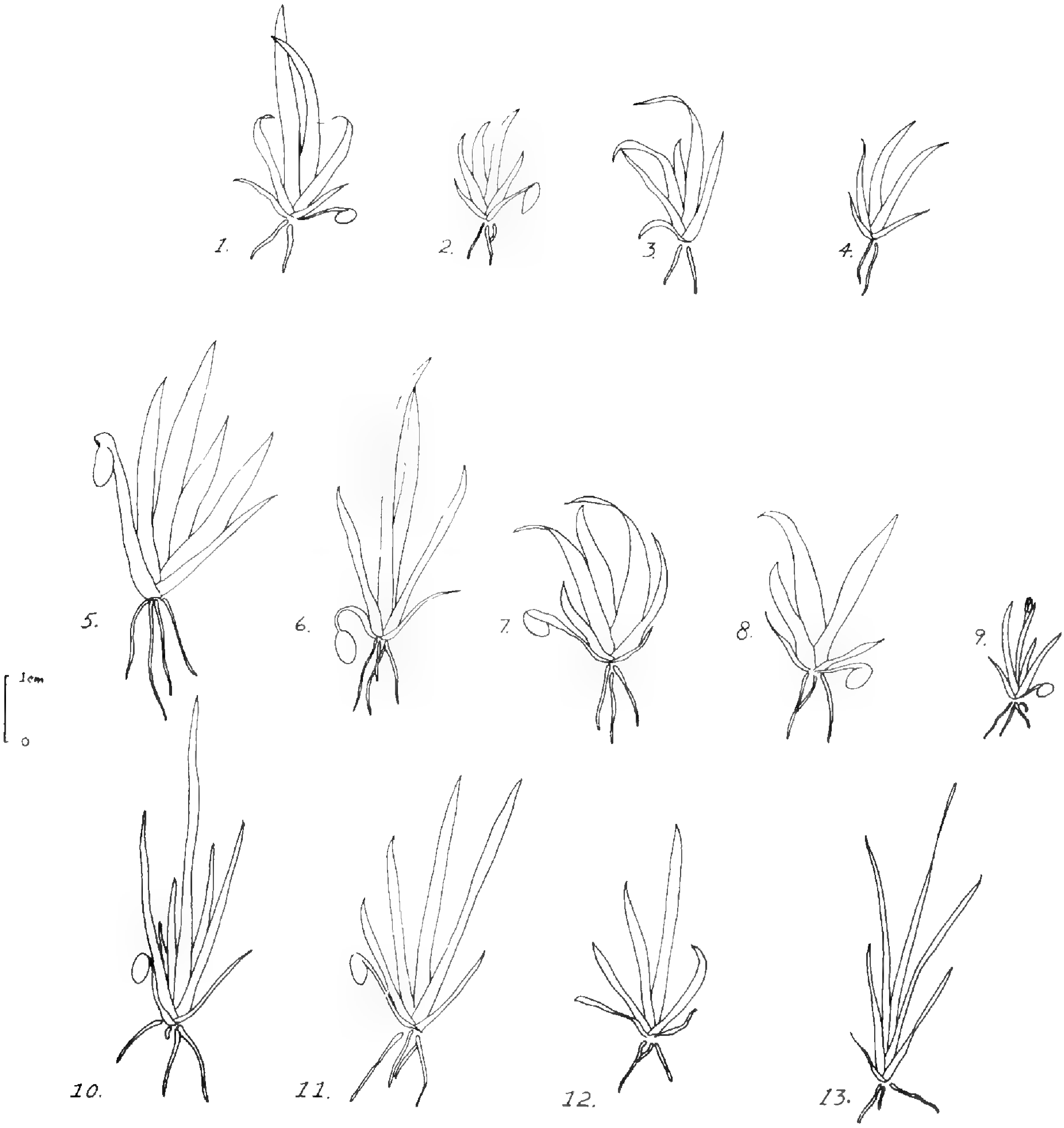
SEEDS OF XYRIS. 8. *X. torta.* 9. *X. caroliniana.* 10. *X. ambigua.* 11. *X. stricta.* 12. *X. iridifolia.*



SEEDS OF XYRIS. 1. *X. longisepala.* 2. *X. difformis* var. *difformis.* 3. *X. jupicai.* 4. *X. serotina.* 5. *X. difformis* var. *floridana.*

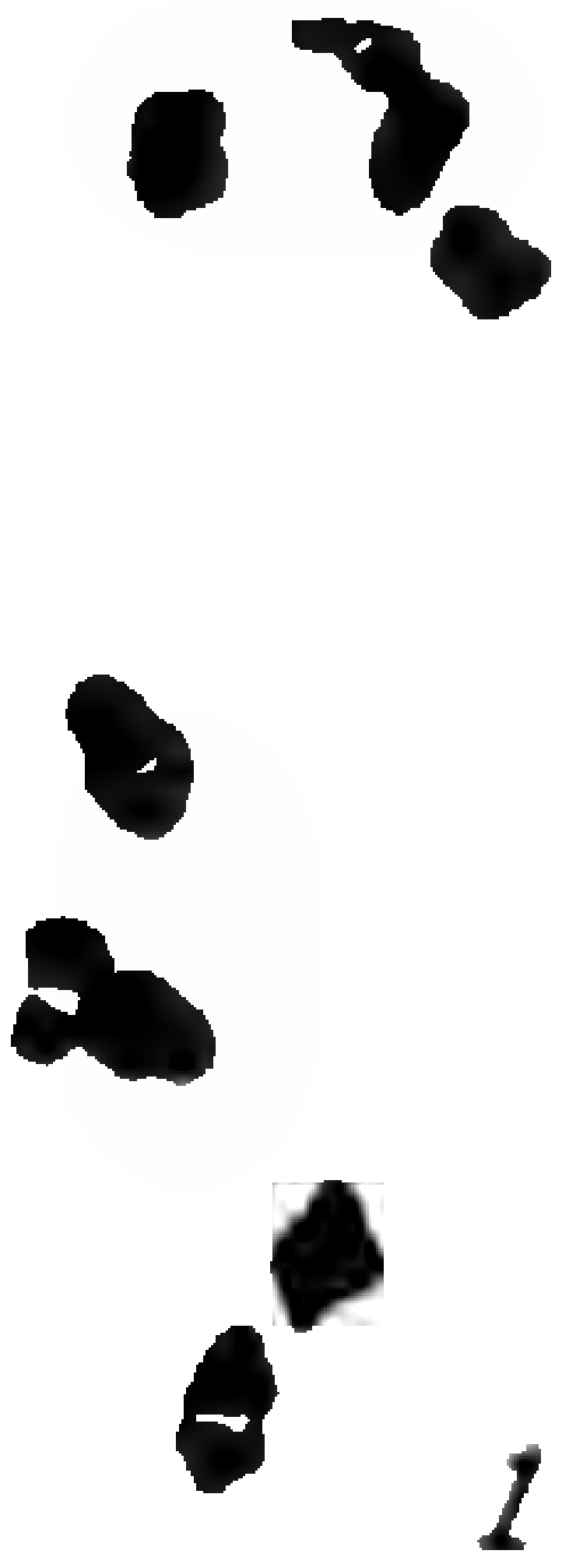


SEEDS OF XYRIS. 6. *X. fimbriata.* 7. *X. scabrifolia.* 8. *X. platylepis.* 9. *X. smalliana.*



(Above) SEEDLINGS OF XYRIS. Age 3 months, from fresh material. 1. *X. difformis* var. *difformis.* 2. *X. iridifolia.* 3. *X. fimbriata.* 4. *X. smalliana.* 5. *X. serotina.* 6. *X. stricta.* 7. *X. ambigua.* 8. *X. platylepis.* 9. *X. brevifolia.* 10. *X. isoetifolia.* 11. *X. longisepala.* 12. *X. jupicai.* 13. *X. baldwiniana.*

(Opposite) MEIOTIC CHROMOSOMES OF XYRIS. 1. *X. ambigua* (prophase I). *X. ambigua* (prophase I.). 3. *X. platylepis* (metaphase I). 4. *X. caroliniana* (prophase I). 5. *X.* 5A, 5B, *X. caroliniana* (metaphase I). 6. *X. baldwiniana* (metaphase I). 7. *X. baldwiniana* (prophase II). 8. *X. serotina* (metaphase I). 9. *X. fimbriata* (metaphase I). 10. *X. brevifolia* (metaphase II).



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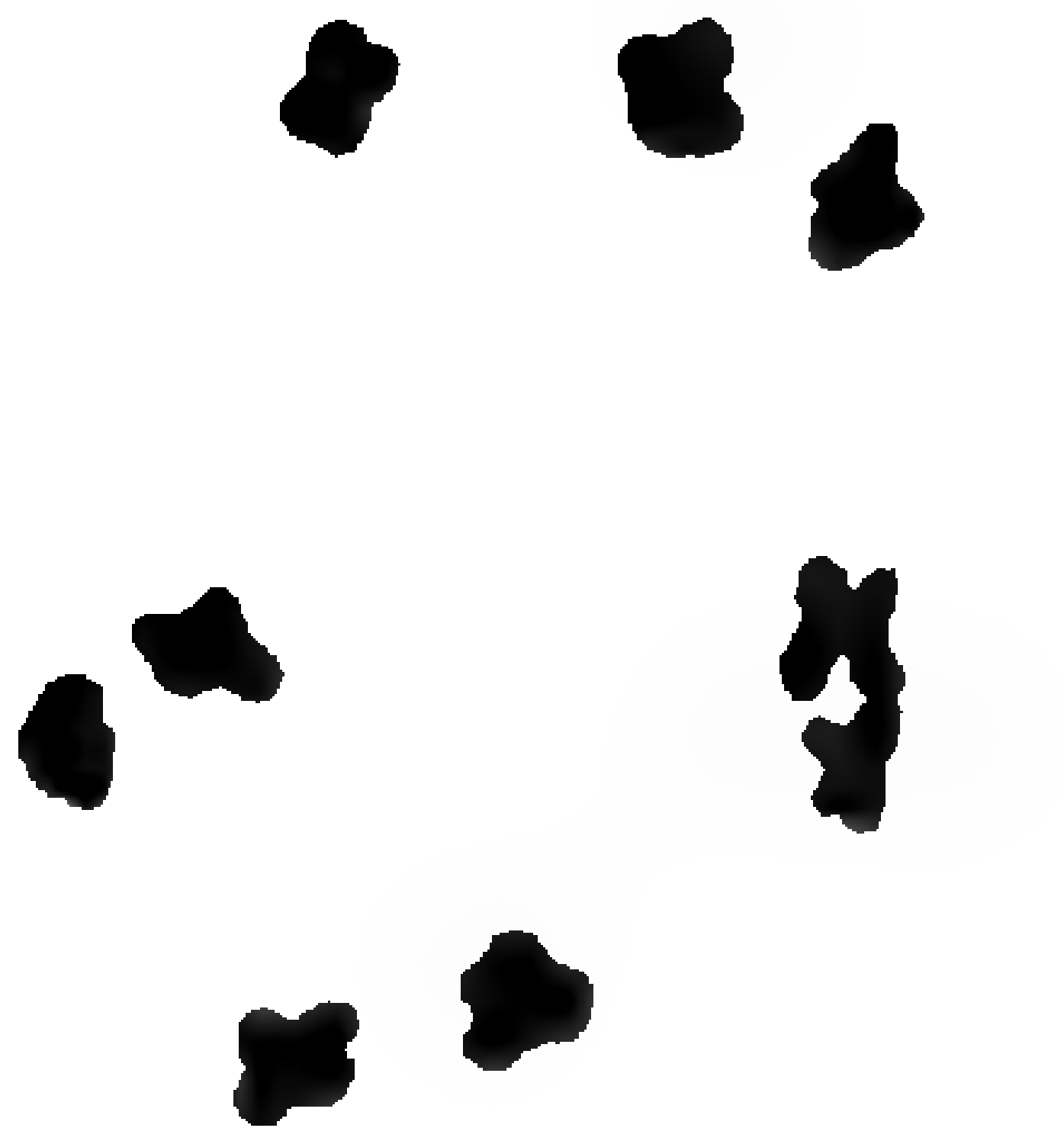

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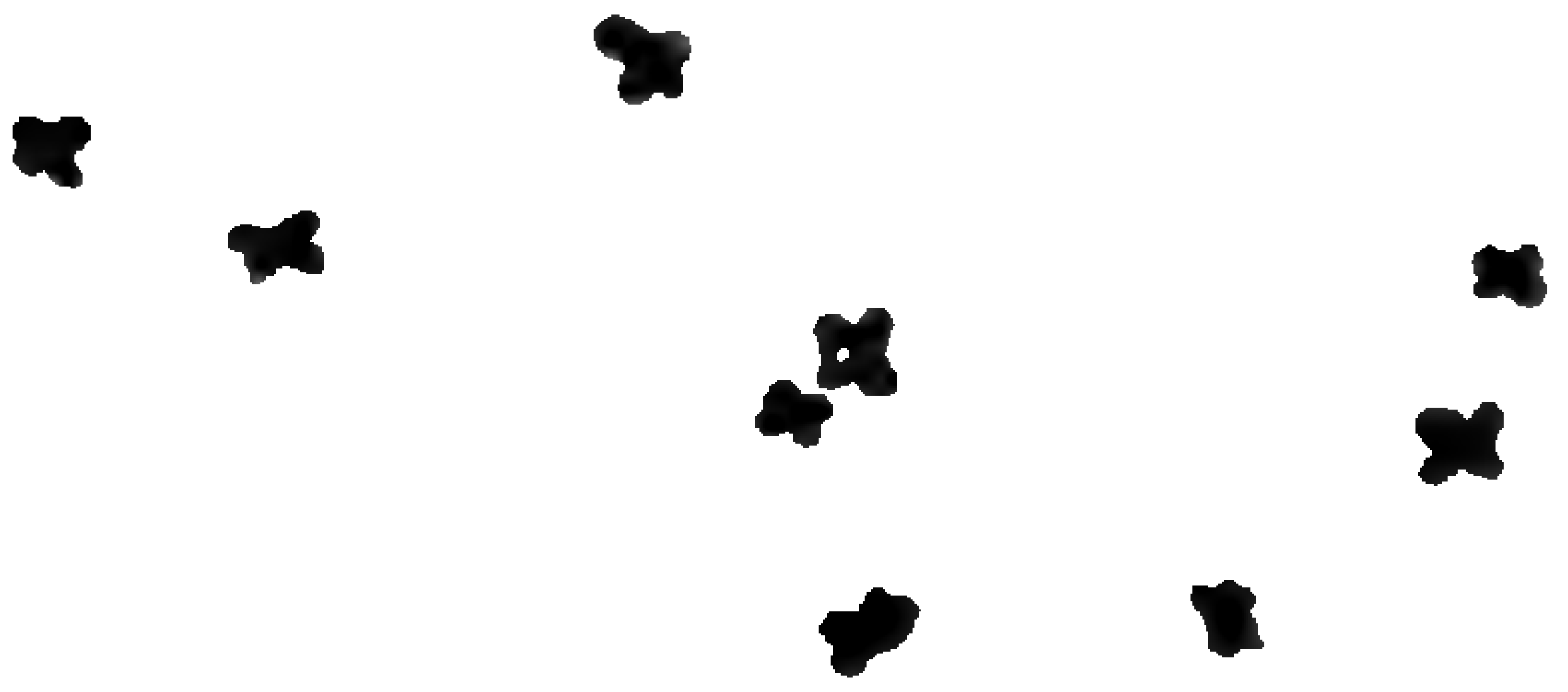
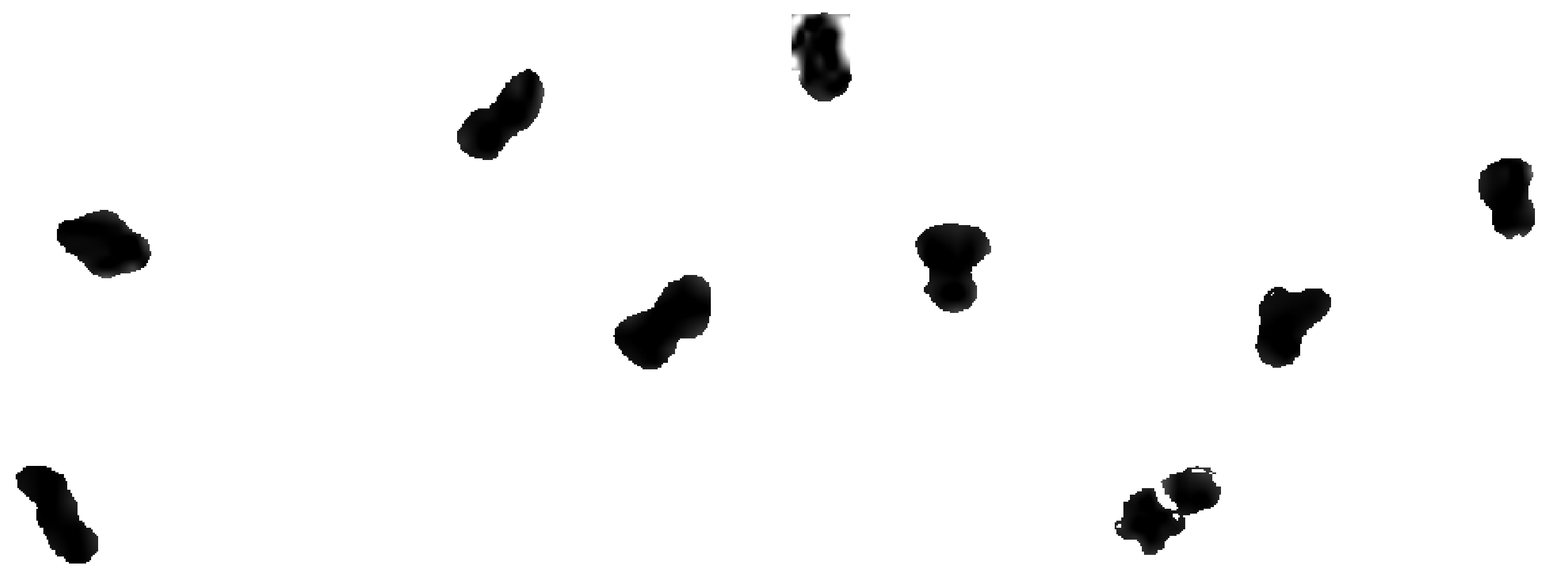


4

5A

5B



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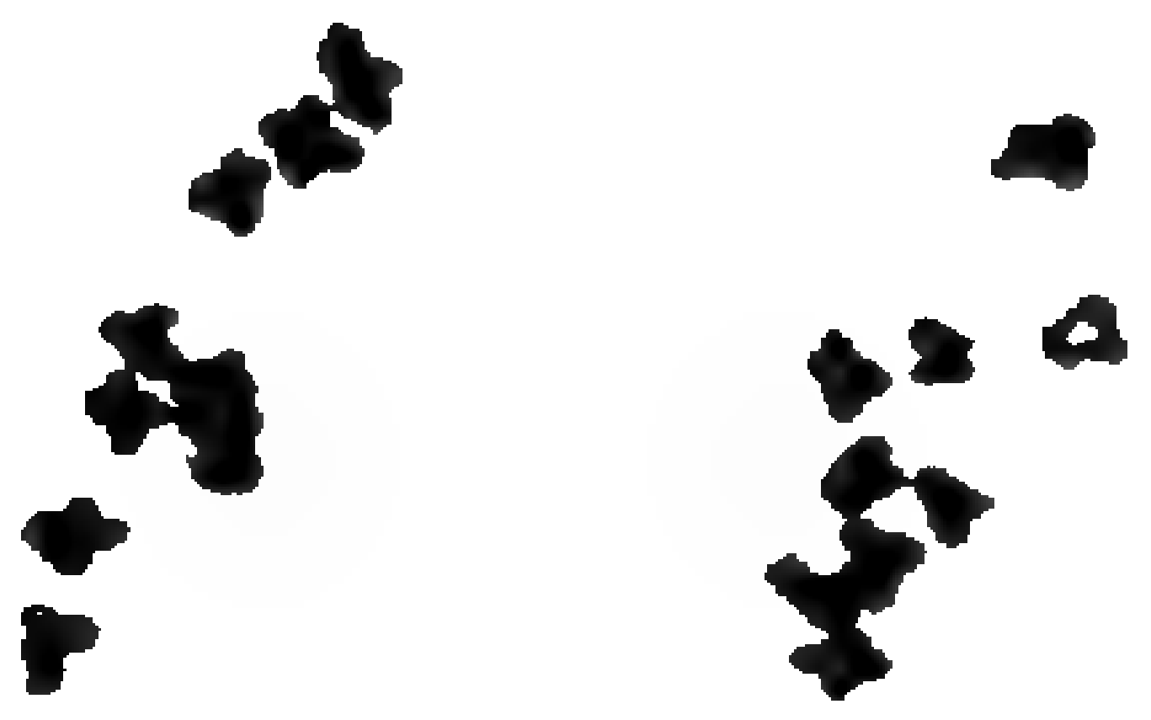

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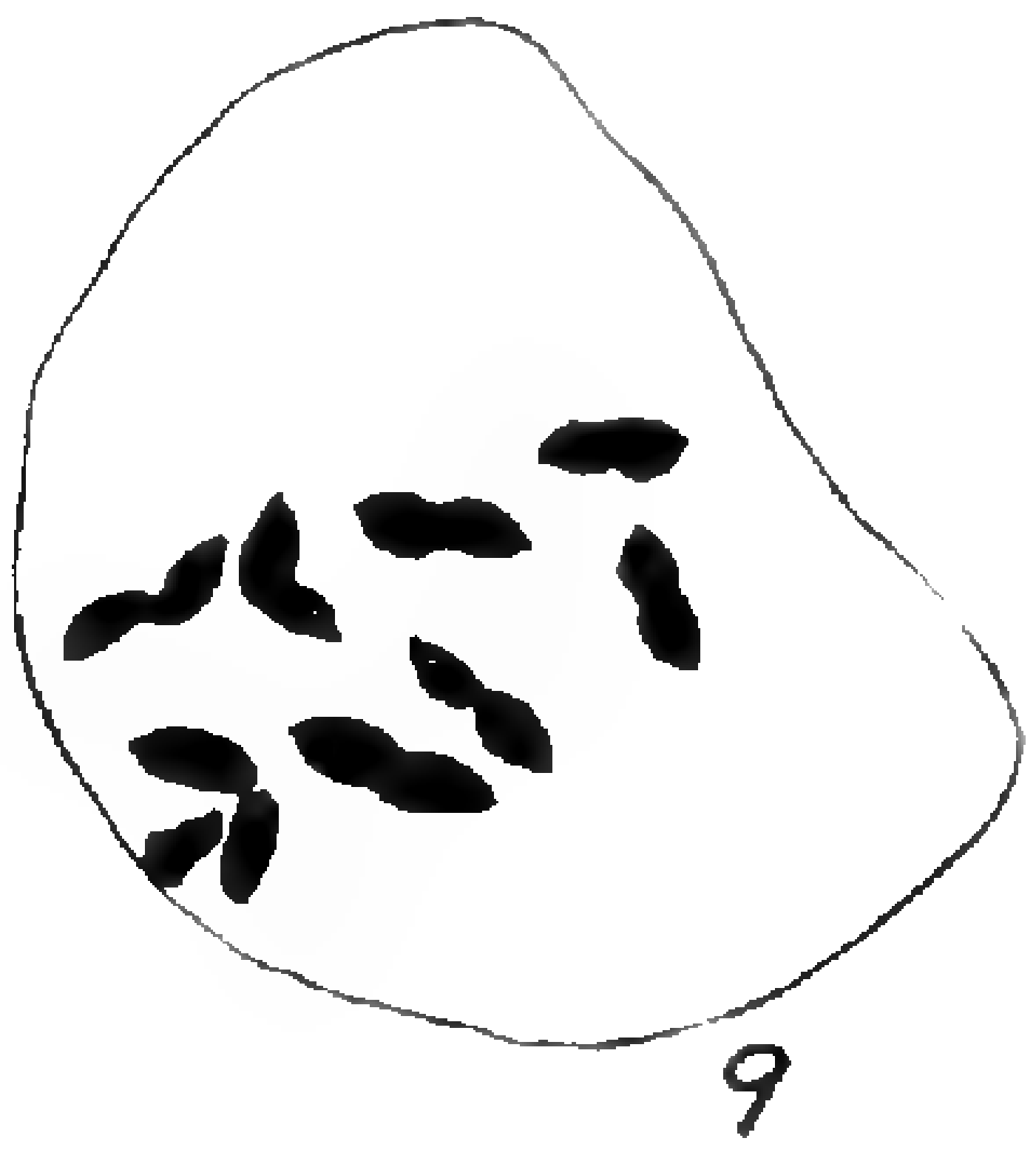


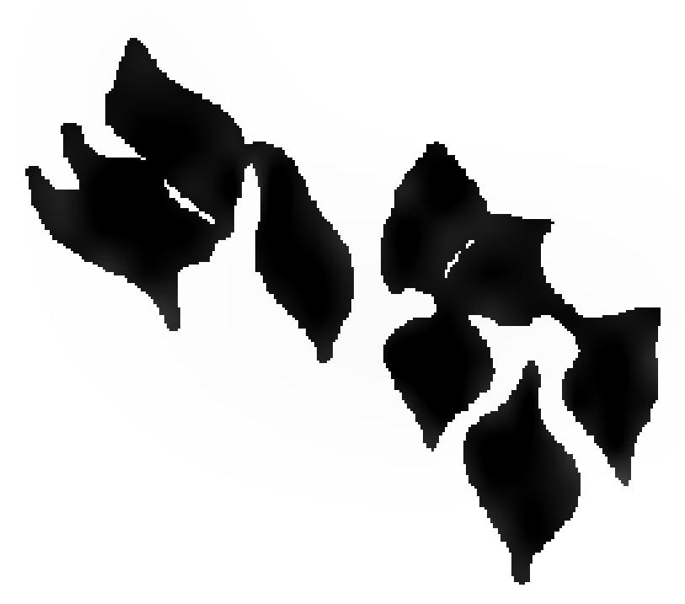
9

10

3. *Xyris brevifolia* Michx. *FLORIDA* LEON CO.: greenhouse stock from 8 mi. w. Tallahassee, grown from seed collected in December 1962; VOLUSIA CO.: *Kral 18442;* WAKULLA CO.: greenhouse stock collected by *Kral & Godfrey* in December 1963 from Newport, the same locality as *Kral 6442.*
4. *Xyris difformis* Chapm. var. *curtissii* (Malme). *FLORIDA.* ESCAMBIA CO.: *Kral 17589;* LIBERTY CO.: *Kral 19316. NORTH CAROLINA.* COLUMBUS CO.: *Kral 19037.*
5. *Xyris difformis* Chapm. var. *difformis. GEORGIA.* WARE CO.: *Kral 19239;* MCINTOSH CO.: *Kral 18765. NORTH CAROLINA.* ROBESON CO.: *Kral 19144. SOUTH CAROLINA.* COLLETON CO.: *Kral 18980;* BERKELEY CO.: *Kral 19213. LOUISIANA.* VERNON PAR.: *Kral 20662;* WASHINGTON PAR.: *Kral 19783.*
6. *Xyris difformis* Chapm. var. *floridana. FLORIDA.* FLAGLER CO.: *Kral 18554;* NASSAU CO.: *Kral 18617A;* VOLUSIA CO.: *Kral 18461. GEORGIA.* CHATHAM CO.: *Kral 18941;* MCINTOSH CO.: *Kral 18748. LOUISIANA.* WASHINGTON PAR.: *Kral 19385.*
7. *Xyris drummondii* Malme. *FLORIDA.* ESCAMBIA CO.: *Kral 17635;* LIBERTY CO.: *Kral 19316.*
8. *Xyris elliottii* Chapm. *FLORIDA.* NASSAU CO.: *Kral 18629A;* ESCAMBIA CO.: *Kral 17729;* GULF CO.: *Kral 17795.*
9. *Xyris fimbriata* Ell. *FLORIDA.* ESCAMBIA CO.: *Kral 17732;* LIBERTY CO.: *Kral 15689;* VOLUSIA CO.: *Kral 18440. GEORGIA.* CAMDEN CO.: *Kral 18618B;* LIBERTY CO.: *Kral 18851;* MCINTOSH CO.: *Kral 18890.*
10. *Xyris flabelliformis* Chapm. *FLORIDA.* JEFFERSON CO.: *Kral 6434;* WAKULLA CO.: (Both the preceeding collected by *Kral & Godfrey* from the numbered localities and transplanted to greenhouse in January 1964.) WALTON CO.: *Kral 19840.*
11. *Xyris caroliniana* Walt. *FLORIDA.* VOLUSIA CO.: *Kral 18464;* WALTON CO.: *Kral 19377. NORTH CAROLINA.* COLUMBUS CO.: *Kral 19051;* ROBESON CO.: *Kral 19116. LOUISIANA.* VERNON PAR.: *Kral 20650. SOUTH CAROLINA.* COLLETON CO.: *Kral 18981.*
12. *Xyris iridifolia* Chapm. *FLORIDA.* LIBERTY CO.: *Kral 15687* (cytological material gathered one year later, in 1963). *GEORGIA.* CAMDEN CO.: *Kral 18617B;* MCINTOSH CO.: *Kral 18766. LOUISIANA.* VERNON PAR.: *Kral 20658;* WASHINGTON PARISH: *Kral 19384.*

(Opposite) MEIOTIC CHROMOSOMES OF XYRIS. 11. *X. drummondii* (A, B metaphase I, C metaphase II). 12. *X. flabelliformis* (metaphase II). 13. *X. torta* (prophase I). 14. *X. elliottii* (prophase I). 15. *X. elliottii* (prophase I). 16. *X. torta* (prophase I). 17. *X. scabrifolia* (metaphase I). 18. *X. caroliniana* (prophase I). 19. *X. difformis* var. *difformis* (metaphase I). 20. *X. difformis* var. *difformis* (prophase I). 21. *X. jupicai* (prophase I). 22. *X. jupicai* (prophase I).

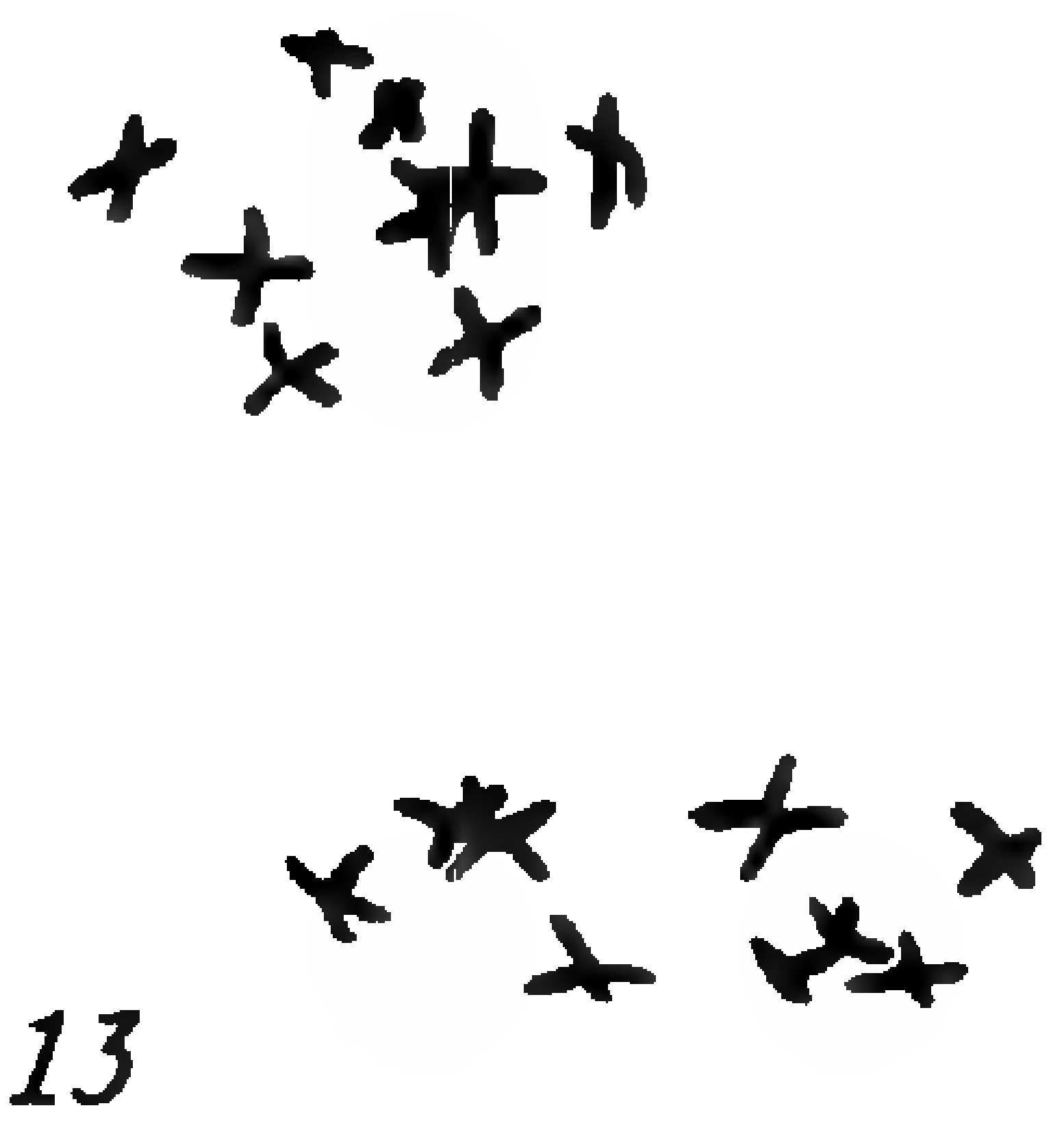
11A



11B

11C

12



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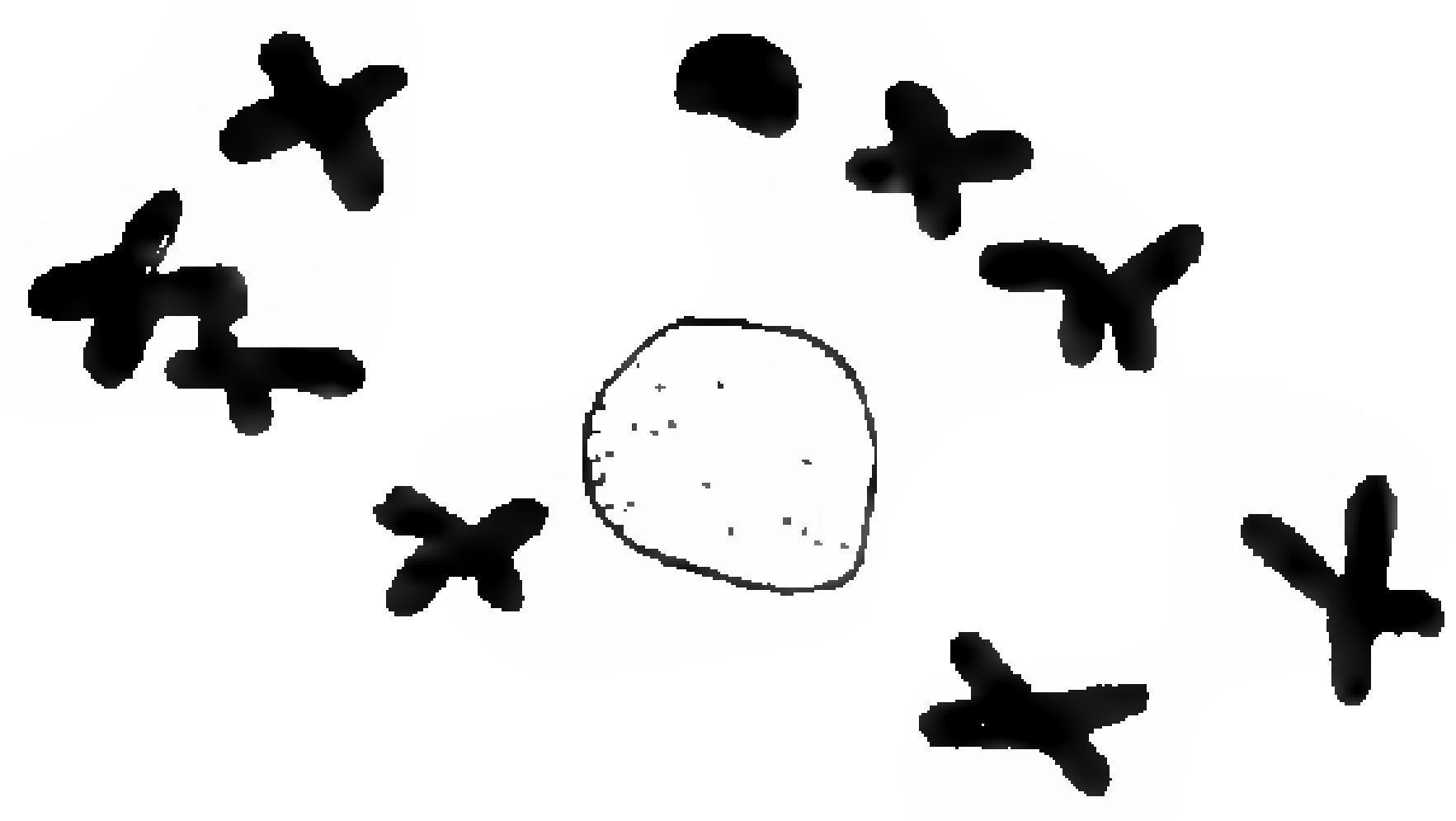

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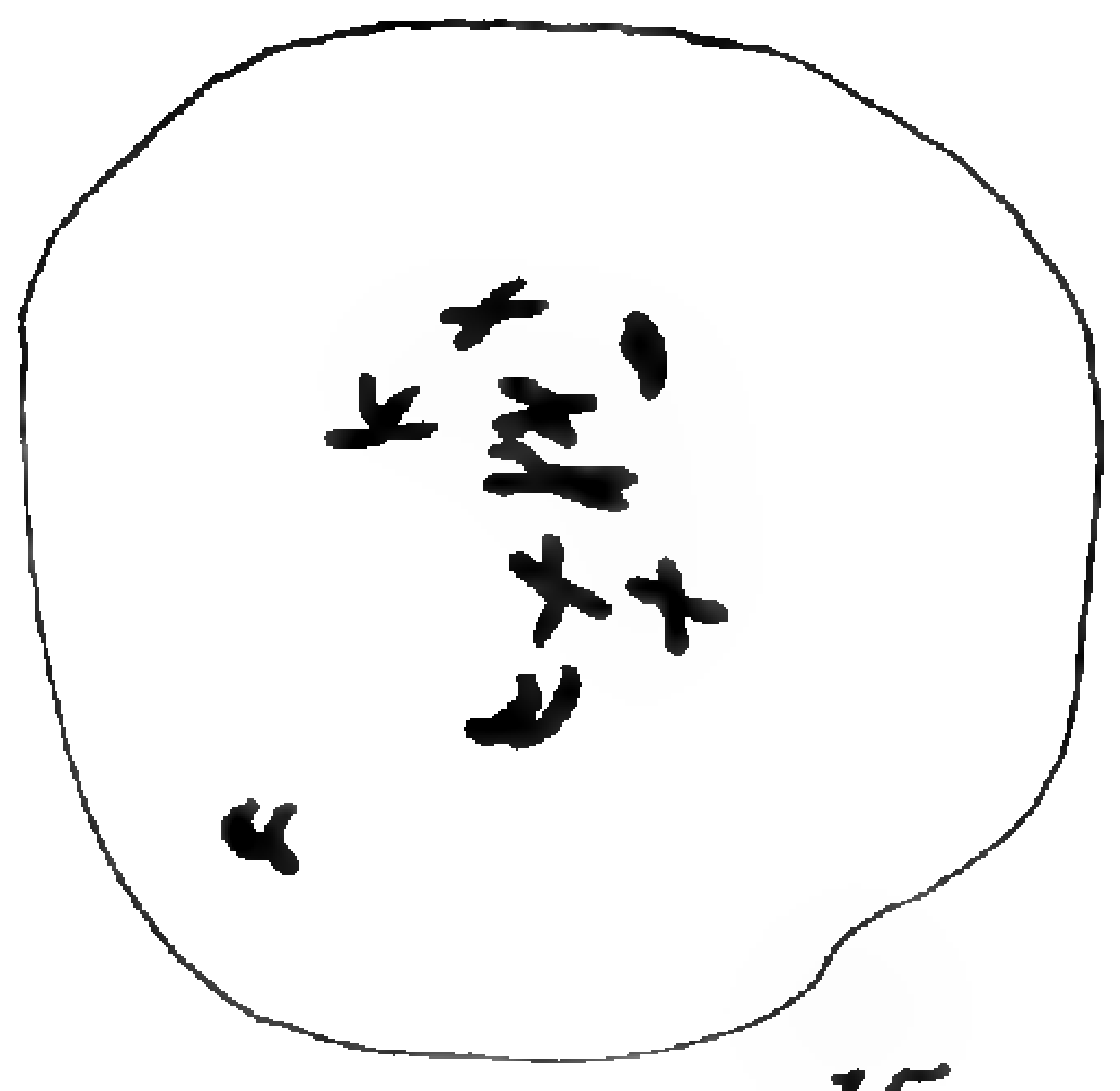

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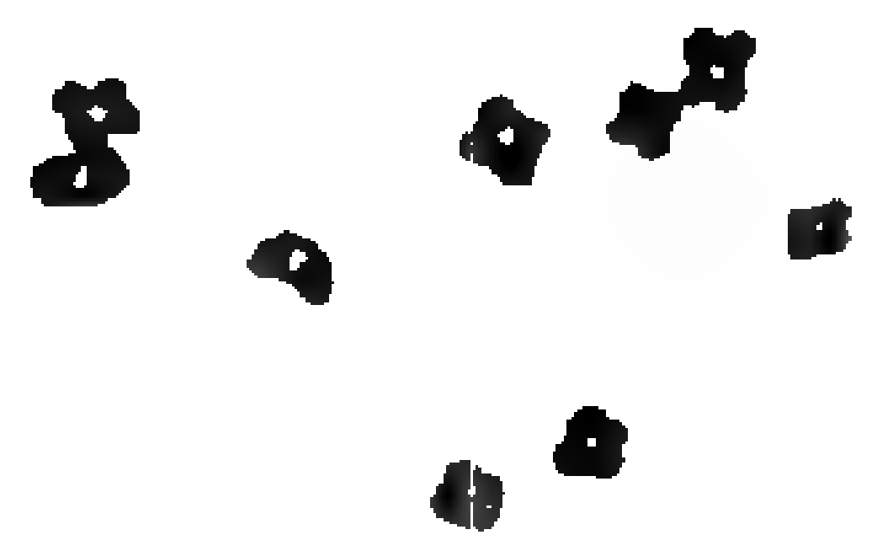

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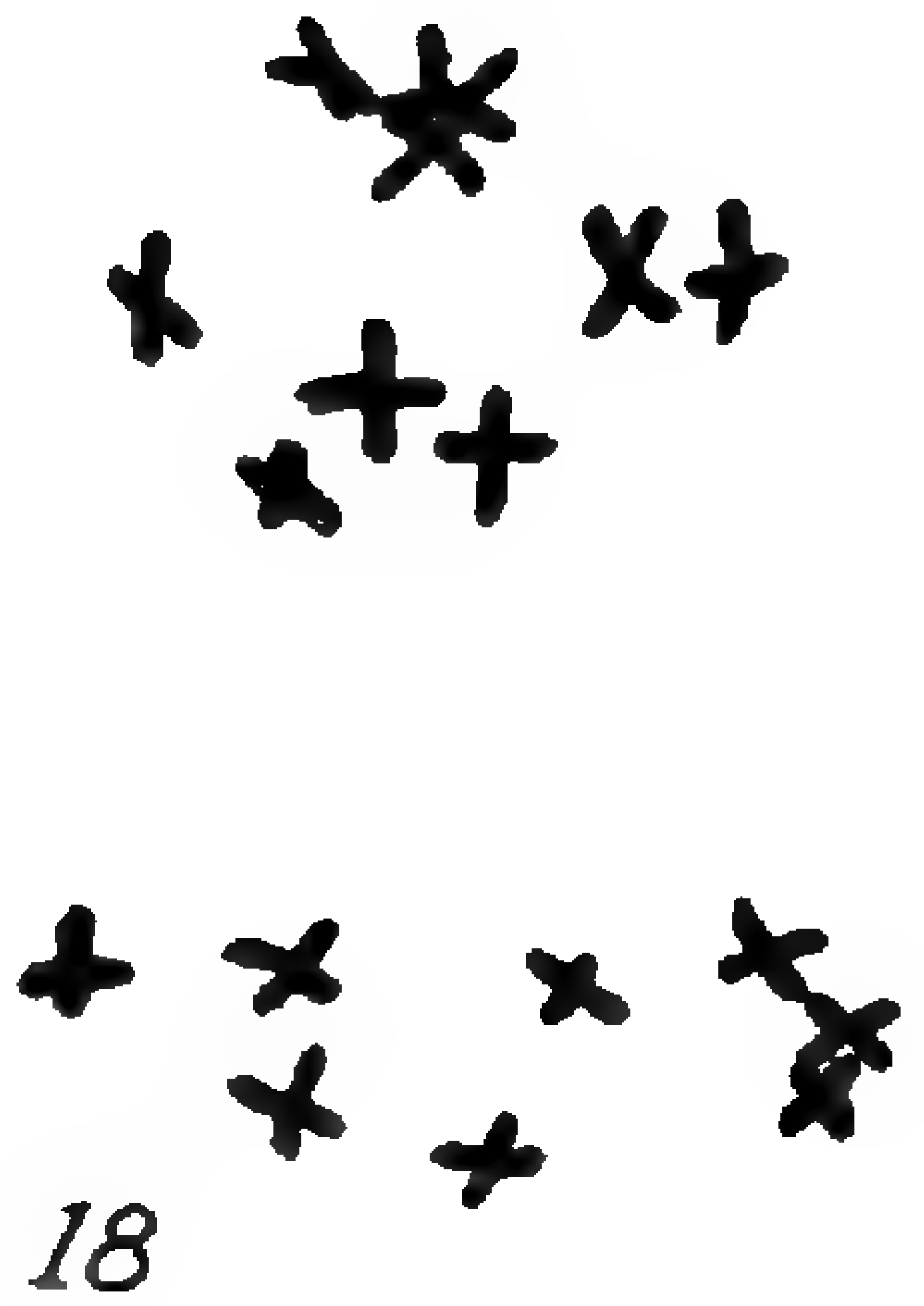
17



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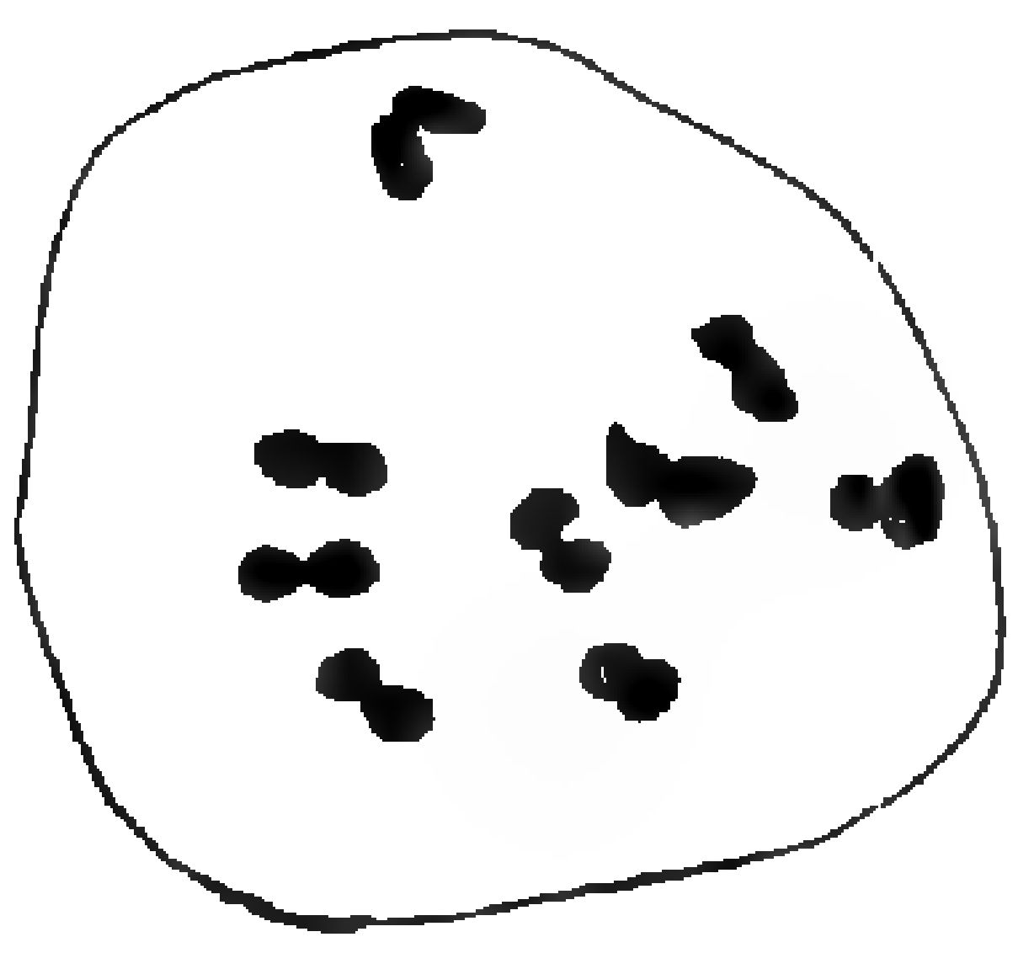

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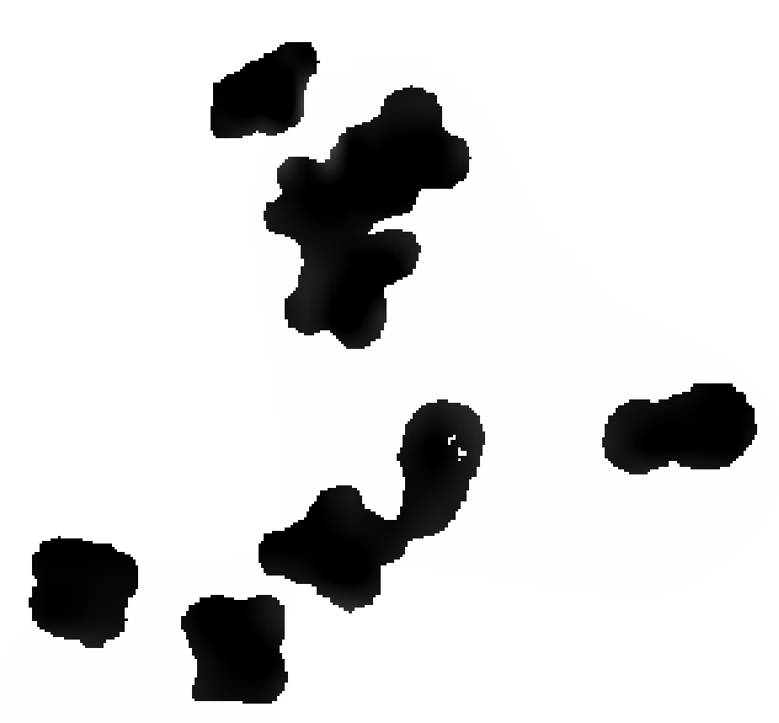

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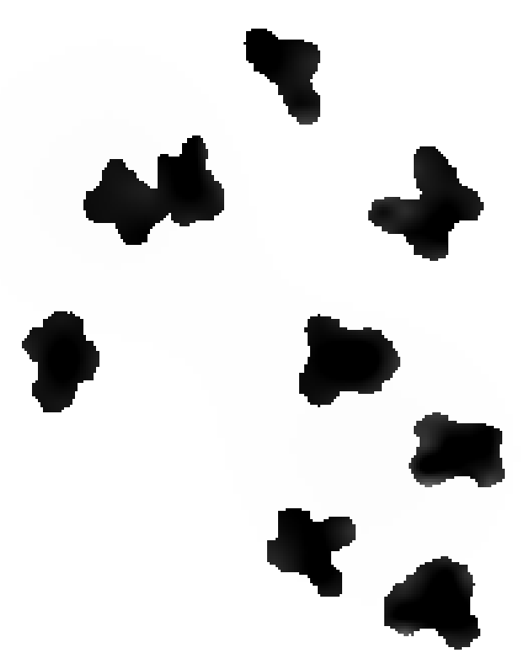

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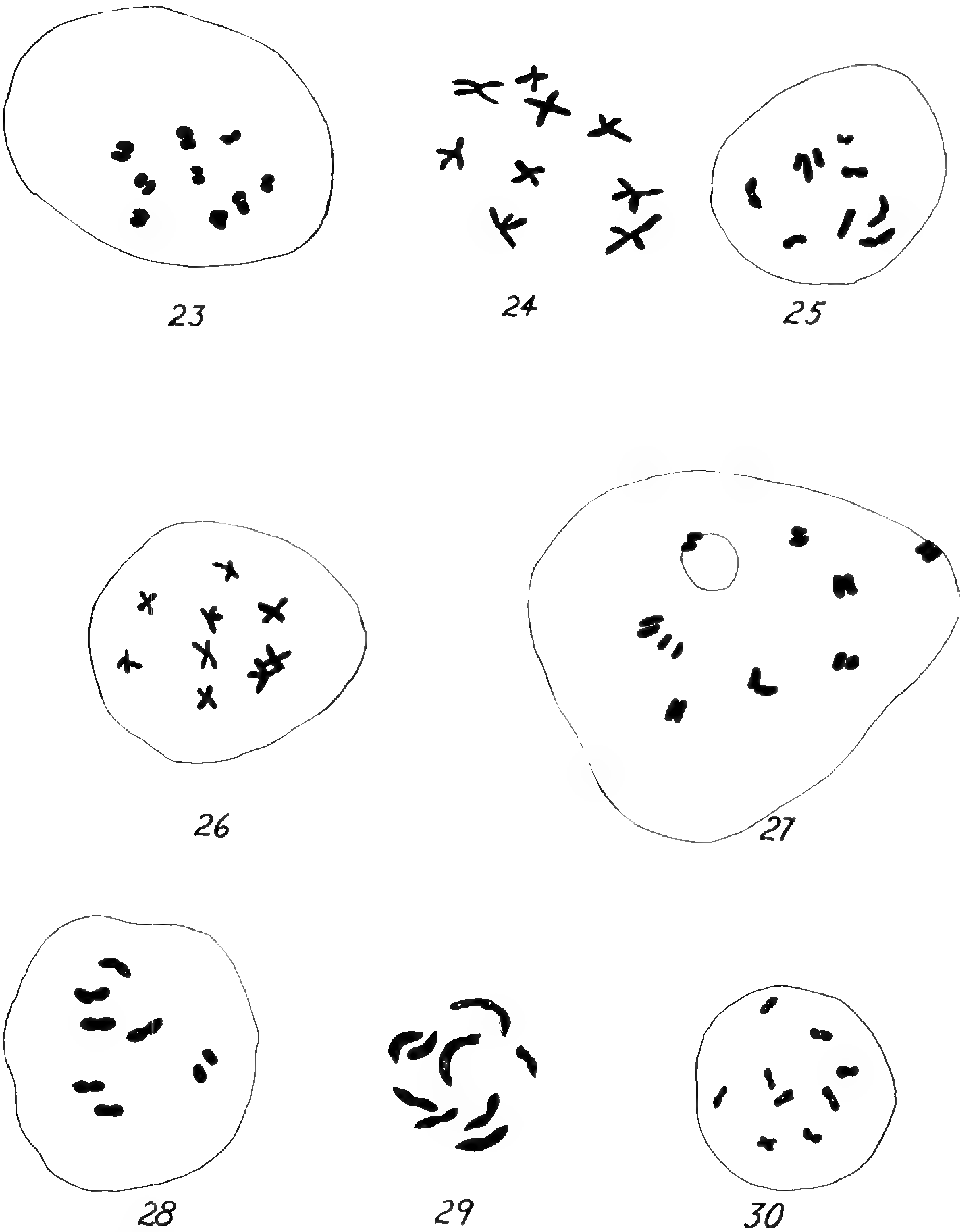
22

13. *Xyris jupicai* Rich. *FLORIDA.* LIBERTY CO.: *Kral 19322;* NASSAU CO.: *Kral 18624A;* VOLUSIA CO.: *Kral 18466;* WALTON CO.: *Kral 18368. GEORGIA.* MCINTOSH CO.: *Kral 18751. LOUISIANA.* LINCOLN PARISH: *Kral 19401.*
14. *Xyris paltylepis* Chapm. *FLORIDA.* NASSAU CO.: *Kral 18618A;* VOLUSIA CO.: *Kral 18447;* WALTON CO.: *Kral 19367. GEORGIA.* WARE CO.: *Kral 19237.*
15. *Xyris scabrifolia* Harper. FLORIDA. BAY CO.: *Kral 15631.*
16. *Xyris serotina* Chapm. *FLORIDA.* ESCAMBIA CO.: *Kral 17725;* LIBERTY CO.: *Kral 15688. GEORGIA.* MCINTOSH CO.: *Kral 18746A. NORTH CAROLINA.* COLUMBUS CO.: *Kral 19035.*
17. *Xyris smalliana* Nash. *FLORIDA.* ESCAMBIA CO.: *Kral 17723;* LIBERTY CO.: *Kral 15687;* MARTIN CO.: *Kral 18232. GEORGIA.* CLINCH CO.: *Kral 19224.*
18. *Xyris stricta* Chapm. *FLORIDA.* ESCAMBIA CO.: *Kral 17733;* LIBERTY CO.: *Kral 15713. GEORGIA.* MCINTOSH CO.: *Kral 18747.*
19. *Xyris torta* J. E. Smith. *LOUISIANA.* LINCOLN PARISH: *Kral 17298.* OUACHITA PARISH: *Kral 17309.* VERNON PARISH: *Kral 20669.*

Root Tips: 2N equals 18

1. *Xyris ambigua* Beyr. *FLORIDA.* SCAMBIA CO.: *Kral 17228;* SANTA ROSA CO.: *Kral 17683;* MARTIN CO.: *Kral 18213. MISSISSIPPI.* PEARL RIVER CO.: *Kral 17401.*
2. *Xyris baldwiniana* Schultes. *FLORIDA.* ESCAMBIA CO.: *Kral 17731;* LIBERTY CO.: roots were gotten from a specimen for which I have lost the population sample, but the location is 5 miles s. of Telogia. *MISSISSIPPI.* PEARL RIVER CO.: *Kral 17362.*
3. *Xyris difformis* Chapm. var. *curtissii. FLORIDA.* ESCAMBIA CO.: *Kral 17589;* SANTA ROSA CO.: *Kral 17686.*
4. *Xyris difformis* Chapm. var. *difformis. FLORIDA.* LEON CO.: *Kral 15564. MISSISSIPPI.* STONE CO.: *Kral 17405.*
5. *Xyris drummondii* Malme. *FLORIDA.* ESCAMBIA CO.: *Kral 17635;* SANTA ROSA CO.: *Kral 17687.*
6. *Xyris elliottii* Chapm. *FLORIDA.* ESCAMBIA CO.: *Kral 17729;* MARTIN CO.: *Kral 18234.*
7. *Xyris fimbriata* Ell. *FLORIDA.* LEON CO.: *Kral 15552.*
8. *Xyris iridifolia* Chapm. *FLORIDA.* LIBERTY CO.: *Kral 15687;* ESCAMBIA CO.: *Kral 17724.*
9. *Xyris isoetifolia* Kral. *FLORIDA.* BAY CO.: *Kral 15651* (type locality).
10. *Xyris jupicai* Rich. *FLORIDA.* ESCAMBIA CO.: *Kral 17727;* LIBERTY CO.: *Kral 19322;* MARTIN CO.: *Kral 18233.*
11. *Xyris platylepis* Chapm. *FLORIDA.* LEON CO.: *Kral 15554B;* MARTIN CO.: collected Dec. 1962 from 5 mi. n. Stuart, and grown in greenhouse at Louisiana Tech.



MEIOTIC CHROMOSOMES OF XYRIS. 23. *X. iridifolia* (metaphase I). 24. *X. iridifolia* (prophase I). 25. *X. fimbriata* (metaphase I). 26. *X. smalliana* (prophase I). 27. *X. stricta* (prophase I). 28. *X. difformis* var. *curtissii* (metaphase I). 29. *X. difformis* var. *floridana* (metaphase I). 30. *X. difformis* var. *difformis* (metaphase I).

12. *Xyris serotina* Chapm. *FLORIDA.* ESCAMBIA CO.: *Kral 17725;* LIBERTY CO.: *Kral 15687;* BAY CO.: *Kral 15652.*
13. *Xyris smalliana* Nash. *FLORIDA.* ESCAMBIA CO.: *Kral 17733;* LIBERTY CO.: *Kral 15713.*
14. *Xyris stricta* Chapm. *FLORIDA.* ESCAMBIA CO.: *Kral 17733;* LIBERTY CO.: *Kral 15713.*

For location of voucher specimens of the above numbers, please consult the mimeographed list of exsiccatae. The writer will be happy to lend specimens of any or all of the above to any other person interested in this genus.

ECOLOGY

As mentioned already, all species of *Xyris* thrive in warm climate, on high hydroperiod soils which are at least slightly acid; thus the most ideal situation for them in North America is the Atlantic and Gulf Coastal Plain of the southern United States. One notices, in travelling the Coastal Plain (exclusive of the Mississippi Embayment) east toward the Atlantic or from the upper terraces toward the lower terraces that the character of soil texture of the majority of wetlands habitats becomes progressively coarser. There are, to be sure, islands of coarser soil inland, as well as interruptions toward the present coast produced by floodplains and deltas of river systems, but the overall trend is toward larger particle sizes in the lower, more recently emergent terraces. Thus, in the lower parts of the Gulf and Atlantic Coastal Plains and in almost all of the Florida peninsula the soils are almost exclusively sands or sandy peat. Of the *Xyris* some *(X. baldwiniana, X. difformis* var. *difformis, X. scabrifolia, X. drummondii, X. torta, X. serotina, X. stricta, X. iridifolia)* appear to show an affinity for finer textured, heavier bog soils and are thus more abundant inland or to the west in the Coastal Plain or appear on wet, fine-textured alluvial situations toward the coast *(X. difformis* var. *difformis, X. serotina, X. stricta, X. iridifolia).* Others *(X. brevifolia, X. flabelliformis, X. elliottii, X. longisepala, X. smalliana, X. difformis* var. *floridana, X. platylepis, X. fimbriata)* appear to be most concentrated on coarser textured, sandier, substrata, hence are usually found closer to the present coast or in peninsular Florida. Still others are not yet well enough known even for such speculative comment, or appear to occur with frequency in either sort of situation *(X. caroliniana, X. difformis* var. *curtissii, X. ambigua, X. jupicai).*

In view of the above statements about soil texture, the greatest number of species of *Xyris* ought to be found in any area of the lower Coastal Plain which has the most diversity of acid lowland soils; this would logically be where sandy pine flatwoods are crossed by one of the major rivers of the Gulf or Atlantic Coastal Plain east of the Mississippi. Some of my best collecting localities have been: George County, Mississippi, along the Escatawpa River; Escambia County, Florida, toward the bay from Pensacola; Franklin County, Florida, in the pine flatwoods and titi swamps along the Apalachicola River, where Dr. Chapman once sought *Xyris;* McIntosh County, Georgia, in the pine flatwoods of the lower Altamaha basin; Bryan County, Georgia and Jasper County, South Carolina, in the pine and cypress flatwoods adjoining the Ogeechee and Savannah Rivers. One locality from any of the areas mentioned above should reward a thorough collector with a majority of the species treated in this work, particularly if the locality has undergone some mechanical disturbance exclusive of draining. One cannot help but wonder at the subtleties of habitat which would enable this many species to occupy an area which superficially seems so monotonous. Is it possible that man, by disturbing such habitats through logging, road building, and bulldozing, has created some additional niches? If he has not, at least he has created situations in which large numbers of niches are contracted into a small space.

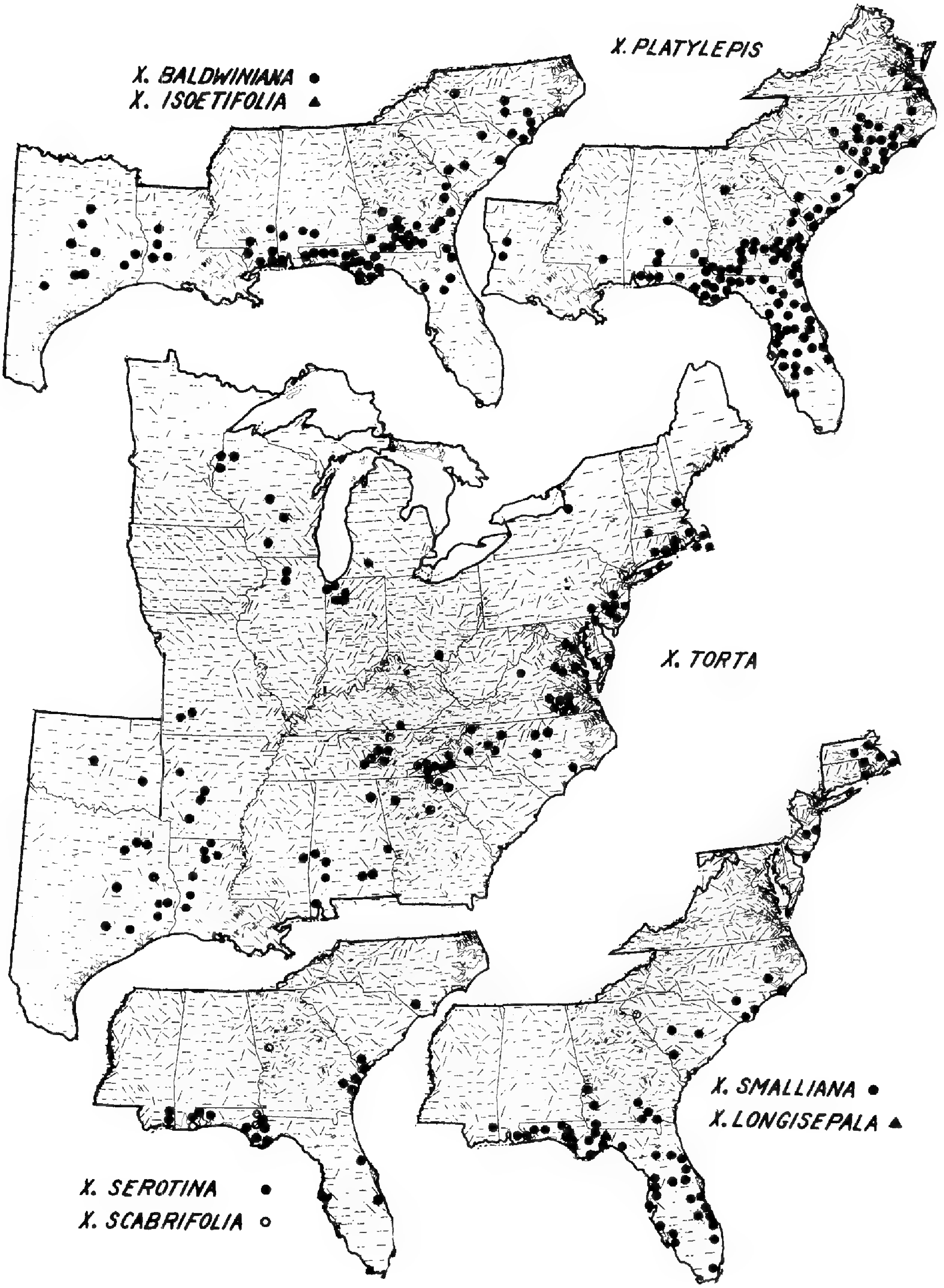
An excellent example for ecological study would be a locality which I encountered in the vicinity of Myrtle Grove, on the west side of Pensacola (ca. 2 mi. s. junction US 98 and county 289A near Myrtle Grove, w. of Pensacola, Escambia County, Florida). This locality is being engulfed rapidly by the City, much of it being converted into suburbia. The substratum is a sandy peat or peat muck. Borrow pits are frequent and provide considerable acreages of exposed, shallow, maroon-tinted water. Roadside ditches and drainage ditches are deep in order that the superabundant groundwater may drain adequately and are of particular interest ecologically because they traverse extremes of habitat, namely cypress domes, hardwood bottoms, titi and pine flatwoods, all of which have their own communities of species of *Xyris*. Before construction of such ditches a few inches of relief would probably have had a lineal expression of hundreds of yards; after construction, many ground-water environments are brought into such close proximity that plants of very high hydroperiod soils are brought within a few feet of plants of relatively low hydroperiod soils because of the production of a relief that did not previously exist. An additional factor is developed in that woody plants which ordinarily form dense thickets along flatwoods streams *(Lyonia, Cliftonia, Cyrilla, Magnolia, Osmanthus, Persea* etc.) and form a shade barrier to the mixing of streambank and flatwoods plants, are removed. In short, the result of all this man-made activity is the production of a habitat so composite and complex that the difference of as much as a few inches of elevation of ditchbank may mean the limit between the zone of one species of *Xyris* and that of another. In this particular locality, a line from one edge of a ditch to the other (approximately 15 feet wide and 6 feet deep) would traverse the habitats of 16 entities of *Xyris,* many of which are beautifully zoned along the ditch. According to my field notes the species zones crossed from the rim of the ditch to the submersed centre are as follows:

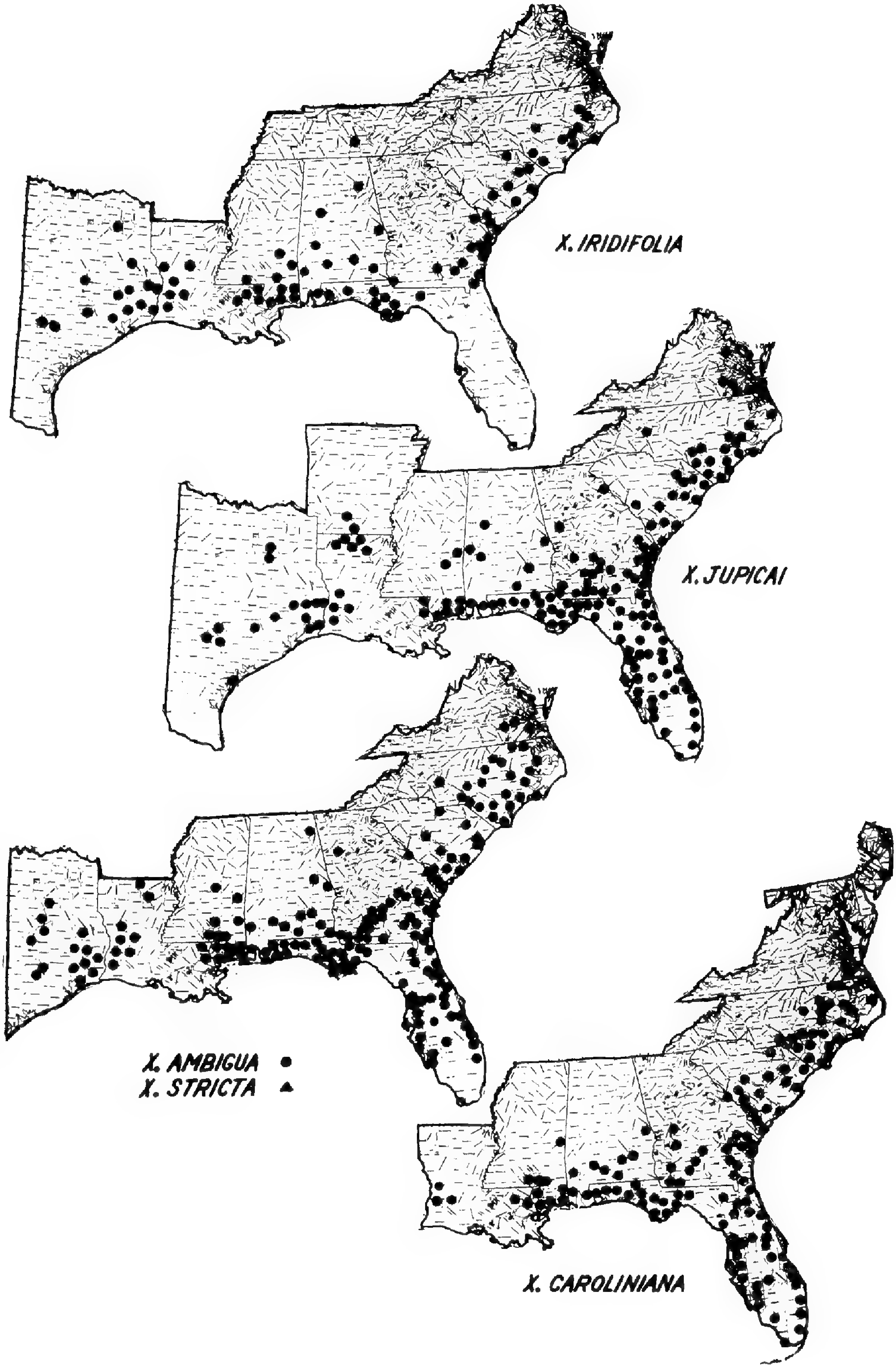
a. *Xyris caroliniana* (high bank)
b. *Xyris flabelliformis, X. brevifolia* (moist upper bank & seepage)
c. *Xyris elliottii, X. baldwiniana, X. ambigua* (lower bank)
d. *Xyris difformis* var. *curtissii, X. drummondii, X. ambigua, X. jupicai* (bank)
e. *Xyris jupicai, X. stricta, X. smalliana, X. serotina* (shallow water)
f. *Xyris smalliana, X. stricta, X. fimbriata* (deeper water)
g. *Xyris iridifolia* (deepest water), sometimes accompanied by *X. smalliana* or *X. fimbriata.*

Such areas are interesting enough to study for days on end; I spent the better part of a day watching these plants noting that all during that time some species or another was opening or closing its flowers and that even these flowers showed differences not remarked on since the time of Dr. Chapman.

However, in retrospect and after having seen many such localities, I am most of all impressed by the fact that all of these cohabitants are so amazingly uniform despite the fineness of the characteristics which distinguish them. In short, hybrid swarms appear to be rare in this genus. A year previously I had suspected that *X. stricta,* invariably in association with *X. ambigua* and *X. iridifolia* in such disturbed sites, and so intermediate in its morphology, must be an F-1 hybrid of the two. Yet seed of it, germinated successfully in the greenhouse, grew up to flowering size in a year to produce an astoundingly similar set of plants rather than the expected segregates; progeny tests of *X. serotina* Chapm., another entity suspected of being hybrid, will probably be quite uniform. Thus I am treating both as species for the time being, while suspecting them as possible apomicts. Later studies will be made of these two, also the complex here treated as *X. difformis* Chapm. If evidence develops that apomixis is frequent in *Xyris,* it would have to be the sort that generates amazingly similar populations over a range extending from at least southern North Carolina south to north Florida and west to Mississippi.

A field study of southern *Xyris* is insight into the fact that some are rapidly increasing their range. These appear to be species which a) have the broadest tolerances as to substratum and moisture and which would b) most quickly occupy disturbed areas of wet ground such as roadside ditches or drainage canals along which great distances could be covered rapidly. Such a species is *X. jupicai,* which appears equally at home on silty or clay alluvium or wet sands. It is not unlikely that, since the creation of our extensive system of roads and canals which interconnect the wetlands of the Coastal Plain, the total area of *X. jupicai* has increased many times. I have so far seen this plant in quantity in undisturbed situations only in peninsular Florida (a possible center for its dispersal in the U.S.); elsewhere it is most commonly found in borrow pits, around farm ponds, but especially in roadside ditches where it may actually be the only species found for miles. Other


X. BALDWINIANA ●
X. ISOETIFOLIA ▲
X. PLATYLEPIS
X. TORTA
X. SMALLIANA ●
X. LONGISEPALA ▲
X. SEROTINA ●
X. SCABRIFOLIA ○

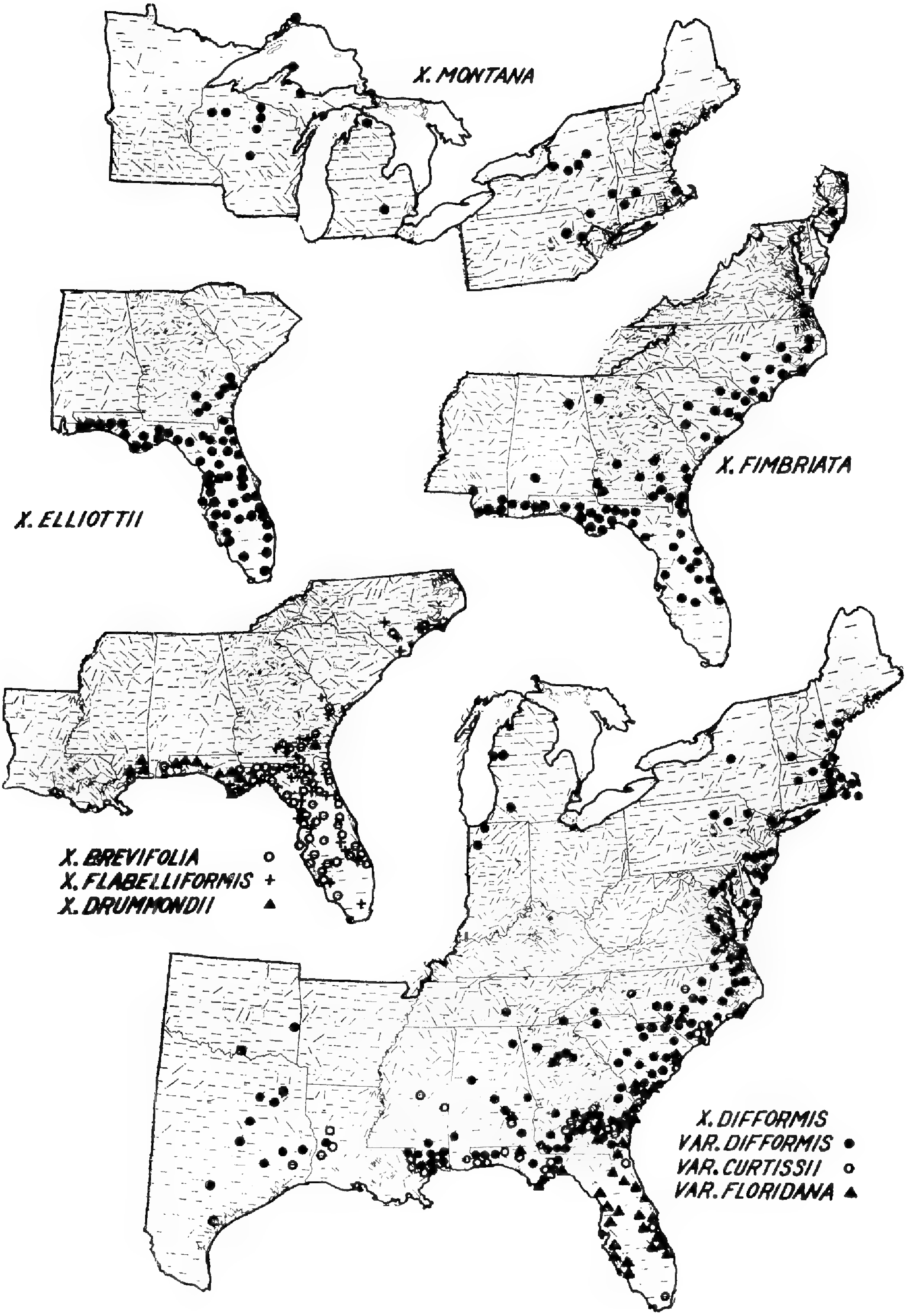


X. IRIDIFOLIA

X. JUPICAI

X. AMBIGUA ●
X. STRICTA ▲

X. CAROLINIANA


X. MONTANA
X. ELLIOTTII
X. FIMBRIATA
X. BREVIFOLIA ○
X. FLABELLIFORMIS +
X. DRUMMONDII ▲
X. DIFFORMIS
VAR. DIFFORMIS ●
VAR. CURTISSII ○
VAR. FLORIDANA ▲

species of alluvial substrata which appear to be rapidly moving are *X. iridifolia* and *X. difformis*. Still others, capable of being weeds on sandy substrata *(X. flabelliformis, X. brevifolia, X. elliottii)* fade out of the picture on heavy substrata. Much yet remains to be learned about the mode of dispersal of such plants.

BASES FOR THE CATEGORISATION OF XYRIS

As commented on earlier, in other sections of this paper, the *Xyris* of the southern Coastal Plain of the United States appear to be quite similar cytologically, are often weedy and prone to cohabit disturbed areas, and are in many regards very similar in floral morphology. Yet it also appears to be true that the differences in morphology which do exist are seemingly unaltered when the species do mix populations. It is possible that they are prevented from hybridisation by external isolating barriers such as the following:

1. Differences in flowering times. Some species *(X. flabelliformis, X. brevifolia, X. baldwiniana, X. elliottii,* and *X. torta)* are usually through flowering and are setting fruit by the time the others begin to bloom. Some species flower in the morning; others bloom later in the morning at a time when early bloomers are closing up, while still others bloom in midday or afternoon. Of course, still more needs to be discovered about time of day of flowering in that many species doubtlessly change their time in relation to change in day length.
2. Differences in habitat. These have been discussed in the section on ecology.
3. Differences in distribution. E.g. *X. torta* has a center of distribution well inland from that of most of the other species; of the dwarf species of *Xyris, X. drummondii* is the only one occurring mainly on the higher terraces of the Gulf Coastal Plain, the other two being seldom far from the present coast. Where populations of all three do overlap (in the vicinity of Pensacola) it is separated from the other two by being distinct in its season of flowering.

The above and doubtlessly many more factors must certainly influence the number of opportunities for exchange of pollen between species, and play a prominent role in influencing the philosophy of this study.

The criteria on which designation of rank of taxa is based are as follows:

a. Species of *Xyris* are those entities which appear to have the same range of characteristics whether they be in pure stands or mixed with populations of other species.

b. Species of *Xyris* are those entities whose reactions to the vagaries of external environment have been observed many times over to move in predictable (if not precisely measurable) patterns. This rules out the designation as species of such natural variations as disturbance reactions.

c. Varieties of *Xyris* are those entities which have an ecological or geographical correlation to their morphologies but which nonetheless maintain their character under the influence of a contrived, uniform, habitat (Greenhouse).

The above criteria are few, but demonstrable.

CITATION OF SPECIES EXAMINED

A complete citation of all specimens examined during the course of this study would be exhaustively long and quite expensive. I am therefore compiling a separate, mimeographed list of specimens recently collected and distributed by Godfrey, Demaree or myself. The reason for such a move is to make available to the reader a large, recently collected, store of carefully documented specimens. My own samples are often of 25 or more plants; many exceed 10; each specimen represents a separate plant in a population, not a splitting up of a few large plants. Sampling was done in short strips through dense stands; along such strips all plants were pressed which had reached flowering and fruiting size, regardless of their size or quality. Therefore some recipients of exsiccatae may not be overjoyed, but they might write the holders of the other duplicates and thus have the entire sample on loan.

A list of specimens loaned to the author and which also form a part of the basis for this study is being prepared and will eventually be available upon request.

SYSTEMATIC TREATMENT

XYRIS (Sect. *Xyris)* L., Sp. Pl. 42. 1753.—Gen. (ed. 5) 25. 1754. (There credited to Gronovius.)

Kotsjilettia Adans., Fam. Pl. 2: 60. 544. 1763.

Perennial, tufted or solitary, scapose herbs from short, soft, fibrous or bulbous bases, the roots fibrous, but fleshy. Leaves basal, tufted, equitant, distichous, the blades linear or terete-filiform, the bases abruptly or gradually dilated. Inflorescence a contracted, compact, bracteate, cone-like spike, the bracts spirally arranged. Flowers perfect, zygomorphic, in the axils of leathery or chaffy, imbricate, bracts, the perianth members all separate, the corolla ephemeral. Calyx of three members; the inner two boat-like, chaffy, keeled, and persistent, the outer one membranaceous, and covering the flower in bud. Corolla of three subequal members each comprised of a broad, yellow or white blade, and a long narrow claw which is concealed by the subtending bract. Stamens three, adnate to the corolla by their filament bases, the anthers divided into two thecae by the broad connective; staminodia three, alternating with the petals, bifid, their margins simple or lined with multicellular trichomes. Ovary superior, 3-parietal, with the placentae somewhat intruding toward their apices; style 3-branched above, the branches each conduplicately folded and terminating in a truncate, short-bearded, stigma. Fruit capsular, oblong-compressed, the thin pericarp with valvular or irregular dehiscence. Seeds small, striate or striate-reticulate, ovoid, ellipsoidal, or fusiform, usually apiculate or caudate.

Type Species. X. indica L.

1. Keel of lateral sepals ciliate or fimbriate.
   2. Tips of lateral sepals exserted beyond the subtending bract, fimbriate (usually crisped); spikes seldom shorter than 1 cm.; seeds seldom shorter than 0.8 mm. fusiform, with broad, flat, longitudinal ridges; sheathes of the scape exceeded by the leaves.
      3. Scape ridges conspicuous, harsh to the touch; spikes ovoid or broadly ellipsoidal, dull brown; bases of leaves soft, straw-coloured to pale green or pinkish; flowers opening in the morning; plants of very wet substrata, the bases often submersed. . . . . 14. *X. fimbriata* Ell.
      3. Scape ridges lower, less conspicuous, smooth (minutely tuberculate or papillose under magnification); spikes narrowly ellipsoidal or lance ovoid, comparatively lustrous; bases of leaves swollen, bulbous, a lustrous chestnut-brown, deeply sunken in the substratum; flowers usually opening in the afternoon; plants of moist, but certainly not wet, substrates. . . . . 10. *X. caroliniana* Walt.
   2. Tips of lateral sepals not exserted beyond the subtending bract and not fimbriate (in old or dried spikes the lateral sepals may separate from the bracts and appear to be exserted, but exsertion is supposed to mean that bracts are shorter than sepals); seed lengths and shapes various, but the seeds without broad, flat, longitudinal ridges; sheath lengths various.
      4. Sheathes of the scapes longer than, or equal in length to, the longer leaves.
         5. The sheathes of the mature scapes as long as or slightly shorter than most of the main foliage leaves.
            6. Leaf bases with tinges of pink or lavender, the surfaces papillose or tuberculate-scabrid; seeds fusiform or narrowly ovoid-caudate, 0.8-1.0 mm. long; leaves narrowly linear, ascending, the margins prominently papillose or tuberculate; lateral sepals slightly curved, narrow, the narrow keel smooth below, sparsely ciliate toward its apex; plants of coldwater sphagnous situations of the boreal forest region. . . . . 22. *X. montana* Ries
            6. Leaf bases marked by dark, chestnut-brown basal "patch," the leaf surface usually smooth; seeds ovoid, ca 0.5 mm. long; leaves broadly linear, usually flabellately arranged; lateral sepals strongly curvate, the keel regularly ciliate almost from the base to the apex; bog plants, very local, from the Gulf Coastal Plain. . . . . 1. *X. drummondii* Malme
         5. Sheathes of the scapes surpassing most or all of the larger leaves.
            7. Leaves flabellately arranged or ascending, usually narrowly

linear; plants characteristically in brown-based clumps of a large number of scapes, the living leaves characteristically green above a stramineous, brown, green or pinkish base; spikes broadly ovoid, but more often globose or hemisphaerical or turbinate, the bracts with thin, erose, maroon or reddish-brown, lacerate borders, keelless; lateral sepals linear-curvate, the keels entire or with distant papillae or ciliae (tips of lateral sepals may resemble tips of upper bracts in being thin, erose, and coloured). . . 2. *X. brevifolia* Michx.

7. Leaves flabellately arranged, broadly linear-curvate; plants characteristically solitary or in small tufts of few scapes (often the leaves are curved toward or flattened against, the sandy substratum, or buried partially in it); living leaves characteristically maroon, save for a pale, scarious margin along the equitant portion; spikes ovoid, acute, the bracts often keeled, the bract margins not differently coloured or coloured only at the very apex, entire or subentire; lateral sepals curvate or sigmoid, the wings broad, the keel ciliate-scabrid (this species may be distinguished during the winter rosette stage by its deep maroon, diminutive, curvate fans of leaves in contrast to the straighter, narrower, usually greener, leaves of *X. brevifolia*). . . . 3. *X. flabelliformis* Chapm.

4. Sheathes of the scape definitely exceeded by the main foliage leaves.

8. Mature spikes 1 cm. long or longer, the larger leaves 10 cm. long or longer; sheathes of the scape with short-cusplike blades.

9. Leaves ascending, twisted, strongly grooved; spikes ovoid, the bracts and lateral sepals with a small apical tuft of short, reddish-brown hairs; bases of leaves abruptly expanded, pinkish or purplish, becoming dark brown, the bases of the plants therefore bulbous and the outermost leaves often scale-like. . . . . . . 13. *X. torta.* J. E. Sm.

9. Leaves spreading, scarcely twisted; spikes narrowly ovoid, ellipsoidal or oblong; bracts and sepals not as above; bases of leaves longitudinally striate (the innermost fresh leaf bases white, the striae in sharp dark contrast) and with the bases of the plants often invested by a stubble or ramentum of fibrous dead leaf bases.

10. Seed farinose, dark when dry and ripe; spikes oblong-cylindric; plant bases maroon, purplish, dark-brown or reddish-brown, usually caespitose on muddy, often submersed substrata; leaves narrowly linear, gradually tapering from the equitant base to tip; petal blades sharply cuneate, 0.5 cm. long, or less, opening about midday. . . . . 8. *X. stricta* Chapm.

10. Seed transluscent, usually paler when dry and ripe; spikes lance-ovoid or ellipsoidal; plant bases usually paler in colour, usually in small clumps or solitary on moist but seldom mucky substrata; the leaves shorter, broader, more flabellately spreading; petal blades obovate, about twice the size of those of *X. stricta,* opening in early morning, closing toward midday. . . . . . . 7. *X. ambigua* Beyr.

8. Mature spikes never 1 cm. long, usually few-flowered; leaves seldom 10 cm. long; blades of scape sheathes short or elongate.

11. Leaf bases pinkish, the leaf surfaces papillose and/or tuberculate-scabrid; seeds 0.8-1.0 mm. long, fusiform; blades of scape sheathes elongate; plants of coldwater, sphagnous, northern bogs. . . . . 22. *X. montana* Ries

11. Leaf bases generally brownish or tan, lustrous, smoothish; seeds not longer than 0.5 mm., ellipsoidal; densely tufted, filiform-leaved plants similar in general appearance to *X. baldwiniana* and so far known only from Washington and Bay counties, Florida. . . . . 6. *X. isoetifolia* Kral

1. Keel of lateral sepals lacerate, usually quite thin, rarely entire.

12. Leaves narrowly linear or filiform, the blades gradually expanding below into lustrous, rich-brown or tan, hard bases; the plants densely caespitose, the spikes ovoid and seldom longer than 1 cm.

13. Leaves linear, flattened in the cross-section of the blade, and with an evident, paler and incrassate, pargin; scape usually narrower than the leaf blades (save for some filiform-leaved populations in southern peninsular Florida), often 2-edged above; staminodia bearded; seeds ellipsoidal, seldom longer than 0.6 mm. . . . . 4. *X. elliottii* Chapm.

13. Leaves filiform, terete to broadly elliptic or blocky in the cross section of the blade and without an evident, incrassate pale margin; scape at least as broad as, usually broader than, the leaf blades, and terete or but slightly edged at one spike-length below a spike; staminodia beardless; seeds narrowly ellipsoidal, nearly 1 mm. long. . . . . 5. *X. baldwiniana* Schultes

12. Leaves broader or not as above, the leaf bases softer or of a different colour; the plants or spikes not as above.

14. Lateral sepals exserted beyond the tips of subtending bracts.

15. Plants densely caespitose, the plant bases pinkish, tuberculate scabrid or papillose, the leaf blades seldom broader than 2 mm., the scape ridges tuberculate-scabrid or papillose; plants of sphagnous boreal lakes and bogs, the spikes usually less than 7 mm. long. . . . . 22. *X. montana* Ries

15. Plants not densely caespitose, the plant bases, if pinkish, smooth, the leaf blades not often as narrow as 2 mm., the scape ridges smooth or remotely papillose; more robust plants of sandy bogs and lakeshores of the Atlantic and Gulf coastal plain.

16. Ripe seeds ellipsoidal, dark amber, not longer than 0.6 mm., the longitudinal and cross-lines conspicuous and fairly regular; thus the alveolae regularly rectangular; keel of the lateral sepals tending to be ciliate toward its base, lacerate above toward the tips. . . . . . . 16. *X. longisepala* Kral

16. Ripe seeds narrowly ovoid or oblong, never as short as 0.6 mm., the longitudinal and cross-lines conspicuous but not so regularly disposed and generally forming broader alveolae; base of keels of lateral sepals lacerate. . . . . 15. *X. smalliana* Nash

14. Lateral sepals included, hidden by the subtending bracts.

17. The bases of the leaves rather abruptly expanded into thickened, flaring, equitant zones, thus the plants bulbous-based (the outer leaves are often shorter, darker, scale-like); scapes often flexuous, usually quite twisted; green, upper portion of leaf blades often conspicuously twisted; flowers opening in the afternoon.

18. Leaf and scape surfaces smooth or scabrous only along the margins and ridges; petals blades obovate; spikes commonly oblong or narrowly ovoid; plant bases pinkish; seeds ovoid, seldom longer than 0.6 mm. . . 11. *X. platylepis* Chapm.

18. Leaf and scape surfaces prominently papillose or tuberculate-scabrid, thus the foliage having a "glazed" look; bases of young or flowering plants pinkish or purplish; petals blades suborbicular; seeds narrowly ovoid or narrowly ellipsoidal, about 1 mm. long. . . . . . . 12. *X. scabrifolia* Harper

17. The bases of the leaves and the plant bases not as above; scapes usually not flexuous, the blades not conspicuously twisted; flowers opening in the early or late morning.

19. Plant bases pinkish or purplish.

20. Summit of scape quite evidently flattened and broad relative to the spike (at least on living specimens); scape ridges few, usually 2 or 3, the 2 most prominent ones along the scape edges . . . therefore the upper scape narrowly ellipsoidal or fusiform in the cross section; plants commonly of wet situations, sunny or shaded, in creek or river bottoms, titi swamps, cypress swamps, or rooted in muck of flowing water ditches, in fact almost always on fine-textured wet substrata; foliage of the plants smooth, a very deep, rich green, save for the reddish or purplish color of the leaf bases.

21. The two principal scape ridges noticeably and abruptly flattened and wing-like below the spike and in the plane of the flattened scape, their combined width (on live specimens) broader than the scape, thus the outline of

the cross section of the scape bi-caudate (from N.J. north, the scape ridges become narrower); fruiting spikes seldom longer than 1.5 cm., ovoid, acute; seeds translucent, ovoid or ellipsoidal, seldom longer than 0.6 mm. . . . . 19. X. *difformis* Chapm. var. *difformis*

21. The two principal scape ridges not abruptly flattened, the scape itself flattened and 2-edged and, in cross section narrowly elliptic; fruiting spikes seldom shorter than 1.5 cm., broadly ellipsoidal or oblong, blunt; seeds farinose, dark when ripe, fusiform or narrowly oblong and never as short as 0.6 mm. (when this species is mixed with the above, as it often is, it is a noticeably larger, broader leaved and scaped, plant). . . . . 17. X. *iridifolia* Chapm.

20. Summit of scape not flattened and broad relative to the spike, the scape ridges usually more than 3 and therefore the upper scape broadly oval or almost round in outline (save for projecting ridges); habitats diverse, usually not alluvial; foliage pinkish or purplish-based but the surfaces, particularly of the outermost leaves papillose or tuberculate-scabrid.

22. Seeds farinose or very dark, thus opaque; mature spikes ovoid, acute; plants, (save for depauperate specimens) seldom shorter than 2 dm.; solitary or in small tufts; an entity of low, acid pine flatwoods and pine flatwoods ditches, but particularly on recently disturbed, acid moist sands of the lower terraces of the Coastal Plain, n. to N.C., west to eastern La. . . . . . . 21. X. *difformis* Chapm. var. *floridana* Kral

22. Seeds not farinose, transluscent (save on extremely old herbarium specimens); mature plants seldom taller than 2 dm. (sometimes taller in northern U.S.), usually in large tufts; mature spikes narrowly to broadly ellipsoidal or ovoid, blunt or acute.

23. Leaves broadly linear, usually with the blade above the equitant portion gladiate; keel of lateral sepals wide, fairly thin, its margin lacerate at least toward tip; seeds ca. 0.5 mm. long, ovoid. . . . 20. X. *difformis* Chapm. var. *curtissii* (Malme) Kral

23. Leaves narrowly linear, usually with the blade above the equitant portion almost linear or tapering gradually to a narrow tip; blade of scape sheath elongate; keel of lateral sepals narrow, rather thick and dark brown, its margin entire or subentire; seeds nearly 1 mm. long, narrowly ellipsoidal and caudate. . . . . . . 22. X. *montana* Ries

19. Plant bases greenish, pale to dark-brown, or stramineous.
  24. Surfaces of leaves and scape roughened, the foliage therefore dull green, save for dark brown or charcoal coloured dead leaf bases; ridges of the scape (1 spike length below spike) at least 4; lateral sepals lacerate, dark brown; seeds farinose; plants in pale or brown-based, rigid leaved tufts on very wet substrata, the scapes seldom a third longer than the longer leaves. . . . . . 9. *X. serotina* Chapm.
  24. Surfaces of leaves and scape smoothish, the foliage therefore lustrous, and of a pale or deep green colour; scape ridges rarely as many as 4, the upper scapes 2-edged.
    25. The two primary scape ridges 1 spike length below a spike commonly flattened, often scabrous, in combination as broad as or broader than the scape (on living plants); perennial save in drought; leaves commonly spreading, the upper, non-clasping portion elliptic-linear; mature spikes ovoid to subglobose, blunt or acute; plants primarily of river swamps (often in shaded situations) of the Coastal Plain. . . . . 19. *X. difformis* Chapm. var. *difformis*
    25. The scape ridges not as above, hardly distinguishable from the somewhat flattened scape and certainly not, in combination, as broad as the upper scape; plants often annual, save on moistest warmest situations; leaves commonly ascending-linear; mature spikes narrowly ovoid to oblong, blunt; plants primarily of sunny disturbed situations or of sandy open swamps in the Coastal Plain; undoubtedly the most abundant *Xyris* of roadside ditches and comprising the weediest, most rapidly spreading species. . . . . 18. *X. jupicai* L. C. Rich

1. XYRIS DRUMMONDII Malme, Ark. Bot. 25A: 14. 1933.

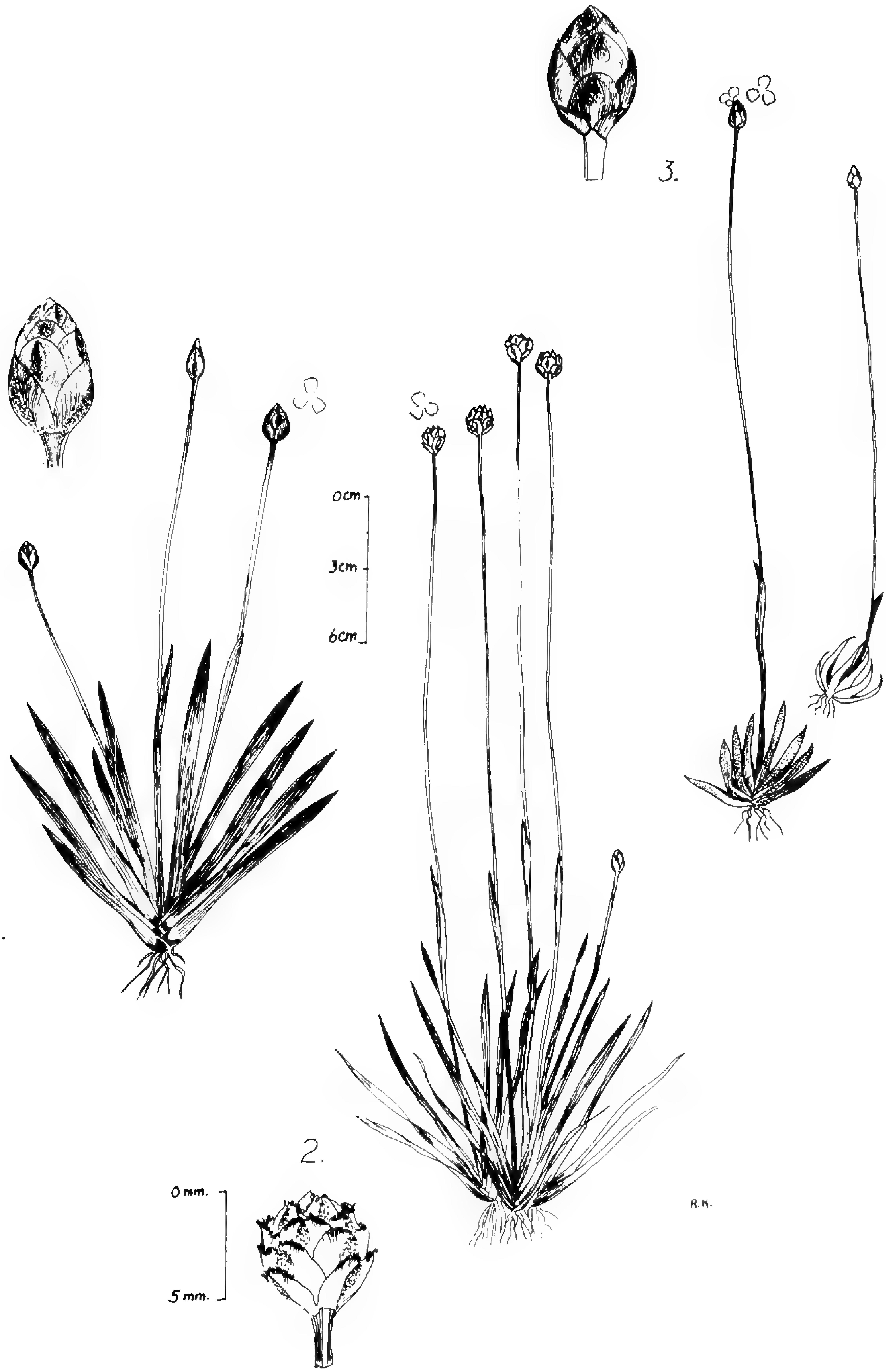
In large tufts, rarely solitary (these are usually seedlings), perennating by means of low-set lateral buds, the plant bases and often the leaf bases buried in a sandy substratum. Principal leaves broadly linear or linear-lanceolate, 3.0-8.0 (-10.0) cm. long, 1.5-5.0 mm. broad, flabellately spreading but not curvate, mostly a lustrous green, but toward the base becoming stramineous and at the very base marked with a conspicuous, dark brown or castaneous "patch." Apex of leaf acute but not curvate. Surface of leaf smooth or with low, short lines of papillae. Margin of blade above the equitant portion papillose or smooth. Sheathes of the scapes about as long as most of the leaves, tightly clasping the scape below, expanding about mid-way up into a narrow, blade-like structure, the margins joining at about 1.0 mm. below the tip. Scapes linear-filiform, sometimes flexuous 4.0-20.0 cm. long, terete and with many, low ribs below, flattened and 2-edged above. Spikes at seed bearing time lance-ovoid, of many, rather rightly imbricated bracts of which the lowest few are barren with elongate green dorsal areas. Fertile bracts suborbicular or broadly obovate, 4.0-5.0 mm. long, definitely keeled, the apex rounded or obtuse, the exposed margin thin and subentire, the outer surface tan or pale brown with a narrowly elliptic, greenish, dorsal area nearly as long as the bract (on leaf-like lowermost bracts, this dorsal area is sometimes prolonged into a pseudo-blade). Lateral sepals included, broadly curvate, the sides broad, thin, brownish, the keel broad, thickened, a lustrous brown, eviently ciliate for most of its length. Petal blades obovate, about 3 mm. long, unfolding in the morning. Seeds ellipsoidal, slightly longer than 0.3 mm., lustrous, transluscent, with 18-20 fine, evenly spaced longitudinal lines and numerous faint cross lines.

Low, moist acid sands or sandy peats of sphagnous peats of roadside ditches, pine flatwoods or disturbed lowlands, Coastal Plain, southeastern Georgia, northwestern Florida, southern Alabama and southern Mississippi.

Type. U.S.A. "ALABAMA"; collected by Drummond. Holotype deposited at K of which a phototype was examined by this writer. Some question as to the actual type locality exists in that there appears to be no actual proof that the itinerary of Drummond included Alabama. It is the opinion of Dr. L. H. Shinners and of Dr. S. W. Geiser (oral communication) that the original label or documentation could have been modified from one of two abbreviations, i.e., "Fla." or "La." During the first part of the 19th century the boundaries of Florida, Alabama, Mississippi and Louisiana underwent considerable change in that large portions of these territories comprised Indian lands whose administration vacillated between at least three governments and it was during this period that Drummond was in the country.

Ecology and Identification. While it is evident that the morphology of this species is very similar to that of *X. brevifolia* and *X. flabelliformis* it does not often mingle with these species. I have seen evidence of all three cohabiting moist sphagnous sands in the vicinity of Pensacola; however *X. drummondii* flowers in mid summer at a time well past the flowering time of most populations of the other two. It is most commonly a part of the hillside bogs so common to the rolling, longleaf pine country of northwest Florida above the lowest terraces.

(Opposite) 1. *Xyris drummondii.* 2. *X. brevifolia.* 3. *X. flabelliformis*


3.
0cm
3cm
6cm
1.
2.
0 mm.
5 mm.
R.K.

X. drummondii is readily separable from other *Xyris* on the basis of its having subequal scape sheath and leaf lengths and also its having, toward or at the base of each leaf a dark, lustrous, patch. In addition, its spikes show in the fresh condition a very noticeable flattening; thus, when the spikes are turned edgewise, they show a narrowly ovoid or lance-ovoid outline. A slight clinal variation may exist within the known range of *X. drummondii,* this having to do with leaf margin and epidermis. The plants from the eastern part of the range tend to have papillate leaf margins and surfaces while those from the western part of the range tend toward smoothness. According to Malme (1925A) the only then existing material of this species comprised the type specimen at Kew, so that the reader must be assured of the rareness of this species, or at least of its scarcity in collections.

2. XYRIS BREVIFOLIA Michx., Fl. Bor. Am. 1:23. 1803. (Figs. p. 219).

In large tufts, rarely solitary, perennating by means of low-set lateral buds. Principal leaves linear to linear-lanceolate, 2.0-5.5 (-7.0) cm. long, 0.3-2.0 mm. broad, the equitant portion from 1/4-2.3 the total leaf length, ascending to flabellately spreading, not curvate, often maroon, purplish, or pinkish during the overwintering or seedling stage, progressively browning and dying toward the centre of the plant as anthesis is reached, then passed, narrowing progressively from the greenish or brownish (sometimes slightly fibrous) equitant base to the acute, slightly incurved apex. Surface of leaf smooth or low-papillose. Margin of blade above the equitant portion incrassate, papillose or smooth. Sheath of the scape longer than the leaves, tightly clasping the scape below, expanding about mid-way up into a blade-like structure (which however is still equitant), the margins joining at from 1.0-3.0 mm. below the tip. Scapes filiform, twisted but rarely flexuous, many-ribbed below, terete and one-to-many ribbed above or sometimes slightly flattened and bicarinate just below the spike. Spikes at seed-bearing time globose (rarely ovoid) to depressed-globose or obovoid, 4.0-8.0 mm. long, 4.0-7.0 mm. broad, of comparatively few, rather loosely imbricated, bracts of which the lowermost are usually barren. Fertile bracts broadly obovate to suborbicular, 3.0-5.0 mm. long, slightly or not at all keeled, the apex rounded, the exposed margin with a thin, narrow but conspicuous reddish or maroon, lacerate, sometimes squarrose, border, the outer surface at anthesis tan with a narrowly elliptic subapical, reddish-brown dorsal area. Lateral sepals included, about the length of the subtending bract, linear, straight or slightly curvate, the sides narrow, thin, pale brown, the keel narrow, thickened, entire or papillate or rarely low-ciliate, a deep lustrous reddish-brown. Petals with obovate blades, 2.5-3.0 mm. long, unfolding in morning. Seeds ellipsoidal, 0.3-0.4 mm. long, with 20-24 evenly distributed, low longitudinal lines, the cross lines not evident.

Low, moist acid sands or sandy-peats of pine flatwoods, pineland pond-shores, lakeshores or particularly abundant on disturbed sandy moist areas, Coastal Plain, eastern North Carolina south to southern Florida and the Florida Keys (south beyond our range into the Caribbean Islands and South America), west to southern Alabama.

Type. U.S.A. GEORGIA. "Wet meadows, coastal Georgia"; collected by Michaux. Holotype at P; this particular specimen does not show the plant bases but consists only of a number of spikes and scapes. However, the spikes show both the globose outline and the fringed, coloured, bracts unique to the species.

Habitat and Identification. X. brevifolia is one of the weedier *Xyris*, often forming solid stands on bulldozed pine flatwoods sands of the Florida peninsula. It actually appears to be confined in its distribution to soils which are very high in sand but which are rarely flooded and thus is commonest within its range on the lowermost terraces of the Coastal Plain. Its range is very similar to that of *X. elliottii* and *X. flabelliformis,* the former also being found in the Caribbean islands. It is often found on exposed seepage sands along roads, usually in association with such species as *Lycopodium alopecuroides, L. carolinianum, L. inundatum, L. cernuum, Eriocaulon* spp., *Lachnocaulon* spp., *Syngonanthus flavidulus,* other *Xyris* such as *X. ambigua, X. elliottii, X. flabelliformis, X. jupicai, X. platylepis, Aletris* spp., orchids such as *Pogonia, Calopogon, Habenaria, Spiranthes, dicots* such as *Drosera* spp., *Sarracenia* spp., *Pinguicula* spp., *Utricularia* (particularly *U. subulata, U. cornuta, U. juncea),* and a multitude of grasses, sedges, rushes and composites. It is similarily abundant on the fluctuating shorelines of pineland ponds and lakes or on recently burned sandy savannas but a removal of pyrrhic or mechanical disturbance factors will mean that this short lived, low, species will give way to an increase of the grass-sedge complex.

The winter rosettes of *X. brevifolia* were collected on 28 December 1962 from a bulldozed flatwoods area 8 mi. w. of Tallahassee, Florida, by the writer and Dr. R. K. Godfrey. These were transplanted to the greenhouse at Louisiana Tech during the first week of January 1963 and in two months had reached anthesis. Seed was gathered and planted shortly thereafter and by June of 1963 these had developed to flowering size, certainly proof that this species is a precocious germinator which can probably produce at least 2 generations during a favorable growing season. In fact *X. brevifolia* may bloom the year round in southern Florida.

X. brevifolia resembles *X. flabelliformis* most closely and has frequently been so identified. It is also true that the two are very often cohabitants of disturbed areas, that they both come into flower at about the same time, and that their flowers are open at the same time of day. In spring of 1958 I made a series of strip samples through mixed populations of the two in Hamilton, Jefferson, and Wakulla counties, Florida, and compared these with similar population samples of *X. brevifolia* from southern Florida where it could be found in pure populations: Hamilton Co., *Kral 6397;* Jefferson Co., *Kral 6430, 6434, 6438;* Wakulla Co., *Kral 6442;* De Soto Co., *Kral 6522;* Charlotte Co., *Kral 6530;* Orange Co., *Kral 6561.* Each sample consists of at least 50 individuals, none from the same clump, an easy matter for a collector in that these *Xyris* formed a turf in the areas sampled. On the basis of a study of the above cited samples, together with an examination of many subsequent but smaller ones and of loan specimens, the following comments are appropriate:

X. brevifolia and *X. flabelliformis* differ in that:

a. The leaf length-leaf breadth ratios for the two are significantly different; those for the former are larger than are those for the latter.

b. The bract margins of the two are significantly different in that those of *X. brevifolia* are purplish, ragged, while those of the latter are not coloured and tend to be entire.

c. The keel of the lateral sepals of the former is entire or remotely papillate; that of the latter is ciliate.

d. The leaf habit of the former is more ascending and the plants tend to be more tufted than is the case with the latter.

e. Maroon pigmentation is less copious in the former than in the latter.

f. Spikes of the former have a lower length-width ratio than do those of the latter.

When large populations of both *X. brevifolia* and *X. flabelliformis* are mixed:

a. Some individuals may closely resemble either of the species.

b. More, however, exhibit intermediate characteristics in regard to leaf length-breadth ratio, bract margin, keel of lateral sepal, habit, and pigmentation.

Thus it would appear that some intergradation is happening, at least in northern Florida, between the two species and that it ought to be studied wherever the ranges of the two overlap. The expressiveness of populations of both species does appear related to whether or not they cohabit an area. A majority of the specimens from these samples has not been distributed, although they have been mounted; these same specimens are available on loan to anyone who wishes statistically to verify my observations.

3. XYRIS FLABELLIFORMIS Chapm., Fl. S. US. 499. 1860. (Figs. p. 219).

Solitary or in small tufts, perennating by means of low-set lateral buds or behaving as an annual. Principal leaves linear-lanceolate, (1.0-) 2.0-3.0 (-4.0) cm. long, 1.0-3.0 (-4.0) mm. broad, usually slightly curvate, the equitant portion from 1/3-1/2 the total leaf length, the surface of the leaf papillose in short transverse lines, often maroon, purplish, or pinkish during the overwintering of vegetative stage, progressively browning and dying toward the centre of the plant as anthesis is reached, then passed; margin of blade above the equitant portion slightly incrassate, papillose or finely tuberculate-scabrid. Sheath of the scape longer than the leaves, tightly clasping the scape below, expanding about midway up into a blade-like structure (which however is still equitant), the margins joining at about 1 mm. beneath the tip. Scapes filiform, twisted, sometimes flexuous, many-ribbed below, terete and 4-many ribbed above just below the spike. Spikes at seed-bearing time ovoid (rarely globose), 4.0-8.0 (rarely 10.0) mm. long, 3.0-5.0 mm. broad, of a comparatively few loosely imbricated bracts. Fertile bracts broadly obovate to suborbicular, 3.0-5.0 mm. long, often low-keeled, the apex rounded or acute, the exposed margin entire or shallow erose, becoming somewhat lacerate with age, the outer surface at anthesis tan with an elliptic subapical, pale green, dorsal area but at fruiting time becoming a darker brown, the dorsal area inconspicuous or reddish-brown. Lateral sepals included, usually about 1 mm. shorter than the subtending bract, bent-curvate, the broad sides thin, lustrous, pale brown, the keel narrow, thickened, ciliate, and deep lustrous reddish-brown. Petals with obovate blades, 2.5-3.0 mm. long, unfolding in the morning. Seeds broadly ellipsoidal, 0.3 mm. long with 20-24 evenly distributed longitudinal low ribs, the cross-lines not evident.

Low, moist acid sands or sandy-peats of pine flatwoods, pineland pondshores, lakeshores or particularly abundant on disturbed sandy moist areas, lower terraces of the Coastal Plain, North Carolina south to Peninsular Florida and west, close to the Gulf Coast, to eastern Louisiana.

Type. U.S.A. FLORIDA. FRANKLIN CO.: "Apalachicola"; collected by Dr. Chapman. The holotype, deposited at NY, bears an undated annotation by Chapman which reads "*X. brevifolia* Michx. var. *subcarinata.*" Isotype at GH.

Ecology and Identification. In regard to habitat and associated species *X. flabelliformis* is very similar to *X. brevifolia*, which see. Over a large part of its range it is found in mixed populations with *X. brevifolia* but it does appear in apparently pure populations and evidently gets farther west than does *X. brevifolia*. However, it is never far from the present coast.

Populations of *X. flabelliformis* have extremely short, curvate, maroon-coloured leaves and narrowly ovoid, fringeless spikes; the lateral sepals are bent-curvate and with a conspicuously ciliate keel. As was explained in the discussion under *X. brevifolia*, these distinguishing characteristics are somewhat modified when *X. flabelliformis* and *X. brevifolia* occur in mixed populations (at least in north Florida.)

4. XYRIS ELLIOTTII Chapm., Fl. S. US. 500. 1860. (Figs. p. 225).

In large tufts, the bases brownish, lustrous, perennating by means of pale, elongated, fleshy lateral buds. Principal leaves linear to narrowly linear (rarely filiform), 10-30 cm. long, 1-2 (2.5) mm. broad, flat to slightly twisted; margins minutely tuberculate, incrassate, pale; surface above the equitant portion green or reddish-green, smooth; tip acute to acuminate, slightly incurved; base hard, brown, abruptly but not broadly dilated, often persistent as chaffy fragments. Sheathes of the scape shorter than the leaves, tight and lustrous brown toward the base, slightly looser toward the oblique, short-tipped, orifice. Scapes 40-60 (-70) cm. long, slightly twisted, or straight, terete with one to several low ridges below, oval or somewhat flattened above in cross section and smooth (or with up to four low ridges, the ridges minutely tuberculate). Spikes of seeding time ovoid to broadly elliptic, acute, 6-15 mm. long, of dull, sometimes appearing shaggy, with several closely imbricate bracts. Fertile bracts 5-6 mm. long, obovate, shreddy at the apex at maturity, the surfaces pale to dark brown, dull, with gray-green, dull, oval or oboval, papillose dorsal areas. Lateral sepals included or slightly exserted, the keel increasingly ragged or ascending fimbriate toward the apex. Blades of petals obovate, ca. 5 mm. long, yellow, opening in the morning. Seeds 0.5-0.6 mm. long ellipsoidal, transluscent, with about 12 distinct, straight, longitudinal lines, the vertical lines faint, at irregular intervals.

Moist sands or sandy peats of savannas, pineland pond margins, lakeshore, and roadside ditches, Coastal Plain, South Carolina south to Florida and west near the coast to southern Mississippi.

Type. U.S.A. FLORIDA. FRANKLIN CO.: "Apalachicola"; collected by Dr. Chapman. Holotype at NY.

This *Xyris* appears to be confined to moist soils which are high in sand; therefore, outside the state of Florida which is primarily sandy, it appears to be commonest on the very lower terraces of the Coastal Plain. Its commonest associated species of *Xyris* are *X. ambigua, X. brevifolia, X. flabelliformis, X. platylepis, X. caroliniana.* To the west it appears to grade into a narrower leaved form; there it is often found in association with *Xyris baldwiniana.* To the south, in the lake-dotted central highlands of Florida, it is often narrow (sometimes even filiform) leaved.

Narrow leaved *X. elliottii* (the variety *stenotera* Malme?) and wider leaved *X. baldwiniana* (the variety *tenuifolia* (Chapm.) Malme) are best distinguished on the basis of bearded staminodia in flowers of the former, vestigial staminodia in flowers of the latter; another good difference consists of the smaller seed of the former. Both species flower at the same time of the year and day, and occur as mixed populations in North Florida, Georgia, and South Carolina. I have observed bees visiting the flowers of both and therefore would not be surprised to discover intermediates, although none have so far been found.

The bulk of populations of *X. elliottii* are easily distinguished on the basis of the incrassate, pale, papillose leaf margin which is usually in sharp contrast to the deeper colour of the blade proper. No other species

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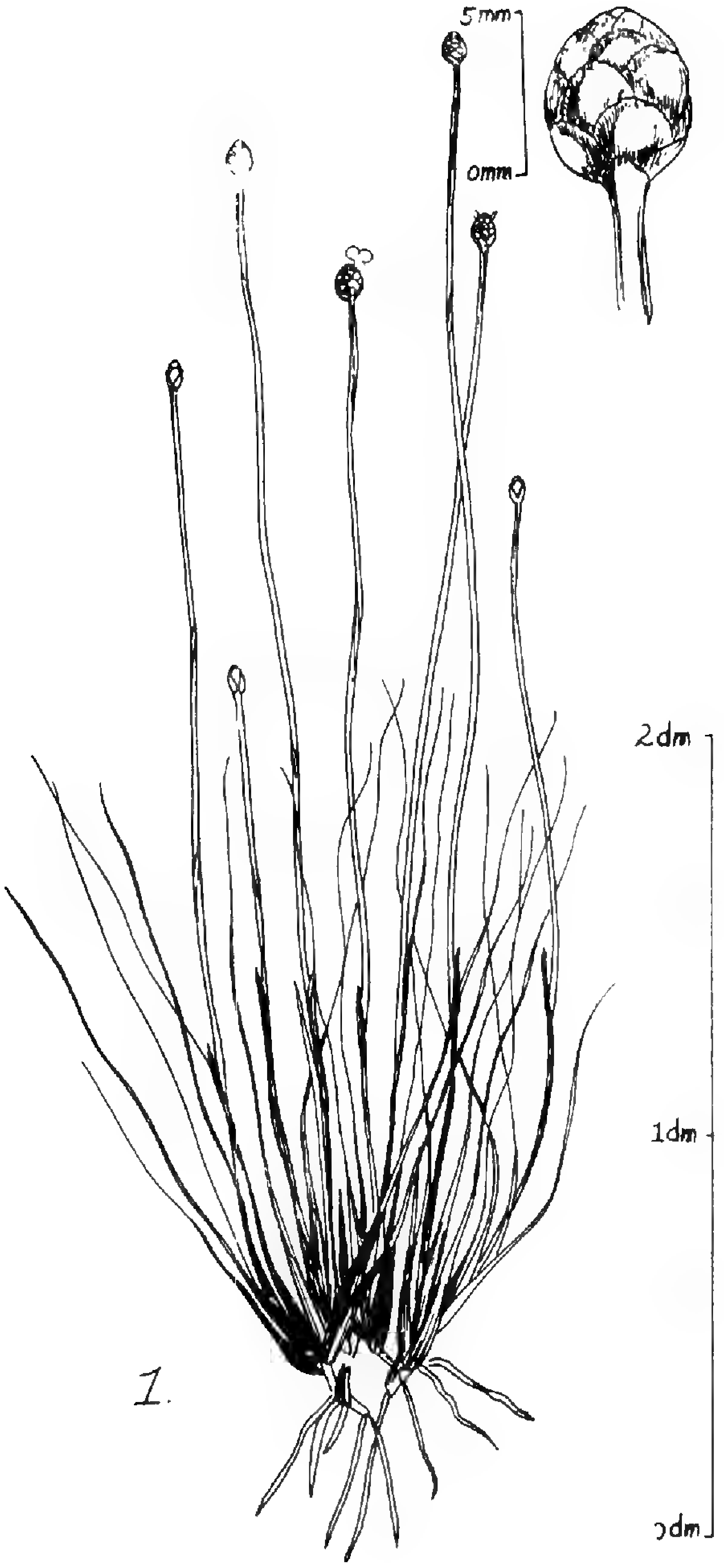
(Opposite) 1. *Xyris baldwiniana.* 2. *X. elliottii.*



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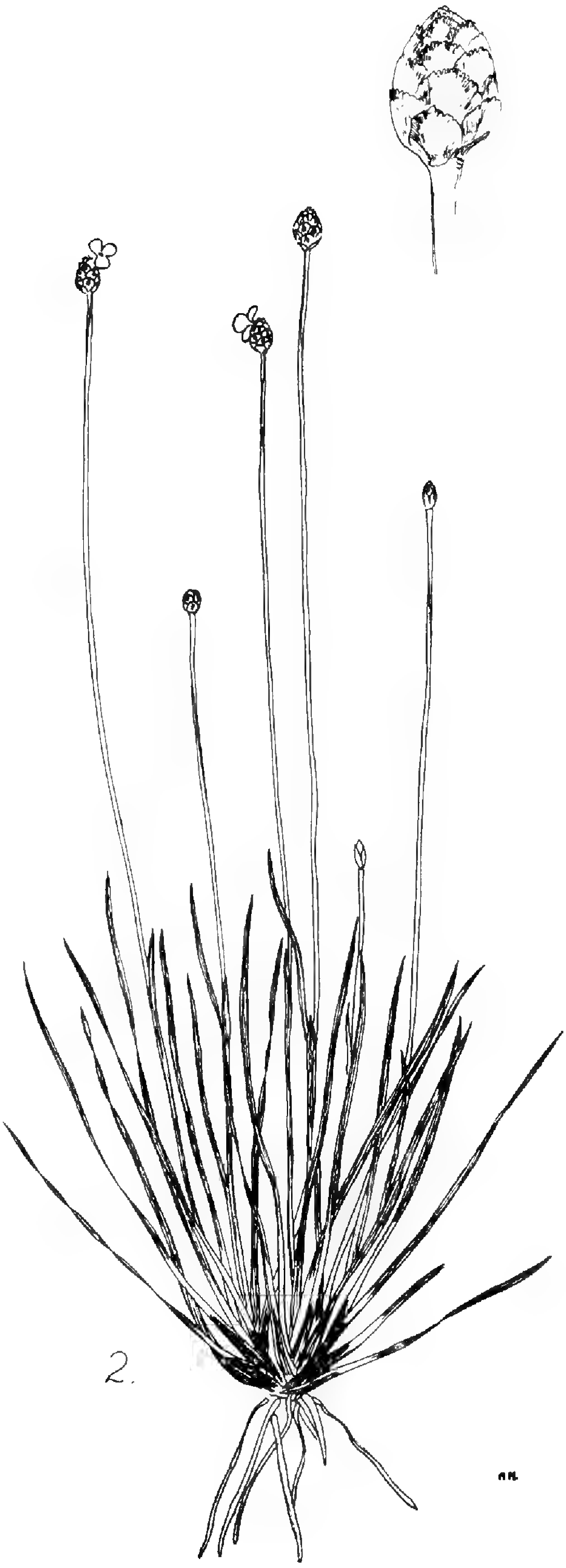


2.

of *Xyris* grows in such large tufts, save *X. baldwiniana*, from which it is generally distinguished by its bearded staminodia and by its scapes which, though flattened above, are usually narrower than the leaves.

5. XYRIS BALDWINIANA Schultes, in R. & S. Syst. Veg. Mant. 1: 351. 1822. (Figs. p. 225).

X. juncea Baldwin ex Ell., Bot. S.C. & Ga. 1: 53. 1816. Not *X. juncea* R. Br. 1810.

X. setacea Chapm. Fl. S. U.S. ed. 2, 658. 1883.

In large tufts, the leaf bases usually brownish, lustrous (rarely pinkish, this usually on very wet sites), perennating by overwintering, fleshy, pale yellow buds. Leaves filiform to linear-filiform, 10-30 cm. long, straight or slightly twisted, green, terete or oval, or blocky in the cross section above the equitant portion, expanding more or less abruptly toward the lustrous base. Sheath of the scape from ½ as long to nearly as long as the principal leaves, tightly investing the scape save for the loose orfice and a short blade. Scape 20-40 (-50) cm. long, usually broader than the leaf, terete below, one-ridged and tending to be terete above. Spikes at seed-bearing time ovoid or ellipsoidal, 4-7 mm. long, acute or blunt, of a few, tightly imbricate bracts. Fertile bracts ovate to obvate, 4-5 mm. long, not keeled, the apex rounded, the exposed margin entire, becoming erose with age, the matrix dull to dark brown or reddish brown, the dorsal area, elliptic, dull green. Lateral sepals included, slightly shorter than the bracts, linear but slightly curvate, reddish brown, the keel lacerate from the tip to about the middle or slightly beyond. Petal blades cuneate-obovate, ca. 3-4 mm. long, unfolding in morning. Seeds oblong or narrowly ellipsoidal 0.8 mm. to nearly 1 mm. long, the longitudinal lines evident, the whole seed transluscent, yellowish or pale amber.

Moist sands or sandy peats of pine flatwoods, hillside bogs, roadside ditches, and savannas, Coastal Plain, North Carolina south into northern Florida and west to eastern Texas.

Type. U.S.A. GEORGIA. "St. Marys R., Ga."; collected by Dr. Baldwin. The specimens, deposited at PH, is now missing its spikes, but the filiform leaves and relatively broad scape mark it well as an example of the species. The type of *X. baldwiniana* var. *tenuifolia* (Chapm.) Malme, deposited at NY, is simply a flatter-leaved version of the same.

Habitat and Identification. X. baldwiniana is typical of grass-sedge bogs throughout its range, but it appears to be more abundant on the somewhat heavier wetlands soils of the higher coastal plain terraces than it is on more newly formed land. Therefore it is quite rare in peninsular Florida, in fact has not been collected from south of Levy Co., Florida. It appears to be most abundant as one travels west in the Coastal Plain, and is probably the most abundant *Xyris* in the bogs of Mississippi and Alabama. It begins to bloom very early in the season, hence is fairly effectively isolated from the pollen of most of the other species in that it has largely ceased to flower by the time most of the others get going.

X. baldwiniana most closely resembles *X. elliottii* and *X. isoetifolia.* It may be distinguished readily from either on the basis of its lack of a staminodial beard, and by its much larger and longer seed.

6. XYRIS **isoetifolia** Kral, sp. nov. Figs. p. 252.

Dense caespitosa filifolia, foliis basin versus brunnescentibus nitidis. Semina parva (paulum minus quam 0.5 mm. longa).

In large tufts, the leaf bases usually brownish, lustrous, perennating by overwintering lateral buds. Leaves filiform to linear-filiform, somewhat flattened in the cross-section, 4.0-15.0 cm. long, smooth, ascending, straight or slightly twisted, green above the equitant portion, pale or brownish below at the very expanded base. Sheath of the scape from ½ as long to nearly as long as the principal leaves, tightly investing the scape save for the loose orifice and short (2.0-4.0 mm.) blade. Scape 15.0-30.0 cm. long, very slightly twisted, occasionally flexuous, linear-filiform, ridgeless, oval or even terete in the cross section above. Spikes at seed-bearing time ellipsoidal to obovoid, 5.0-7.0 mm. long, of few, rather loosely imbricated, bracts. Fertile bracts broadly oblong to obovate, the longer about 4.5 mm., not keeled, the apex rounded, the exposed margin subentire or erose with age, the matrix scarious and pale brown, the dorsal area narrowly to broadly elliptic, pale green. Lateral sepals included, ca. 4.0 mm. long, linear-curvate, reddish brown, the keel ciliate. Petal blades obovate, ca. 4 mm. long, opening in the morning. Seeds ellipsoidal, slightly less than 0.5 mm. long, transluscent, the 12-14 longitudinal lines distinct and straight, the horizontal lines much fainter.

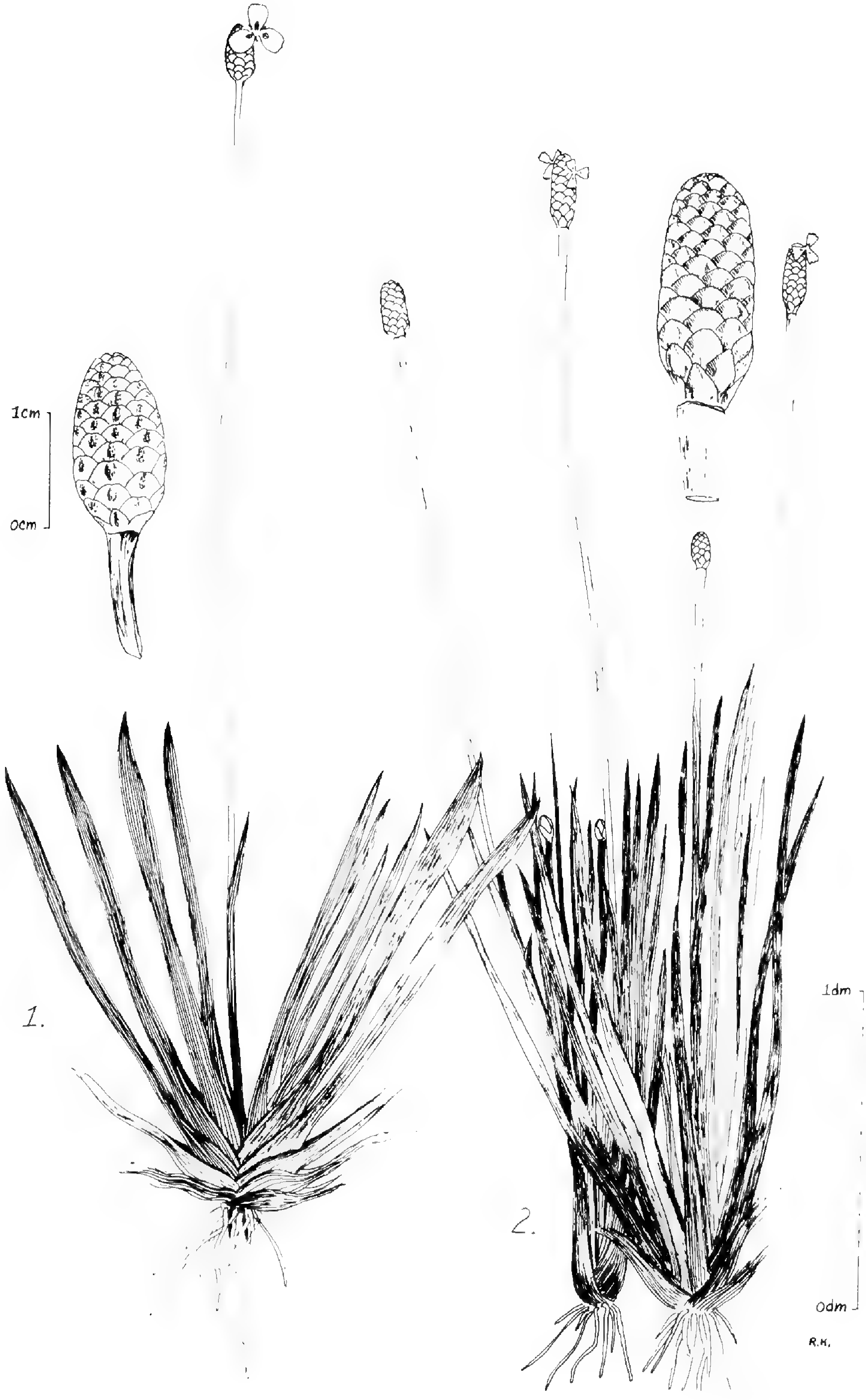
Moist sands or sandy-peat of savanna bogs, flatwoods pond margins and lakeshores, northwest Florida (Bay & Gulf Counties).

Type. U.S.A. *FLORIDA.* BAY CO.: 5 mi. n. Youngstown; sandy peat of boggy clearing in longleaf pine flatwoods-savanna, *Kral 15651.* Deposited at SMU. Isotypes at: BM, DS, DUKE, F, FLAS, FSU, GH, IA, ILL, ISC, K, LPI, MICH, MSC, NCSC, NY, P, PH, PUL, RS, SMU, US, USL, VDB.

Habitat and *Identification. X. isoetifolia* is locally abundant on moist sands or sandy peats but has not been found on wet situations. On the type locality it was in association with the extremely rare *X. scabrifolia* Harper, together with *X. ambigua.*

X. isoetifolia most closely resembles *X. baldwiniana;* in fact I recorded it as such in my field notebook. However, *X. isoetifolia* has bearded staminodia, a loosely imbricated spike, small seed, and ciliate lateral sepals in contrast to the beardless staminodia, tightly imbricated spike, lacerate lateral sepals, and seed nearly 1 mm. long of *X. baldwiniana.*

Seedlings of this and of *X. baldwiniana* are green, with very slender, straight, fleshy leaves, but I have been unable as yet to bring material of either to maturity in the greenhouse.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7. XYRIS AMBIGUA Beyr. ex Kunth, Enum. Pl. 4: 13. 1843.

Solitary or in small tufts, the base hard, often fibrous, perennating by both terminal and lateral overwintering buds. Leaves broadly linear, spreading, 10.0-40.0 cm. long, 0.3-2.0 cm. broad (tending to be more ascending and linear-leaved on heavier soils), a dark and lustrous green above the equitant portion (ca. 2/3 the total leaf length), the basal, equitant portion stramineous, brownish, or pinkish, narrowing more or less gradually to and abrupt, slightly incurved, tip. Surface of the leaves smooth or slightly papillose; margin of the leaves papillose, rarely harshly scabrous. Sheathes of the scapes from 1/3 to nearly as long as the principal leaves, rather loosely investing the scape save for a distal, blade-like portion, the margins of which converge to form a short (ca. 2 mm.) tip; bases of the sheathes usually lustrous, stramineous to castaneous. Scape (15-) 70-100 cm. long, twisted but rarely flexuous, many-ribbed below, becoming flattened and 2-edged above. Spikes at seed bearing time ellipsoidal to lance-ovoid, 1.0-3.0 cm. long, of many tightly imbricated bracts. Fertile bracts broadly obovate or suborbicular, 5.0-8.0 mm. long, not keeled, the apex rounded, the exposed margin subentire or erose with age, the matrix reddish-brown or pale brown, the dorsal area roughly rectangular, olive to dark brown. Lateral sepals included, curvate, a dark lustrous brown, the thickened keel nearly as broad as the sepal sides, ciliate-scabrid. Petal blades yellow, obovate, ca. 8 mm. long, unfolding in morning. Seeds ellipsoidal to broadly ovoid, caudate at one end, 0.5-0.6 mm. long, lustrous with 20-22 distinct, papillose longitudinal lines and several faint cross lines.

Moist sands or sandy-peats of bog margins, savannas, pine flatwoods, lakeshores and roadside ditches, Coastal Plain, Virginia south into Florida and west to eastern Texas.

Type. U.S.A. GEORGIA: "Margins of swamps, Georgia"; collected by Beyrich. I have never seen this type but understand that it was destroyed during the air raids of Berlin. A neotype is hereby designated: U.S.A. FLORIDA. LIBERTY CO.: 2 mi. n. Sumatra; black sandy peat of grass-sedge, longleaf pine savanna, *Kral 15694;* deposited at SMU, isotypes at: BM, DUKE, FSU, GH, IA, ISC, K, MICH, NCSC, NY, PH, RSA, UC, US, USF, USL, VDB.

Habitat and Identification. X. ambigua is perhaps the most abundant of all the *Xyris* which frequent the huge expanses of savanna or grass-sedge bog so common to the Gulf and Atlantic Coastal Plain. As a rule it is not found in sites where its bases would be submersed for any

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(Opposite) 1. *Xyris ambigua.* 2. *X. stricta.*

length of time. It is to be looked for along the *upper* edges of wet places and in association with such other *Xyris* as *X. flabelliformis, X. brevifolia, X. elliottii, X. caroliniana*, therefore it is above the wetter situations occupied by *X. iridifolia, X. fimbriata, X. smalliana, X. jupicai, X. difformis, X. serotina, X. stricta.*

X. ambigua is closest in its external appearance to *X. stricta*, but the bases of the latter are invaribly darkly pigmented, the leaves narrower and more ascending, the scape broader and flatter, the spike oblong. While the petal blades of *X. ambigua* are obovate, nearly 1 cm. long, and open in the morning, those of *X. stricta* are cuneate, about 0.5 cm. long or less, and open about midday. *X. ambigua* appears to develop two forms to the west in Mississippi, Louisiana, and eastern Texas; one form has a large stature and appears the same as the eastern plant while the other has more maroon pigmentation of leaf bases and is a much smaller plant with smaller flowers. Both forms may cohabit a single area and the difference between them is therefore quite striking.

A very good means of field identification of this species consists of stripping the outer, often fibrous, leaf bases away and examining the surfaces of the bases of the inner leaves. Here, very prominent, dark, longitudinal veins are evident in sharp contrast to the white or pale intervening tissue.

This species often takes two years to reach flowering size. Seedlings are very similar to *X. flabelliformis* in appearance, being short, flabellately spreading, curvate and maroon-based.

8. XYRIS STRICTA Chapmn., Fl. S. U.S. 500. 1860. (Figs. p. 228).

Tufted, usually in large, rigid-leaved, clumps, whose brown, fibrous bases are set on muck or wet sand in shallow water. Leaves narrowly linear, (15-) 20-50 cm. long, 2-5 mm. broad, gradually tapering to a slender, incurved tip, green above the equitant portion (rarely maroon), but reddish-brown or maroon toward the base (old leaves are very often persistent as brown, almost black scales or shreds); margins tuberculate or papillate, incrassate; surfaces smooth, very rarely papillate. Sheathes of the scapes shorter than the leaves, tight and brownish or castaneous below, becoming maroon or green toward the oblique, short-bladed orifice. Scapes linear, (40-) 45-85 cm. long, roundish toward the base, with a few low, tuberculate, spiral ridges, definitely flattened above toward the spike, the two marginal ridges papillate or tuberculate, sometimes accompanied by 2-4 lower ridges between the margins. Spikes oblong, narrowly ellipsoidal or lance-ovoid, 1.0-2.0 (-2.5) cm. long, blunt, of very many, tightly imbricate scales. Fertile bracts suborbicular, ca. 5-6 mm. long, the outer surface castaneous save for the greenish, rectangular dorsal area, the margins entire. Lateral sepals curvate, about the length of the bracts, a lustrous reddish brown, the wings broad and thin, the keel thicker and ciliate from base to apex. Blades of petals cuneate 3.0-3.5 mm. long, yellow, unfolding in the late morning, closing in the early afternoon. Seeds ellipsoidal, ca. 0.8 mm. long, caudate at one end, opaque, with 18-20 longitudinal rows of dark, contiguous papillae and somewhat less distinct, irregularly disposed cross lines, all emparting a dark colour to the seed which may also be farinose.

Wet sandy peat, sandy clay, peat muck, or alluvium, often with the bases submersed, cypress flats, roadside ditches, pineland ponds, southern Mississippi east to northern Florida and north in the Coastal Plain (primarily the lower terraces) to South Carolina.

Type. U.S.A. FLORIDA. FRANKLIN CO.: "Apalachicola"; collected by Dr. Chapman. Holotype at NY; isotype at GH.

Remarks. Xyris stricta is definitely an entity of wet sites, its commonest associates among the *Xyris* being *X. iridifolia, X. smalliana, X. jupicai, X. fimbriata, X. serotina.* However, it most closely resembles either *X. iridifolia* or *X. ambigua* the latter almost invariably present on higher ground somewhere nearby. Differences between these three entities are therefore expressed in tabular form below:

X. ambigua	X. stricta	X. iridifolia
Old leaf bases persistent as brownish shreds.	Ditto.	Old leaf bases not persisting, not fibrous.
Bases of leaves brownish or stramineous, very rarely purplish.	Bases of leaves purplish.	Bases of leaves bright pink or purple.
Plants solitary or in small tufts.	Plants caespitose, in large tufts.	Plants solitary or in small tufts.
Leaves spreading widely, broad-linear, often curvate, dull green above the equitant base.	Leaves spreading-ascending, very rigid and narrow, tapering, deep-green above the equitant base.	Leaves spreading-ascending, very broad-linear, a deep lustrous green above the equitant base.
Scape somewhat flattened and 2-edged above, but narrow in relation to spike.	Scape conspicuously flattened above, broad in relation to the spike.	Scape conspicuously broadened and flattened below the spike.
Spikes lance-ovoid or narrowly ovoid, acute, the dorsal area pale green, the rest of the outer surface pale brown or tan.	Spikes usually oblong, blunt, the dorsal area deep green, the rest of the bract deep shining brown.	Spike broadly oblong, blunt, with dark brown scales and a dark green dorsal area.
Petal blades obovate, sometimes nearly 1 cm. long, opening in early morning.	Petal blades cuneate, less than 0.5 cm. long, opening in late morning.	Petal blades cuneate, less than 0.5 cm. long, opening in early morning.
Lateral sepal curvate, the keel narrower than the broader wing, ciliate-scabrid.	Lateral sepals curvate, the keels as broad as the wing or broader, ciliate.	Lateral sepal almost straight, its keel lacerate, thinner.
Seeds transluscent, ovoid, ca. 0.5 mm. long or slightly longer.	Seeds usually farinose, opaque, dark-lined, ca. 0.7-0.8 mm. long, narrowly ovoid.	Seed farinose, fusiform, usually 0.8-1.0 mm. long.

Chapman, in the first (1860) edition of his Flora, described *X. stricta* as follows:

> Scape flattened and broadly margined, rough-edged above, smooth and 1-2 angled below, slightly striate; leaves long, linear, smooth; spikes oblong or cylindrical, obtuse, many-flowered; bracts dark brown, orbicular, crowded on the spike; lateral sepals broadly winged above the middle, narrowed below; petals small, wedge-obovate;


1cm.
0cm
1.
2.
3.
4.
2dm
1dm
0dm

> seeds ovoid.—Shallow ponds in the pine barrens, West Florida. July-Sept.—Scapes slender, clustered, 2-3 feet high. Leaves 1-1½ feet long. Spikes 9-12 lines long. Petals 2 lines long.

This is in contrast to his description of X. *ambigua* which is as follows:

> Scape rigid, finely furrowed, rough, 2-edged above, 1-angled below; leaves linear-lanceolate, rough on the edges; spike ovate-lanceolate or oblong, even, often acute, many-flowered; bracts light brown, oval, not crowded on the spike; lateral sepals lanceolate, tapering at each end, shining, narrowly winged; petals round obovate; seeds ovoid.— Open grassy pine barrens, Florida to North Carolina. July-Sept.—Scape 2-3 feet high, mostly solitary. Leaves 6-12 inches long. Spikes 9-15 lines long. Petals ½ inch long.

I have examined and measured hundreds of the above entities and yet am unable to draw a much more accurate description than did Chapman. In succinct fashion, he quickly states the essential differences between the two entities which include for the former a flatter scape, longer and narrower leaves, narrower more oblong spike outline, darker bracts, broader sepals, smaller petals and a wetter habitat, together with a caespitose habit. The only characteristic he did not note consists of farinosity of seed. However, despite the clarity of Chapman's description, *Xyris stricta* has since been treated as X. *ambigua.* The reason for this ignorance is probably that no other worker had seen X. *stricta* in its natural habitat, nor had later workers bothered to look at the seeds.

Franklin County Florida still has broad areas of marsh, bog, pine flatwoods and savanna that are little changed from Chapman's day. When one takes the narrow state highway which extends north from Apalachicola toward Telogia in Liberty County it is not difficult to appreciate why Chapman developed an interest in the genus, for certainly this road must traverse more habitats for it than any other comparable length of road in the United States. In the gum and cypress pond pine swamps along the way are countless tufts of this peculiar *Xyris,* while the neighboring pinelands support large populations of X. *ambigua.* It is not surprising that Chapman quickly noted the difference in habitat of the two.

My interest in X. *stricta* was first aroused during the examination of a large collection of a robust, maroon-based, *ambigua*-like *Xyris,* the specimens gotten by Dr. Godfrey *(No. 55724)* from the edge of a cypress-gum swamp 7 mi. n. of East Point. All of the specimens showed flattened, dilated upper scapes farinose seed, and maroon pigmented narrowly linear leaves in addition to many *ambigua* characteristics such as tightly imbricate, narrow spikes, ciliate sepal keels and long-persistent, fibrous

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(Opposite) 1. X. *caroliniana.* 2. X. *torta.* 3. X. *scabrifolia.* 4. X. *platylepis.*

leaf bases. After examination of the type specimen for *Xyris stricta* kindly sent from the New York Botanical Garden, I concluded that it was the same sort of plant as the Godfrey collections and that, whatever the biological status of *X. stricta,* it is certainly not the same as *X. ambigua.* In fact, *X. stricta* appeared to me to have so many characteristics of *X. iridifolia* in addition to those of *X. ambigua* that it could be a hybrid between the two (1960).

In July 1963, Dr. Godfrey and I returned to the locality from which his collection came in order to get further samples of this apparently uniform population. During the summer of that same year several more populations of it were observed along the same road, one particularly fine one in Liberty County south of Telogia. In almost every instance *X. stricta* was found in association with *X. ambigua* and *X. iridifolia,* the former invariably on higher, comparatively drier sites, the latter always rooted in the muck of adjoining cypress-gum swamps, while *X. stricta* would occupy the ecotone.

During December of 1962 and January 1963 seeds and transplant material of *Xyris stricta* and other *Xyris* was gotten. From the seeds of *X. stricta* sown, a very large number of maroon leaved seedlings developed (similar in pigmentation to those of *X. iridifolia* but narrower leaved). Of these 25 survived to flower and set seed by fall of 1963. The uniformity of the progeny of what I had suspected to be an F-1 hybrid of course led to my present treatment of this entity. Future tests will be made to determine whether *X. stricta* is apomictic. In the summer of 1963 I was fortunate in finding several more populations of *Xyris stricta* in Florida as well as in Mississippi, Georgia and South Carolina. There is an astounding similarity between all of these populations. Therefore if *X. stricta* is apomictic, it is apparently very well established and is showing no observable tendency to produce intermediates with any associated species of *Xyris.*

9. XYRIS SEROTINA Chapm., Fl. S. U.S. 500. 1860. (Figs. p. 252).

Tufted, usually in large, dark brown or charcoal-based clumps of spreading-leaved plants, the bases of which are set on muck or wet sand and in shallow water. Leaves broadly linear, 20-50 cm. long, 3-12 mm. broad, stiff, dull green, broadening gradually from the incurved tip to a pale green, pale-brown or stramineous base (old leaves very often persist as dark gray-brown scales); margins tuberculate scabrid, incrassate; surfaces, particularly of outer leaves, tuberculate scabrid in short, diagonal lines. Sheathes of the scapes much shorter than the leaves, tight and lustrous brown below, looser above and with a broadly expanded, blade-like orifice, which terminates in a short, cusp-like blade. Scapes linear, 24-60 cm. long, straight, usually not much longer than the longer leaves, several-angled below, the angles ridged, scabrous, becoming somewhat flattened above, the two most prominent scabrous ridges comprising the edges, with from 1 to 6 additional but less conspicuous ridges.

Spikes ovoid or broadly ellipsoidal, 1.0-1.8 cm. long, acute or blunt, of several tightly imbricated bracts, the lower ones barren. Fertile bracts suborbicular, reniform or broadly obovate, 5-7 mm. long, entire (save in age), the outer surface a dull brown, the dorsal area deltoid, greenish or greenish-brown or reddish-brown. Lateral sepals slightly curvate, linear, about the length of the bracts, dark-brown, the thin keel lacerate from at least the middle to the apex. Blades of petals cuneate, 3.0-3.5 mm. long, yellow, unfolding in the late morning, closing in the early afternoon. Seeds ellipsoidal, ca. 0.6 mm. long, caudate, opaque and farinose, with 2 0-24 dark, longitudinal lines of contiguous papillae and several, slightly less conspicuous, less regular, cross lines.

Wet sandy peat, sandy clay, peat-muck, or alluvium, often with the bases in shallow water, cypress flatwoods, roadside ditches, pineland pond edges, southern Mississippi east to northern Florida and north in the Coastal Plain into North Carolina.

Type. U.S.A. FLORIDA. (Apalachicola?); collected by Chapman. Holotype at NY; isotypes at GH.

The plant here treated as *X. serotina* was described by Chapman (l.c.) as follows:

> Scapes clustered, twisted and mostly spiral, rough-angled and 2-edged above, striate; leaves linear-lanceolate, rigid, rough on the edges; spikes many-flowered, ovoid, obtuse, dark brown, even; bracts round-obovate, closely imbricated; lateral sepals linear, narrowly winged above, fimbriate and at length incised; petals small, obovate; seeds ovoid, pulverulent.—Varies with shorter leaves (2-3 inches), and smaller globose or ovate heads.—Pine-barren swamps, West Florida. Sept. and Oct.—Scapes 1-1½ feet high. Leaves 8-12 inches long. Spikes 6-9 lines long. Petals 2 lines long.

I have seen it, usually in association with *X. stricta*, *X. iridifolia,* in the cypress-pond pine country from southern Mississippi to central Florida and north to eastern North Carolina and, as is the case with *X. stricta,* there is a remarkable uniformity of populations over this large range. Its scabrosity quickly distinguishes it from one farinose seeded entity, *X. iridifolia;* its lack of maroon pigmentation and more robust, broader-leaved, habit distinguish it from *X. difformis* var. *floridana,* the third farinose-seeded entity.

It is evident from the above quoted description that Chapman included in his *X. serotina* the smaller maroon based plant here treated as a variety of *X. difformis.* Evidence in favor of the present treatment is developed in the discussion accompanying *X. difformis.*

X. serotina is slow to develop from seed. Seedlings from a sowing made in March 1963 have still not attained flowering size (Jan. 64). From the beginning they were singularly lacking in the maroon pigmentation common to the other farinose seeded Xyrids.

10. XYRIS CAROLINIANA Walt., Fl. Car. 69. 1788. (Figs. p. 232).

Xyris flexuosa Muhl. ex. Ell. Sk. Bot. S.C. & Ga. 1: 51. 1816.

X. torta Kunth, Enum. Pl. 4: 14. 1843, not *X. torta* Sm. 1818.

X. arenicola Small, Fl. SE. U.S. 234. 1903, not *X. arenicola* Miq. 1844.

Solitary or in small tufts, the bases deeply set in the substrate, perennating by means of pale, elongated, fleshy lateral buds. Outer leaves scaly, castaneous; principal leaves linear, 20-50 cm. long, 2-5 mm. broad, twisted and flexuous, fleshy, minutely tuberculate along the margins, otherwise smooth and lustrous; tip blunt to acute; base abruptly dilated, dark brown, shiny, long-persistent as scales. Sheathes of the scapes shorter than the leaves, tight below, loose toward the oblique orifice which is tipped by a short (2-4 mm.) blade. Scapes linear, 50-110 cm. long, twisted, flexuous, smooth, terete and minutely ridged below, becoming oval in cross section and smooth to 1-ridged above, the ridges if present minutely tuberculate. Spikes (1.3-) 1.5-3.0 cm. long, elliptic to narrowly oblanceolate in outline, blunt to broadly acute, of few to many closely imbricate bracts. Fertile bracts 0.5-1.0 (1.3) cm. long, oblong to obovate, entire or emarginate, becoming erose, the matrix reddish-brown to tan with an elliptic or rectangular gray-green or brown dorsal area. Lateral sepals linear, slightly to conspicuously exserted, tan to reddish-brown with a broad keel which is entire below but fimbriate at its exserted apex. Petal blades obovate, 8-9 mm. long, yellow or white, in most populations opening in the afternoon. Seeds fusiform, narrow, 0.8-1.0 mm. long, transluscent with about 20 pale, strip-like, longitudinal lines, the vertical lines not evident.

Moist sands of pine flatwoods or savannas; well drained sands or lower reaches of scrub oak-pine barrens, New Jersey to Florida, west to Texas.

Type. U.S.A. "de la Caroline Meridionale" *Fraser.* In the Herbarium Lamarck, P.

The Muhlenberg name *X. flexuosa* (1813) was taken up by Elliott (1816) and specimens conforming to the Elliott description are to be found at both PH and CHARL. Dr. Shinners, in reading the Elliott reference, discovered an error on the part of Elliott which I (and several others before me) had not noticed, namely that that author listed *X. caroliniana* as a synonymn of his *X. flexuosa.* Admittedly, the name "X. caroliniana" is earlier but the difficulty had always been one of associating the brief Walterian description with any one species. According to Rendle (1899) the specimen on which Walter had based the name was no longer extant, or at least this inference was made plain. Dr. Shinners then suggested the possibility that such a specimen might be a part of the collections sent to Lamarck by Fraser. I sent a complete series of specimens of *Xyris* to Paris for comparison. Dr. Alicia Lourteig, who obligingly made the comparisons with material in the Lamarck herbarium, assures me that, of the specimens sent, the material of *X. flexuosa (Demaree 32511)* matches perfectly with a specimen there which bears the caption "de la Caroline Meridionale. 2. "Fraser" "Xyris caroliniana. Lam. Gen." Thus, at last, a positive identification of Walter's

Xyris caroliniana is possible! The mystery is in how this particular specimen could have escaped the attention of so many for such a long time, and I wish now to give grateful credit to Dr. Shinners for calling an error to my attention as well as for suggesting a solution. A phototype is deposited at SMU, another at VDB.

Ecology and Identification. X. caroliniana survives on relatively dry pineland soils and is never found in permanently wet soils. In grass-sedge bogs it is usually in association with *X. ambigua* and, in peninsular Florida, with *X. brevifolia* and *X. elliottii*. Its evidently succulent leaf bases, together with the deepset habit of rootstock no doubt are the reasons for its success on higher ground than that occupied by other Xyrids. To the north, in the Atlantic Coastal Plain, specimens of *X. caroliniana* get shorter and have smaller spikes. In southern Georgia, southern Mississippi, but especially southern Florida, is a white flowered form *(X. pallescens* Small) which characteristically flowers earlier in the day than does the yellow flowered form.

Since the time of Kunth (1848) *X. caroliniana* has been confused with another bulbous-based *Xyris, X. torta*. Some of the authors who have confused the two are Chapman (1860 and later eds.), Gray (1868), Ries (1892), Britton & Brown (1896, and Rendle (1899). It was not until Harper (1904) pointed out this error that the name "torta" was properly applied to the plant for which it originally was intended. The differences between these two Xyrids are:

1. *X. caroliniana (flexuosa)* is a plant primarily of the lower terraces of the Atlantic and Gulf Coastal Plain while *X. torta* is primarily in the interior or north Atlantic provinces save west of the Mississippi River; the former is on drier soils, while the latter is on wet, often sphagnous, substrates.
2. *X. caroliniana* has deepset, very broad and castaneous, leaf bases in contrast to the smaller, more shallowly set leaf bases of *X. torta*.
3. *X. caroliniana* has narrower, usually longer, spikes and exserted lateral sepals in contrast to the shorter, broader spikes of *X. torta* whose lateral sepals are included.
4. The lateral sepals of *X. caroliniana* are almost linear, the keel very long-fimbriate toward its apex, while the sepals of *X. torta* are very curvate with keels ciliate from the base to the apex which bears a small tuft of fimbriae.
5. The bracts of *X. caroliniana* lack the apical tuft of short hairs present on the apex of the bracts of *X. torta*.
6. The seed of *X. caroliniana* are narrowly oblong, almost twice as long as the plump seed of *X. torta*.
7. *X. caroliniana* flowers later in the season than does *X. torta*.
8. *X. caroliniana* usually opens its flowers in afternoon; *X. torta* flowers in the morning.

11. XYRIS PLATYLEPIS Chapm., Fl. S. U.S. 501. 1860. (Figs. p. 232).

Solitary or in small tufts, the bases shallowly set on the substrate, perennating by means of pale, fleshy, lateral buds. Outer leaves scaly, pinkish, becoming a dull gray-brown; principal leaves linear 20-40 (50) cm. long, 5-10 mm. broad, twisted, ascending, flexuous, fleshy, minutely tuberculate or smooth along the margin, otherwise smooth; tip blunt to acute; equitant portion dilated, fleshy, ivory white or pink or purplish toward the base. Sheathes of the scape shorter than the leaves, castaneous or a paler brown and tight toward the base, looser toward the oblique, short-bladed orifice. Scapes 50-110 cm. long, twisted, flexuous, smooth to minutely ridged and terete below, oval in the cross section and smooth to 1-ridged above the ridges, if present, papillate. Spikes elliptic to ovoid or oblong, 1.5-3.0 (-4.0) cm. long, of numerous, closely imbricate bracts. Fertile bracts obovate, 5-7 mm. long, entire (becoming slightly erose with age), brownish or pale tan with an oblong to deltoid, dark green dorsal area. Lateral sepals included, light brown, about the length of the subtending bracts, linear, the keel narrow save toward the apex where it is lacerate. Blades of petals broadly obovate, ca. 5 mm. long, yellow or white, opening in the afternoon. Seeds ellipsoidal, ca. 0.5-0.6 mm. long, transluscent, with 10-12 rather irregularly longitudinal lines together with a scattering of less distinct vertical lines.

Moist to wet sands or sandy peats of pineland pond margins, savannas, bogs, and roadside ditches, Coastal Plain, Virginia south to southern Florida and west to central Louisiana.

Type. U.S.A. FLORIDA. FRANKLIN CO.: "Apalachicola"; collected by Dr. Chapman. Holotype at NY.

Remarks: This species, because of its coloured, fleshy and scale-like, leaf bases could be confused with *X. torta* or *X. scabrifolia.* From the former it is distinguished by its lacerate sepal keels; from the latter it is distinguished by its smaller seed and its smooth leaf and scape surfaces.

Xyris platylepis is seldom found with its bases in water; rather, it is found with such species as *X. ambigua, X. flabelliformis, X. brevifolia,* on moist sites which are seldom if ever inundated. It is a rather weedy species, being quick to occupy moist sands of bulldozed pine flatwoods, or areas which have been heavily logged, or sandy seepage areas along roads. In such places its reproduction may form a turf, the rosettes maroon and curvate-leaved, thus strongly resembling *X. flabelliformis.* Seed sown in fall or early spring will develop into plants of flowering size by the following fall. Dr. Fosberg reports it from Hawaii (there in association with the old world *X. complanata).*

12. XYRIS SCABRIFOLIA Harper, Bull. Torrey Club 30: 325. 1903. (Figs p. 232).

Solitary, or in very small tufts, bulbous-based, the bases shallowly set on the substratum, perennating by elongate, fleshy, corn-coloured, lateral buds. Outer leaves scaly, pinkish, later brown; principal leaves linear, 10-40 cm. long, 5-10 mm. broad, twisted, striate-scabrid throughout, the blades dull green, the equitant portion fleshy and pinkish, later brownish and fibrous. Sheathes of the scapes shorter than the leaves, tight below, and castaneous, looser and greenish above toward the oblique orifice which is tipped by a short blade. Scapes linear, 30-60 cm. long, twisted and sometimes flexuous, terete and multicarinate toward the base, 2 to 4 ridged above, striate-tuberculate throughout, but particularly harsh on the ridges. Spikes 10-20 mm. long, obovoid or ellipsoidal, of many, tightly imbricate bracts. Fertile bracts 6-8 mm. long, obovate, subentire, tan with a broadly elliptic or rhombic gray-green dorsal area, becoming somewhat erose, dark reddish brown with a red-brown dorsal area. Lateral sepals included, linear, about the length of the subtending bracts, brown, the margin of the narrow keel lacerate below, fimbriate toward the apex. Blades of petals ca. 5 mm. long, suborbicular, yellow, opening in the afternoon. Seeds oblong to ellipsoidal from 0.6 mm. to nearly 1.0 mm. long, caudate, translucent with 12-14 distinct, smoothish longitudinal lines and scattered, indistinct, irregularly disposed vertical lines.

Moist to wet sandy peats of acid sphagnous bogs or sandy seepage areas in the pinelands, northwest Florida and central Georgia.

Type. U.S.A. GEORGIA. MERIWETHER CO.: open bog near Woodbury, *Harper 1254.* Holotype at NY.

Remarks. This is unquestionably the rarest entity of *Xyris* in the southeastern United States, being known only from a few scattered localities in northwest Florida and only from the type locality in Georgia. In fact, it has not been again collected from the type locality. The species with which it is associated are *X. flexuosa, X. ambigua, X. baldwiniana, X. drummondii;* however it most closely resembles *X. platylepis,* a far commoner plant with similarly pink, fleshy, bulbous bases and twisted scapes, being distinguishable from it primarily by its scabrousness, its much longer, more oblong-and-caudate seeds, and its generally lower stature.

Seeds of *X. scabrifolia* were gathered from a locality 5 miles n. of Youngstown, Bay County, Florida, in January 1963 and planted in March of the same year in the greenhouse. A crop of plants of flowering size developed by mid-summer of the same year, these showing considerable variation in papillosity, leaf character, and spike shape with some individuals being suspiciously close to *X. jupicai* Rich. Further progeny tests will therefore be made of this peculiar entity.

13. XYRIS TORTA J. E. Sm., in Rees Cycl. 39: Xyris no. 11. 1819. (Figs. p. 232).

Xyris Indica L., Sp. Pl. 42. 1753. In part.

Xyris bulbosa Kunth, Enum., Plant. 11: 1843.

Xyris flexuosa Chapm., Fl. S. U.S. 500; Ries, Bull. Torrey Club 19: 37. 1892; Rendle, Journ. Bot. 37: 499. 1899.

Kotsjelottia flexuosa Nieuwl., Am. Midl. Nat. 3: 99. 1913.

Solitary or in tufts of a few individuals, bulbous-based, perennating by pairs of stout, fleshy, lateral buds which arise from two of the innermost leaf axils. Leaves of two sorts, the outer scale-like (from the bud scales), the inner elongate-linear. Principal leaves linear, ascending, 20-50 cm. long, 2-5 mm. wide, twisted, grooved longitudinally, the upper (blade) portion dark green, lustrous, narrowing rather abruptly to a blunt, incurved, thickened tip, the equitant portion pinkish, purplish or yellow green, flaring rather abruptly to the fleshy, pale or castaneous base. Leaf surfaces smooth or papillose; leaf margins narrowly incrassate, smooth or papillose. (Outer leaves are usually much shorter than the inner, are maroon or more commonly a dark, lustrous brown, are often scale-like with very dilated bases and slender, often acuminate, tips.) Sheathes of the scape shorter than the principal leaves, tightly clasping the scapes below, becoming looser toward the orifice which has a short, erect, slightly divergent blade at its tip. Scapes 15.0-80.0 (-100) cm. long, 1.0-1.5 (-2.0) mm. broad, slightly to very twisted and flexuous and many-ridged below, 2-4 (-6) ridged above and somewhat flattened above toward the spike. Spikes at seeding time broadly ovoid or ellipsoidal to lance-ovoid or rarely oblong, 0.8-2.5 cm. long, 0.6-1.0 cm. broad, of many, tightly imbricated bracts. Fertile bracts broadly obovate to suborbicular, 5.0-7.0 mm. long, a deep lustrous brown within, a dull brown on the outer surface save for a pale, gray-green, elliptical, subapical dorsal area; exposed margin of the bract entire or sparingly ciliate save for a short-fimbriate, usually slightly emarginate, apex. Lateral sepals included, slightly shorter than the subtending bract, a lustrous brown, lunate, the broad, thickened keel ciliate-scabrid from near the base to the apex where appears a small tuft of reddish-brown or blonde trichomes. Blades of petals obovate, ca. 4 mm. long, unfolding in the morning. Seeds ellipsoidal, ca. 0.5 mm. long, caudate, with 14-18 prominent longitudinal lines (these under high magnification a series of contiguous papillae) and indistinct, narrower, cross-lines, transluscent save for the region of the embryo.

Sphagnous bogs, streambanks, lake and pondshores, wet sandy swales, and acid sandy swamps primarily above the Coastal Plain (save at its northern extremities or toward the west) from the Canadian Shield west to the limit of coniferous forest, south in the Atlantic United States to Piedmont, Georgia, and west in the Piedmont and Coastal Plain to Texas and Oklahoma.

Type. "North America"; collected by Peter Kalm. Holotype in the Linnaean Herbarium, London.

Remarks. Many species of *Xyris* are confined to purely sandy or sandy-peat soils. *Xyris torta,* however, appears upon a wide spectrum of soils, providing they are moist and acid enough. In the northern part of its range it is very often luxuriant in sphagnum bogs as well as on the various substrata created by road or railroad construction. In the Piedmont province it may be either in boggy pockets amongst the red clay hills or in seepage areas generally. Throughout its range it appears to quickly come into artificially created moist areas such as quarries, gravel pits, farm pond margins. The genera it is often associated with are: *Sphagnum, Lycopodium, Dulichium, Cyperus, Eleocharis, Eriophorum, Scirpus, Fimbristylis, Rhynchospora, Panicum, Paspalum, Juncus, Polygala, Sarracenia, Drosera, Pinguicula, Rhexia,* together with several other genera of grass-sedge or sphagnous bog communities. It is one of the earliest to bloom of the *Xyris,* usually being past anthesis by the middle of summer in the southern states and certainly well before most *X. jupicai* and *X. difformis* reach their prime. Thus far, I have not seen intermediates between it and other species with which it may associate, which in addition to the above mentioned species may occasionally include *X. iridifolia, X. ambigua, X. baldwiniana, X. platylepis.* It is not one of the species which thrives in water; rather it tends to grow either with its bases set deeply in sphagnous hummocks or on the upper edges of shores or seepage areas.

X. torta is one of the elements upon which Linnaeus based *X. indica* (Sp. Pl. 42. 1753). The other element of *X. indica* is East Indian and from the illustrations on which it is partly based (Pluk. Alm. t. 416, f. 4; Pis. Bras. 238) it is not this bulbous-based, twisted-leaved plant. The East Indian specimen, collected by Hermann, upon which *X. indica* is also partly based is no longer extant (Rendle, 1899).

That *X. indica* was based upon discordant elements has long been known. The first to take action was Sir J. E. Smith (in Rees' Cycl. 39, 1818), who designated the east Indian element as being the actual *X. indica* and who named the North American element *X. torta.* Two specimens of this entity were available to Smith; one Clayton 219 (at BM), the other a collection by Peter Kalm from "North America" (at LINN). This latter specimen (according to Rendle, 1899) bears the following comment by Smith: "X. indica of Pursh? torta J. E. S." This latter specimen was long ago decided upon as the type (Nilsson 1892). It would appear to me that J. E. Smith acted in accordance with our present Code of Nomenclature and that no further argument about his decision ought to exist today.

Because of its several resemblances to the Coastal Plain bulbous-based *Xyris* (here treated as *X. caroliniana* Walt.) the history of the epithet "torta" has been tortuous since the time of its inception. Rather than follow the lead proscribed by Smith which was followed by Roemer & Schultes (Mant. Pl. I, 1822, Mant. Pl. Additam. II, 1827), Kunth (1843) confused the inland "torta" with the Coastal Plain *caroliniana (flexuosa).* Therefore the identity of the two different species ought to be taken up here.

Xyris torta, in addition to being unusual in the southeastern Coastal Plain, has, within its usually ovoid spikes, curvate lateral sepals which are ciliate-keeled save at the very apex where the ciliae are longer and form a small tuft. Its ellipsoidal or ovoid seed are about 0.5 mm. long. It is a plant of wet soil.

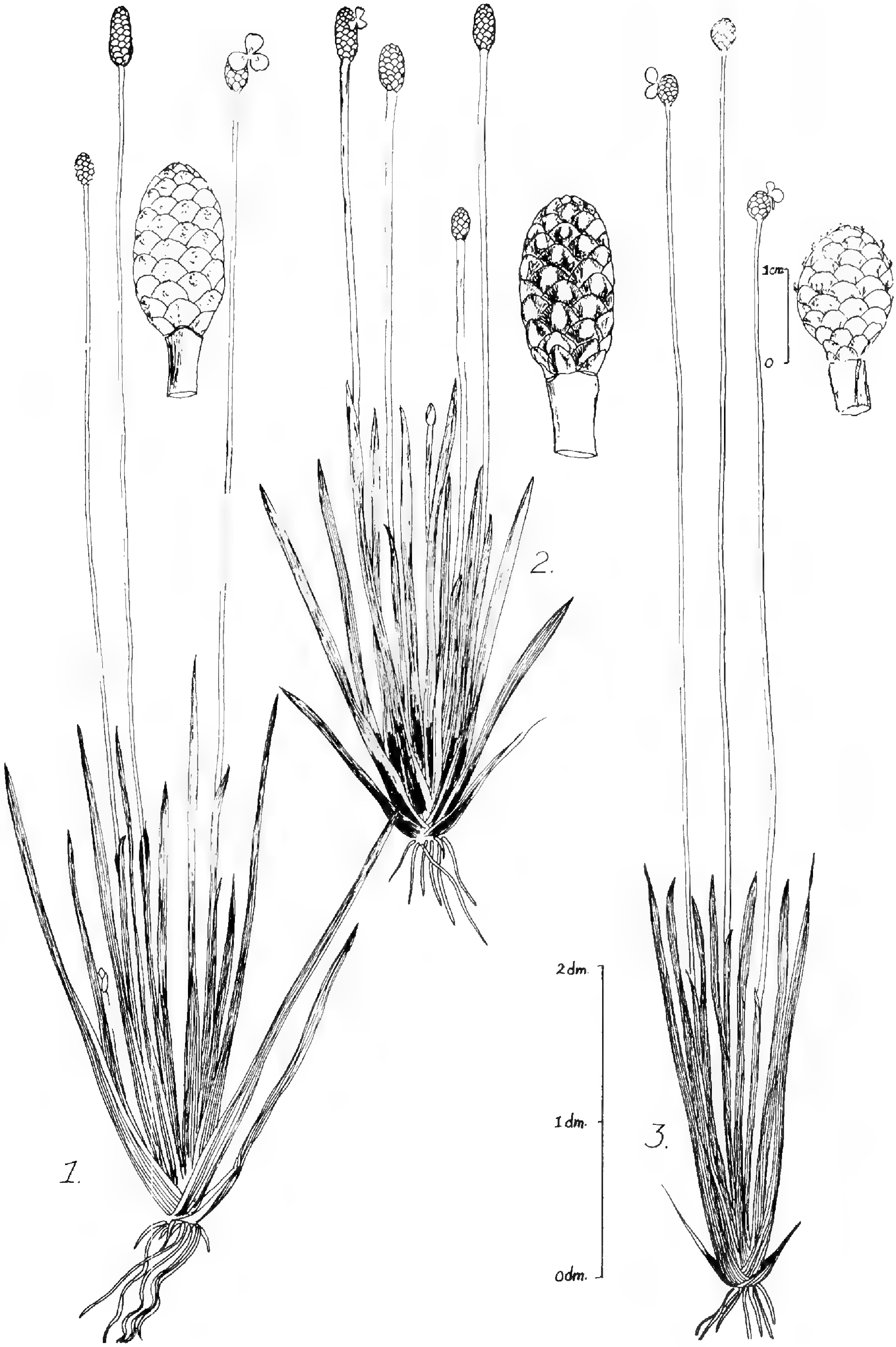
Xyris caroliniana, a species confined to the Coastal Plain, has within its narrowly ellipsoidal or lance-ovoid spikes, relatively straight, elongate lateral sepals whose keels are ciliate toward the base, long-fimbriate at the apex. Its oblong or narrowly elliptical seed are well in excess of 0.5 mm. usually at least 0.7 mm. long. It is a plant of damp to relatively dry sands, certainly not of wet soils.

No specimen of the former *Xyris* is in the Elliott Herbarium at Charleston; the presence there of a specimen of the latter certainly constitutes evidence that the Muhlenberg name *flexuosa* was definitely applied to the Coastal Plain entity by Elliott. However, subsequent authors such as Chapman (1860), Ries (1892), Britton & Brown (1896) and others confused the two in the same manner as Kunth (l.c.). For further clarification see the discussion under *X. caroliniana.* Also see Harper (1904).

14. XYRIS FIMBRIATA Ell., Bot. S.C. & Ga. 1: 52. 1816.

Solitary or in small tufts, perennating by means of low-set lateral buds (these therefore usually buried in and overwintering in a mucky substratum). Principal leaves ascending, linear, 4.0-70.0 cm. long, 0.5-2.5 cm. broad, flat or slightly twisted, ascending, the upper part green, lustrous, becoming pale green, stramineous or even pinkish toward the base, narrowing progressively from the broad, sheathing equitant portion to the acute, slightly incurved apex, the equitant portion not more than 1/6 the total leaf length. Surface of the leaf smooth; margin of the blade papillose. Sheathes of the scape shorter than the fully developed leaves, (15-40 cm. long), short bladed, rather loose above. Scapes linear 80-150 cm. long, twisted and multicarinate below, flattened and 2 to 3 ridged (-4 ridged) above, the ridges tuberculate-scabrid. Spikes at seed bearing time ellipsoidal to short-oblong, less commonly ovoid, 1.2-2.5 cm. long, of many, rather tightly imbricated bracts, the lowest barren. Fertile bracts broadly obovate to suborbicular, 5.0-8.0 mm. long, not keeled, the apex rounded, the exposed margin subentire, the other surface tan or dull brown with a broadly ovate or triangular, silvery-green or pale-green subapical dorsal area about ½ the length of the bract. Lateral sepals prominently exserted, linear-cuneate, the broad sides thin, a pale lustrous yellow-brown, the keel slightly thickened, a darker brown, broad, the margin long-fimbriate, particularly toward its apex. Blades of petals 5-6 mm. long, obovate, opening in the morning. Seeds narrowly fusiform or oblong, 0.8-1.0 mm. long, pale but lustrous, with about 12 broad, pale, flattened, longitudinal, wavy lines which are nearly as broad as the intervals.

(Opposite) 1. *X. smalliana.* 2. *X. iridifolia.* 3. *X. fimbriata.*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Sand, sandy-peat, sandy-muck or peat-muck of pineland pools, cypress ponds, river and streambanks, lakeshores, ditches and swamps, Coastal Plain, New Jersey south to southern Florida and west in lower coastal plain to Mississippi.

Type. U.S.A. GEORGIA. "sent from Georgia by Dr. Baldwin"; presumably collected by Baldwin. Holotype at CHARL.

Ecology and Identification. X. fimbriata is definitely a wetland *Xyris*, forming sometimes pure stands in the countless cypress domes, gum swamps, and ditches of the Atlantic and Gulf Coastal Plain. Often the plants are submersed for up to nearly half their length, and it is not unusual to see luxuriant reproduction completely submersed in a foot or more of water. It is a definite perennial, but evidently requires a constantly moist, if not wet, substratum in that both adult plants and reproduction die out by thousands if the substratum dries. Its commonest associates among the *Xyris* are *X. smalliana, X. jupicai, X. iridifolia, X. stricta, X. serotina, X. difformis,* but usually only *X. smalliana* accompanies it into the wettest situations.

Any drainage ditch or roadside ditch through the swamp-infiltrated pinelands of the lower coastal plain provides a contraction of habitats by providing additional, compressed, relief (as stated in the section on ecology). Thus, on such an artificial habitat a wet ground species such as *X. fimbriata* may be wihtin a yard of other *Xyris* of much lower hydroperiod soils. A similar situation could arise naturally where large trees have toppled to leave small potholes in which drainage water accumulates. Yet, in spite of artificial or natural compression of habitat, I have yet to see what appears to be a hybrid swarm involving *X. fimbriata.* A possible explanation for this may lie partly in the very late flowering season of this species, which is probably the last of them all to come into bloom. In addition, this species flowers in the morning while its most common cohabitant, *X. smalliana,* flowers in the afternoon.

X. fimbriata is one of the few of our *Xyris* which is very quickly distinguishable from the others; its scape ridges are always harsh to the touch, its spikes are dull and appear fuzzy from the numbers of exserted, fimbriate, lateral sepals, and its very tall, willowy appearance make it easily distinguishable from a distance. A testimonial to the ease with which it may be identified is in its singularly uncomplicated nomenclature.

15. XYRIS SMALLIANA Nash, Bull. Torrey Club 22: 159. 1895.

Xyris caroliniana Walt. var. *olneyi* Wood, Classbook ed. 2: 564. 1847.
Xyris congdoni Small; Britton, Man. Ed. 2: 1057. 1905.
Xyris smalliana Nash var. *congdoni* Malme, Mull. Torrey Club 64: 45. 1937.
Xyris smalliana var. *olneyi* (Wood) Gleason ex Malme, N. Am. Fl. 19: 13. 1937.

Solitary or in small tufts, perennating by pairs of lateral buds whose scales quickly become green, elongate. Principal leaves linear (19-)

30-50 (-60) cm. long, 0.5-1.5 cm. broad, usually pinkish, sometimes pale green toward the base, the rest of the leaf a deep lustrous green, flat or slightly twisted, and more or less evenly tapering to a slightly incurved acute tip. Sheathes of the scape shorter than the leaves, the oblique orifice terminating in a cusp-like blade. Scapes 50-150 cm. long terete and very low ribbed below, 1-2 ridged and somewhat flattened toward the spike, smooth. Spikes 1-2 cm. long (rarely to 2.5 cm.), ellipsoidal or narrowly ovoid, of many, closely imbricated, bracts. Fertile bracts 5-8 mm. long, ovate, entire, the matrix a lustrous brown, the dorsal area gray-green, elliptic. Lateral sepals slightly to conspicuously exserted, pale brown, the keel lacerate toward its apex, entire below. Blades of petals obovate, 5-6 mm. long, yellow, unfolding in the afternoon. Seeds narrowly ellipsoidal to ovoid, 0.7 mm. long or somewhat longer, the longitudinal ribs few, often irregular; cross lines evident, irregularly distributed.

Sands, sandy peats, peat-mucks of pineland pools, roadside ditches, riverbanks, ponds, cypress ponds and lakeshores, primarily not far from the seacoast, Maine south to peninsular Florida, west in the Coastal Plain to Mississippi.

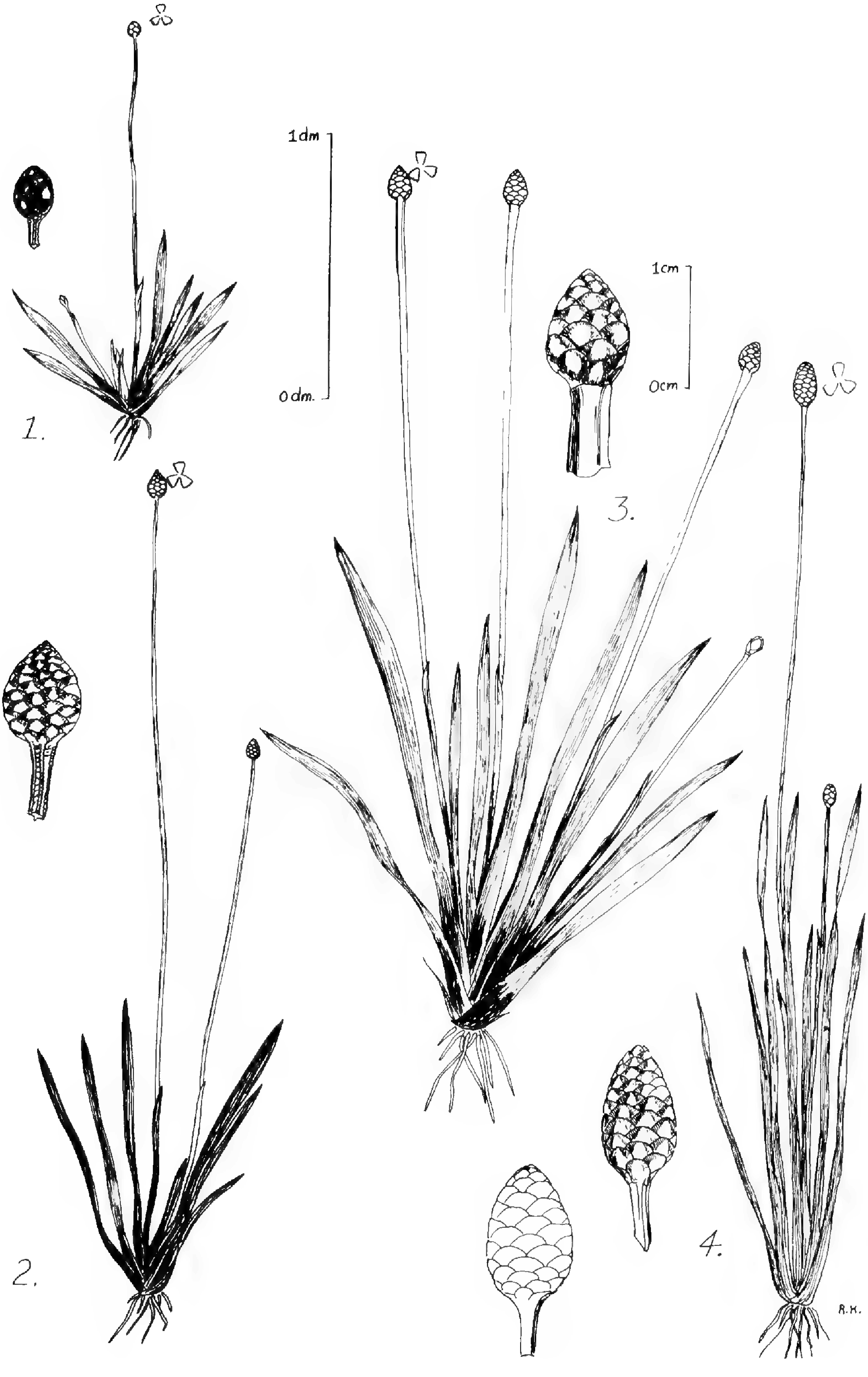
Type. U.S.A. FLORIDA. LAKE CO.: in water at Lake Ella, vicinity of Eustis, *Nash 1584. Holotype* at NY.

Remarks. This tall *Xyris* is most often in association with *X. fimbriata* and *X. jupicai* throughout its range, but does not appear to get as far inland. It is quickly discernable from the former by its smooth scape edges (in contrast to the scabrous ones of *X. fimbriata)* and from the latter by its exserted sepals and larger seed.

16. XYRIS **longisepala** Kral, sp. nov.

Caules singulares vel subcaespitosi laeves. Planta post meridiem florens. Semina ellipsoidea alveolata usque 0.5 mm. longa.

Solitary or in small tufts, smooth. Leaf linear (6.0-) 8.0-25.0 cm. long, 1.0-2.0 mm. broad, acute, (in drying indistinctly nerved, the marginal nerves thickened and pale-cartilaginous) pinkish or pale-brown or greenish below, a dull green above, sometimes with some reddish-brown streaks of pigmentation. Scape (30.0-) 40.0-80.0 (-82.5) cm. long, 0.7-1.0 mm. broad (measured at 1 spike length below the spike base) twisted but not flexuous, terete and many-ridged below, somewhat flattened in the cross-section and 1-ridged above. Sheathes of the scapes 5.0-15.5 cm. long, dilated above, but narrowing to very short, cusp-like blades. Spikes ellipsoidal to oblong, 1.0-1.6 cm. long, 0.5-0.8 cm. thick, blunt, of many somewhat loosely imbricated bracts. Fertile bracts broadly oblong, 4.0-6.0 mm. long approximately 3.0 mm. broad, at anthesis entire, in fruit somewhat erose, tan with a pale greenish or reddish-brown dorsal area. Lateral sepal linear-curvate, approximately 0.5-1.0 mm. longer than the subtending bract, the keel lacerate-fimbriate or somewhat ciliate for 2/3 of its length toward the summit where the fimbriae are longest.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Blades of petals obovate, ca. 3.5 mm. long, opening in the afternoon. Seeds ellipsoidal, about 0.4-0.5 mm. long with about 12 prominent longitudinal nerves and several slightly less distinct cross lines.

Moist to wet sandy shores of limesink lakes and ponds, northwest Florida.

Type. U.S.A. FLORIDA BAY CO.: sandy shores of Merial Lake, n. of Panama City, *R. Kral 15672.* Holotype at SMU; isotypes at: BM, DS, DUKE, F, FLAS, FSU, GH, IA, ILL, ISC, K, MICH, MSC, NCSC, NY, PC, PH, RSA, UC, US, USL, VDB.

Ecology and Identification. X. longisepala, together with *Rhexia salicifolia* and *Hypericum lissophloeus,* appears to be confined in distribution to the rash of sinkhole ponds and lakes so characteristic of the karst topography of northwestern Florida. It is particularly abundant during low-water periods, when large expanses of almost pure sand are exposed along the lake margins. Here it may be in association with *X. smalliana* or *X. jupicai* or both, together with another new species of *Xyris, X. isoetifolia.*

It is immediately distinguishable from *Xyris jupicai* in that its flowers open in the afternoon, at a time when those of the latter are closed. However *X. smalliana* flowers are open at the same time of day and plants of that species bear many resemblances to this newly described one. Essentially the differences are in the lower stature, the different spikeshape, the character of the keel of the lateral sepal, the smaller petals, and especially the smaller seed with its regularly ridged testum.

I was unable to get a crop of *X. longisepala* to grow beyond the seedling stage in that the entire crop was allowed to dry out during my field tour of summer 1963. However, the seedlings are closest in character to those of *X. smalliana,* to which this species must be quite closely related.

17. XYRIS IRIDIFOLIA Chapm., Fl. S. U.S. 501. 1860. (Figs. p. 243).

Solitary or in small tufts, the pinkish or purplish, keeled, bases, shallowly set on a mucky substratum, perennating by means of lateral, overwintering shoots. Leaves linear, iridiform, 40-70 cm. long 10-25 mm. broad, flat or slightly twisted, smooth, and a deep, rich green; tip broadly acute to blunt, incurved; base slightly dilated, keeled, pink or pale maroon, with a broadly hyaline margin. Sheathes of the scape shorter than the leaves, deep brown or reddish brown and tight below, becoming somewhat looser and green above, the oblique orifice with a short cusp-like blade. Scapes 60-80 cm. tall, linear, straight or slightly twisted, terete and 2-ridged below, conspicuously broadened and flattened above, the edges smooth. Spikes oblong to broadly oblanceolate, rarely ovoid, 2.0-3.5 cm. long, blunt, of very many, closely imbricate bracts, the lower ones barren. Fertile bracts 6-7 mm. long, broadly obovate to suborbicular, entire, the outer surfaces dark purplish or reddish-brown, shining save

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(Opposite) 1. *X. difformis* var. *curtissii.* 2. *X. difformis* var. *floridana.* 3. *X. difformis* var. *difformis.* 4. *X. jupicai.*

for a paler green or gray-green oval or triangular dorsal area. Lateral sepals included, linear, about the length of the bracts, castaneous, with a broad, lacerate keel. Blades of the petals cuneate, ca. 3 mm. long, yellow, opening in the morning. Seeds oblong-fusiform, 0.8-1.0 mm. long, opaque, dark, farinose, the regularly arranged longitudinal lines obscured by the farina.

Wet sands, but more commonly wet sandy clay, sandy peat or peat muck or alluvium of stream banks, cypress swamps, marshes or pineland pond margins, the bases commonly submersed, Coastal Plain, southeastern Virginia south to northern Florida and west to eastern Texas.

Type. U.S.A. FLORIDA. FRANKLIN CO.: "Apalachicola"; collected by Dr. Chapman. Holotype at NY.

Remarks. This is such a distinct species that it has no synonymy, a rare thing in *Xyris*. It is best developed on fine textured wet soils such as peat mucks, clays, or alluvium; it may survive for a season but will not perennate on a soil which dries out at any time. Its commonest associates are *X. fimbriata*, *X. smalliana*, *X. stricta*, *X. serotina*, *X. jupicai* and *X. difformis*. It, together with *X. difformis*, will often form belts of rich green along the creeks in southern Mississippi and in the pinelands of Louisiana. It may reach flowering size from seed in one season; the seedlings show the same high concentration of reddish pigment, often being a pure maroon from base to tip. *X. iridifolia* appears to be one of the *Xyris* whose distribution is confined to the heavier soils; it is therefore one of the more frequently encountered *Xyris* west of the Mississippi River. East of the Mississippi it becomes somewhat more scarce, save where belts of finer alluvial soil cross the sandy pinelands and it has yet to be found in peninsular Florida whose soils are almost exclusively sands.

Xyris iridifolia shares the characteristic of farinose seed with three other entities of *Xyris* namely *X. serotina*, *X. difformis* var. *floridana*, and *X. stricta;* it is usually in the same area with all of these in the southeastern Coastal Plain. However, *X. serotina* lacks the purplish leaf bases and has a much smaller spike; *X. difformis* var. *floridana* is a much more slender plant with a much smaller spike and seed; *X. stricta* has much narrower leaves and the keels of its lateral sepals are ciliate.

The field work of summer, 1962, 1963, has convinced me that *X. iridifolia* is a remarkably uniform entity throughout its considerable range and does not appear to produce hybrids with other species (contrary to my previous, less qualified, opinion in Rhodora, 1960).

A large quantity of seed of *X. iridifolia* was gathered in December 1962, planted in the greenhouse in March 1963 and by fall had grown into a large crop of seedling plants all of which were remarkably similar. This seed was from an area which also supported very large populations of *X. stricta*, *X. ambigua*, the former of the two being strongly suspect as a hybrid between *X. iridifolia* and *X. ambigua*.

18. XYRIS JUPICAI L. C. Rich., Act. Soc. Hist. Nat. Paris 1: 106. 1792. (Figs. p. 246).

?*X. anceps* Pers. Syn. Pl. 1: 56. 1805.
X. jupicae Michx. Fl. Bor. Am. 1: 23. 1803.
X. communis Kunth. Enum. Pl. 4: 12. 1843.
X. arenicola Miq. Linnaea 18: 75. 1844.
?*X. ekmanii* Malme, Ark. Bot. 19: 4. 1925.

Short lived perennial, solitary or in small tufts, dying completely after one year from seed or perennating from bulbous lateral overwintering buds. Leaves linear, 10-60 cm. long, 5-10 mm. broad, ascending, lustrous, yellow-green, pale or stramineous toward the base. Sheathes of the scape shorter than the principal leaves, somewhat loose toward the oblique orifice which terminates in a short, cusp-like blade. Scapes 20-70 (-90) cm. long, terete and many ridged below becoming somewhat flattened, narrower, and usually one or two-edged above. Spikes at seeding time ovoid, ellipsoidal or oblong, 5-15 mm. long of many (several in depauperate individuals) rather loosely imbricated bracts. Fertile bracts obovate to oval, 5-7 mm. long, the exposed margins subentire, the outer surface pale to dark brown, dull, the dorsal area rectangular to elliptic, green, or brownish on old spikes. Lateral sepals included, about the length of the bracts, linear and slightly curvate, the thin wings broad, the somewhat thicker keel lacerate for the upper 2/3 or 1/2 its length. Blades of petals cuneate, ca. 3 mm. long, yellow, opening in the morning. Seeds broadly ellipsoidal, ca. 4-5 mm. long, the longitudinal ribs numerous but faint; cross lines not evident.

Wet sands or sandy peat or alluvium of roadside ditches, flatwoods pond margins, cypress swamps and lakeshores, but particularly in mechanically disturbed wetlands, Coastal Plain, New Jersey south to Florida and west, chiefly in the Coastal Plain to Texas and Arkansas: this species probably adventive from Latin America.

Type. FRENCH GUIANA. "Cayenne"; collected by LeBlond. Holotype presumably at P. An isotype of what is probably this plant is the type of *Xyris communis* Kunth.

Remarks. This is probably the most expressive, morphologically and ecologically, of all the *Xyris* I have had field experience with. From all appearances it is spreading very rapidly in the Coastal Plain, in that it is certainly the commonest *Xyris* of roadside ditches; thus the proportion of it in collections appears to be growing in relation to that of other species. In the Florida Everglades I have seen it form on wet, mildly acid, sites, stands so extensive as to meet the horizon; there it makes up a very significant part of the sea of grasses and sedges and appears to be very effectively naturalised. This is in sharp contrast to its behavior in ditches which cut through very acid *Sphagnum-Sarracenia* bogs inland or to the north; here it appears not to spread beyond the limits of the ditches, leaving the bogs themselves to be held by such *Xyris* as

X. platylepis, X. ambigua, X. torta, etc. It appears to spread into the more acid sites only when these are disturbed, and then only when soil is directly exposed, later giving way to higher successional levels of plants. Thus it appears to me to be commonest, most natural, on less-acid marshy situations. This is at least the case in Florida where it is part of a mildly acid marsh complex made up of such species as *Dichromena colorata, Rhynchospora inundata, R. schoenoides, R. microcarpa, Fuirena breviseta, Fimbristylis caroliniana, Psilocarya nitens, P. schiedeana, Manisuris rugosa, Panicum hemitomon* and such plants as occupy the "twilight" zone between brackish marsh and acid marsh. Many of the above mentioned plants also thrive along roadside ditches in the lower coastal plain though they might not survive in the more acid wetlands adjacent unless these are disturbed. The above speculations are based upon countless observations, particularly in the Florida marshlands, and would make an interesting ecological proof.

In peninsular Florida, *X. jupicai* is most often associated with *X. elliottii, X. bravifolia, X. smalliana, X. difformis* var. *floridana, X. fimbriata,* but is most often in the same moisture zone as the latter three. Yet *X. jupicai,* unlike these species has a wider tolerance, apparently, to both soil texture and soil moisture (both of which are at least indirectly related to pH) and thus can find greater avenues of dispersion to the north and to the west. It can be equally at home on alluvium or sand, thus its broader "niche" plus its tropical distribution lead me to speculate further. Seeds of it could have been introduced with the introduction of rice culture (as is true of several of our sedges), or could have come to us through the Caribbean island arc. A southern oriental origin is not out of the question, but could more effectively be studied in the process of a world-wide revision. I would not be much surprised if material closely agreeing with *X. jupicai* could be found in southern Asia and that the Hermann collection on which *X. indica* was partly based (but which is now missing, according to Rendle, l.c.) may have been the same thing. Some pre and shortly post-Linnaean illustrations of plants which fall within this complex do bear resemblance to this species.

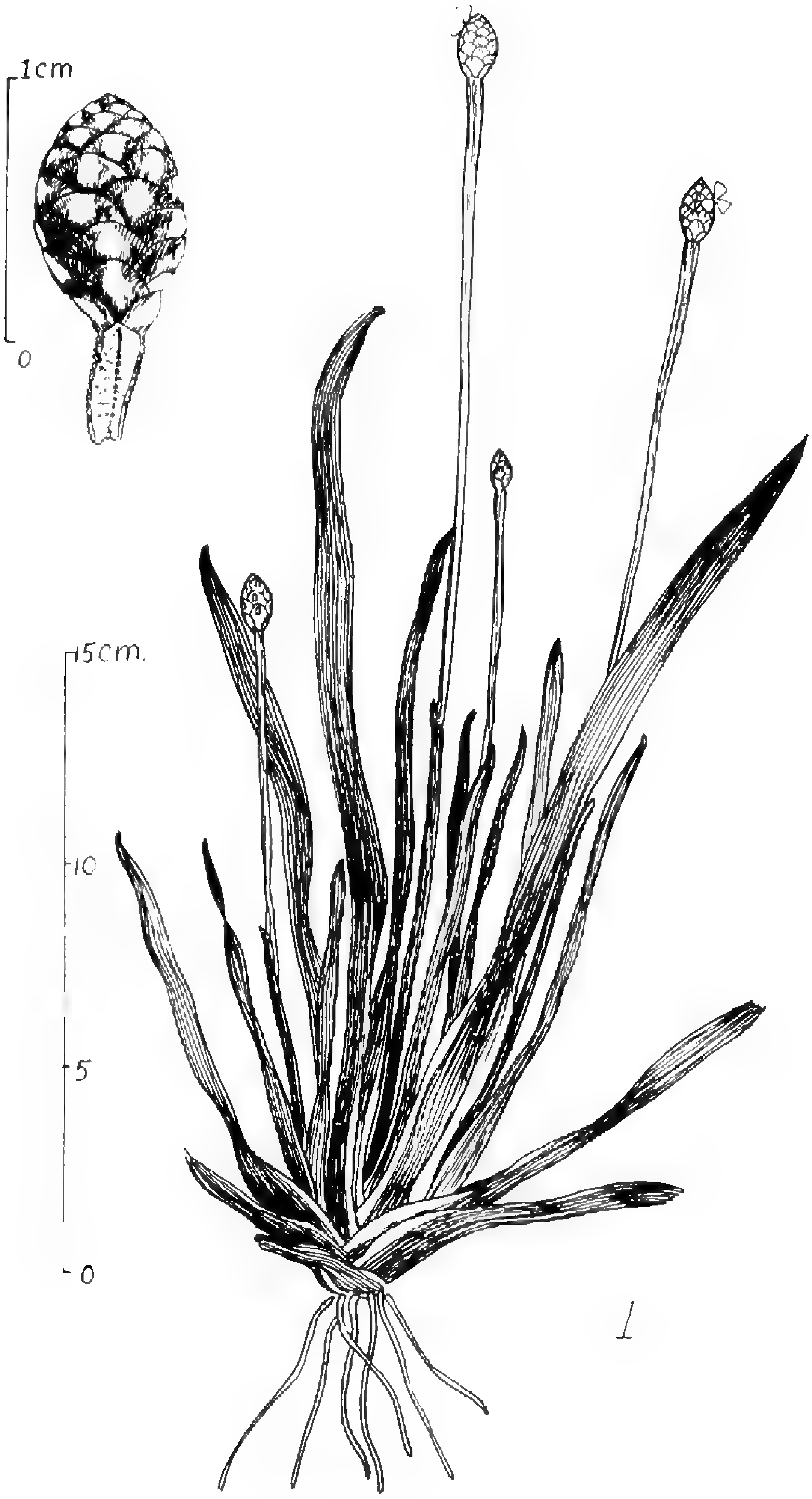
In such a genus as *Xyris,* whose species are often very close morphologically and cytologically, the nomenclature of the most widespread and weedy entities is naturally the greatest problem. That of *X. jupicai* has become almost inextricably interwoven with that of *X. difformis* so that an extremely large number of Old and New World names for both and for each has become involved. Several present authors, having decided that little consistent difference exists between the complex of forms representing both species, have designated all as *X. caroliniana.* Yet it has just been determined that true *X. caroliniana* belongs to an entirely different complex.

My own solution to the problem is predicated on what I believe to be a demonstrable difference between *X. jupicai* and *X. difformis* (see discussion under *X. difformis* and varieties). It is my contention that a weedy *Xyris (X. jupicai)* which lacks reddish or purplish pigmentation, which has narrow, ascending leaves, and which has very narrow scape ridges is presently contending for habitats in the southern U.S. with a less-weedy, reddish-pigmented, spreading-leaved, broad-scaped native *Xyris* whose northern range is as yet uninvaded. I have seen mixed populations of the two in Virginia, the Carolinas, Georgia, Florida, Mississippi, and eastern Louisiana and have yet to see examples of intermediates. After some practice in noting the differences between the two species any trained observer would find it an easy matter to sort them in the field and to note the frequency of occurrence of both on the same disturbed sites (i.e. bulldozed swampy woods, roadside ditches, farm pond margins, power line clearings through swamp forest) yet the absence of intergradation. The main problem is to attempt to convince a reader who then promptly goes to an herbarium collection of both species. Unfortunately the broad, scapes, reddish pigmentation and spreading-leaved habit of *X. difformis* are all modified through the process of pressing and drying. It is also true that late summer material, or seeding material which is beginning to die back, will not show the fine character of pigmentation and will look much like herbarium material in the other respects. Yet differences are there, consistent ones, should the studnt look for them in the field.

19. XYRIS DIFFORMIS Chapm., Fl. S. U.S. 500. 1860. (Figs. p. 246).

?*Xyris elata* Chapm. Fl. S. U.S. 501. 1860.

Solitary or in small tufts, the soft, pinkish or purplish (rarely greenish) bases rooted on wet sand or muck, perennating by pairs of pale, low-set, lateral shoot buds. Principal leaves broadly linear or linear-elliptic, 10-50 cm. long, 0.5-1.5 cm. broad, usually flabellately spreading, a dark and lustrous green but toward the bases becoming pinkish, purplish or reddish. Apex of the leaf acute, slightly incurved. Surface of the leaf smooth. Margin of the leaf above the equitant portion usually papillose, rarely smooth. Sheaths of the scapes shorter than most of the leaves, thin, tight, save at the slightly loosened, oblique orifice whose upper margin converges to a short, cusp-like blade. Scapes linear, 15-70 cm. long, terete, brownish and twisted below, straightening and becoming deep green and oval in the cross section above with two prominent, broad, thin ridges whose combined breadth is at least equal that of the scape (in southern specimens) and whose margins are papillose, together with occasional, lower ridges. Spikes at seed bearing time ovoid, ca. 1 cm. long (less in northern specimens), acute, dark, of many, usually tightly imbricated bracts of which the lower few are barren (to the north the spikes become shorter, broader, blunter). Fertile bracts 5-7 mm. long, obovate to oval, not keeled, the apex rounded and subentire, the outer surface usually deep brown, lustrous, the dorsal area greenish or gray green, rectangular to round or elliptic. Lateral



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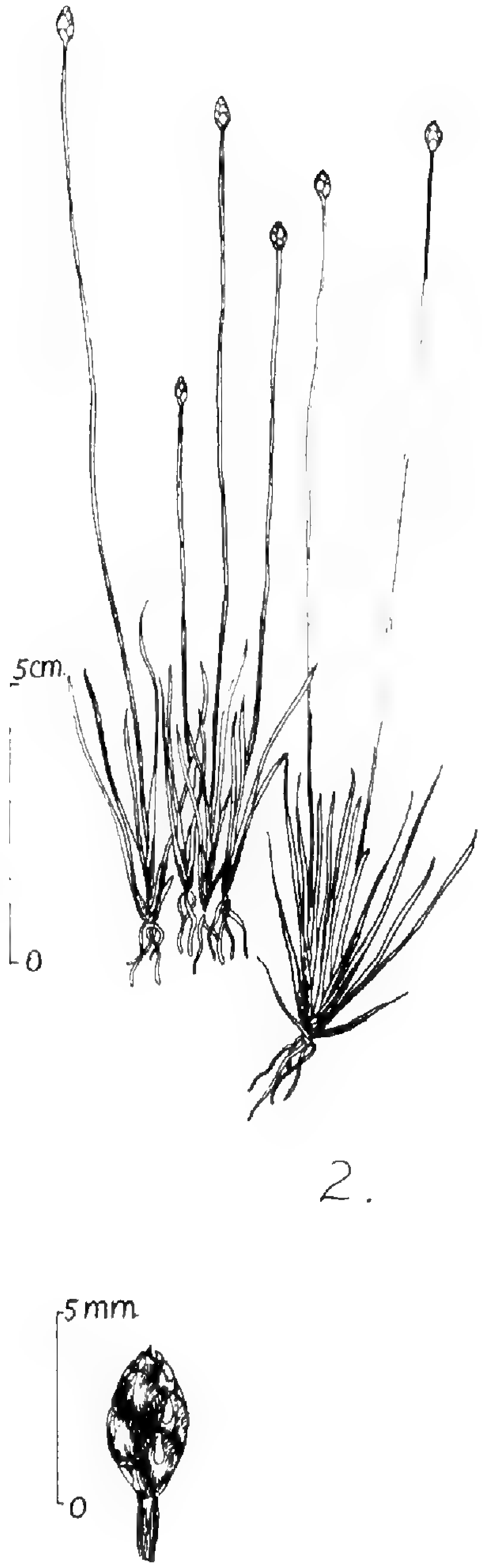

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sepals included, about the length of the bracts, the wings very broad, thin and pale brown, the keel slightly thicker and darker, its margin jagged from about the middle to the apex. Blades of the petals cuneate, ca. 4 mm. long or less, yellow, unfolding in the morning. Seeds broadly ellipsoidal, ca. 0.5 mm. long, transluscent, with 24-28 very fine, straight, longitudinal lines of small papillae, the vertical lines straight, but very indistinct.

Wet sands or sandy peats of flatwoods pond margins, ditches and lakeshores, but more often on alluvial situations (often in fairly heavy shade), primarily in the Coastal Plain from eastern Texas to its northern limits in New England and southeastern Canada, but inland into the Canadian Shield (by way of the St. Lawrence River?) and Great Lakes system.

Type. U.S.A. FLORIDA. FRANKLIN CO.: "marshes, Apalachicola"; collected by Dr. Chapman. Holotype at NY, as designated by Dr. Blomquist.

Remarks. A partial solution to the complex nomenclature engendered by many conflicting senses of *X. caroliniana* Walter could only come through considering *X. difformis* to be the same as the more weedy *X. jupicai,* whose range extends at the least over a large part of the warmer Americas. However, *X. difformis* does differ from *X. jupicai* in several, consistently demonstrable, ways. It is my belief (see discussion under *X. jupicai)* that two constellations of forms exist within the United States. One, here treated as *X. difformis,* is comprised of maroon-pigmented, sometimes roughened-or-papillose, spreading-leaved, natives. The other is composed of green and ascending-leaved, smoothish, weeds which may not be native to the country or are at least violently expanding their range in the nature of adventives. The two complexes overlap in range in the southern United States, but only the former extends out of the Coastal Plain into other physiographic provinces. If my viewpoint is used, then the earliest name applying to a *Xyris* in this complex is *X. jupicai* Rich (1792) and that for the maroon pigmented entities is *X. difformis.*

Convinced at last (1960) of the distinctness of *X. difformis,* I became involved with locating mixed populations of *X. difformis* and *X. jupicai,* for the purpose of seeing what effect these two similar entities might have on each other. In August of 1960 I did find such a situation in Nansemond County, Virginia, *(Kral 13797, 13798).* On muck, under heavy shade of bottomland hardwoods, was a large stand of *X. difformis* with its spreading, broad, deep-green but maroon-based leaves, broad scapes and ovoid spikes. Countless hundreds of individuals were present, but none of any other species of *Xyris.* However, less than ½ mile distant, the road I was travelling cut through the acid sands of loblolly pine flatwoods. In the ditches on both sides of the road was a super-

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(Opposite) 1. *X. serotina.* 2. *X. isoetifolia.*

abundance, but in this case two kinds, of *Xyris*. One was clearly *X. difformis;* the other, while of about the same stature, lacked the reddish pigment, had narrower spikes and scapes, and narrower, paler-green, ascending, leaves, all characteristics of *X. jupicai*. No evidence of intermediate forms could be seen, although I examined many hundreds of individuals that day and the mixed population extended along the road for more than half a mile.

Curiosity still further aroused I decided to look at all available material of this complex in my own and in borrowed collections to see if the character of pinkish or maroon pigmentation could consistently be correlated with the other "difformis" type characteristics of scape and leaf. Almost invariably associated with the reddish pigmentation were deeper green foliage, broadened, flattened, upper scapes, and darker, more ovoid, spikes; conversely, all green or dull-based plants had paler foliage (probably because of lack of red pigment) narrower upper scapes, and spikes tending to be narrower. (On older or faded specimens it was often necessary to study leaf surfaces at high magnification so as to notice presence or absence of pigment-congested strands of cells.) By utilising the above mentioned characteristics, together with the more spreading-leaved habital character of *X. difformis,* I was able to sort rapidly, thus distinguish, specimens which previously had caused me much difficulty. Subsequent fieldwork with *Xyris* during summers of 1962, 1963, 1964, in the Carolinas, Florida, Georgia, Louisiana, and Mississippi was rewarding in concepts of habitats of the two entities. I began to look for *X. difformis* in hardwood bottoms, or along pineland streams and river systems, often under relatively undisturbed conditions and in fairly heavy shade, and it was never a problem to find *X. jupicai* along most of the wet roadsides or in other disturbed wetlands. I presently suspect that the entity most at home in undisturbed habitats is *X. difformis* and that *X. jupicai* is not evident or at least is less frequent, in such situations. On the other hand, *X. difformis* does appear on disturbed wetlands (seldom far from stream or river bottoms) but is less often encountered there than is *X. jupicai*. In that few instances of morphological intermediacy have as yet been encountered, and in that the two often do occur in mixed stands, these entities must be biologically distinct.

An examination of specimens from this complex borrowed from DUKE, SMU, WISC., has resulted in suspicion that *jupicai* characters appear to disappear north of New Jersey, while *difformis* characters persist. I have observed that the character of leaf papillae displayed in such entities as *X. papillosa, X. bayardi, X. curtissii,* and *X. serotina* (sensu Malme and later authors) is invariably correlated to the production of reddish pigment, and thus it appears to me that too many other characteristics are shared by the first four entities above for sensible, distinguishable, treatments of them to be rendered. I believe that the above constitute a natural assmblage of varieties and forms, the central type of which is *X. difformis*, which includes an extremely wide range extending from the Gulf and southern Atlantic United States all the way along the coast to the southern and eastern fringe of the Canadian Shield.

20. XYRIS DIFFORMIS Chapm. var. **curtissii** (Malme), Kral, comb. nov.
    X. neglecta Small, Bull. Torrey Club 21: 30. 1894; not *X. neglecta* Nilss. 1892.
    X. curtissii Malme, Ark. Bot. 13: 24. 1913.
    X. papillosa Fassett, Rhodora 39: 459-460. 1937.
    X. serotina Chapm. var. *curtissii* (Malme) Kral, Rhodora 62: 310. 1960.

As the species but smaller (not often taller than 2 dm.), more tufted, and with the margins of the equitant portion of the leaves very broad and pinkish-transluscent. Surfaces of the leaves papillose or low tuberculate, the papillae or tubercles in slightly diagonal lines, the leaf bases pinkish or purplish and similarly papillate. Sheathes of the scape looser, the bases a rich brown, sometimes castaneous. Scapes rarely as tall as 20 cm., terete with many low ridges below becoming 3-7 carinate and blocky or angled in the cross section above (save in northern forms which may be oval in cross section and with but 1 pair or only one of scape ridges), the margins of the scape ridges papillate or scabrid. Spikes at seeding time broadly ovoid to ellipsoidal, seldom longer than 0.5 cm., of but few bracts. Fertile bracts about 3-4 mm. long, suborbicular to broadly obovate, the outer surfaces pale to deep brown, lustrous, the dorsal areas ellipsoidal, gray-green, becoming brown and indistinct with age. Lateral sepals included, about the length of the bracts, linear-curvate, a lustrous brown, the thin wings broad the slightly thicker keel broadened and somewhat lacerate toward its tip, or even entire. Blades of the petals obovate or cuneate, slightly less than 3 mm. long, yellowish, unfolding in the early morning. Seeds oblong or ellipsoidal, ca. 0.5 mm. long (longer in some northern forms), transluscent, with 12-14 faint, longitudinal lines, the vertical lines even more faint.

Sandy peats of ditches and bogs, flatwoods or acid seepage areas, the Great Lakes system and southeastern Canada south, primarily toward the coast into the peninsula of Florida and west, primarily in the Coastal Plain to eastern Texas.

Type. U.S.A. FLORIDA. DUVAL CO.: "near Jacksonville"; collected by Curtiss *(Curtiss 4316);* holotype at NY.

Remarks. This little plant, often not taller than such Xyrids as *X. drummondii, X. flabelliformis, X. brevifolia,* is quickly recognisable by its pinkish, papillate bases, caespitose habit, round or scabrous-angled upper scapes, and small, transluscent seed. It could be cursorily confused with depauperate examples of the variety *floridana* of *X. difformis,* but these are distinguishable by their farinose seed. Chapman (1860) could have been referring to either when he commented, in regard to

X. serotina:

> "Varies with shorter leaves (2-3 inches), and smaller globose or ovate heads. . . . . .".

However the plant described by Chapman as *X. serotina* most closely fits his specimens of a larger, greenish or stramineous (not pinkish) based entity which is here decided upon as type for *X. serotina*. Thus the pinkish or maroon based plants are here considered as varieties of *X. difformis*.

Papillose, clear-seeded, Xyrids to the north have been identified variously as *X. bayardii* Fernald, *X. montana* Ries, *X. papillosa* Fassett. I have examined the types of the former and the latter and specimens of all; the type of the first is indistinguishable from the Curtiss collection here called type for *X. difformis* var. *curtissii;* the second may have forms which have slightly larger seed, but its so-called "rhizomes" appear to be nothing more than the same sort of habitat reaction found in southern forms of "curtissii" and in other *Xyris;* the third is the result of a northerner's first contact with a papillose-leaved *Xyris*.

The variety *curtissii* is most abundant where moist seepage areas of sand are exposed in hillside bogs, pondshores, streambanks, roadbanks, or savannas; it also forms tufts on sphagnous substrata. The bases of the plants, because of the nature of such habitats, are often buried in detritus or wash, and are therefore often very pale, often colourless.

21. XYRIS DIFFORMIS Chapm. var. **floridana** Kral, var. nov.

Folia linearia 10-30 (rarius -50) cm. longa, 1.5-6.0 mm. lata, tuberculato-scabrida, vaginis laxis. Semina non translucida.

As the species but with surfaces and margins of the linear (10-30, rarely to 50 cm. long, 1.5-6.0 mm. broad) leaves tuberculate scabrid, dull green save for the pinkish or purplish or maroon, thin margined, equitant portion, the papillae or tubercles in short horizontal or oblique lines. Sheathes of the scape loose save at the very base, which is a deep rich brown, sometimes castaneous. Scapes linear, twisted and terete below, but straight, 20-50 (-75) cm. tall, becoming broadly oval or blocky or angled in the cross section above, with 3-7 (-13) prominent, tuberculate-scabrid ridges, the two broadest comprising the scape edges. Spikes at seeding time broadly ovoid, 1.0-1.5 cm. long, acute or sometimes acuminate, of many tightly appressed bracts, the lower barren. Fertile bracts 4-7 mm. long, obovate to suborbicular, the outer surface a dark lustrous brown, the dorsal areas dull green, oval or obovate, the exposed margin entire or becoming somewhat lacerate with age. Lateral sepals included, ca. 5 mm. long, castaneous, the keel lacerate from near the base to the apex. Blades of the petals cuneate, slightly less than 3 mm. long, yellow, opening in the morning. Seeds broadly ellipsoidal, slightly less than 0.5 mm. long, opaque, with 18-20 somewhat irregular longitudinal, raised

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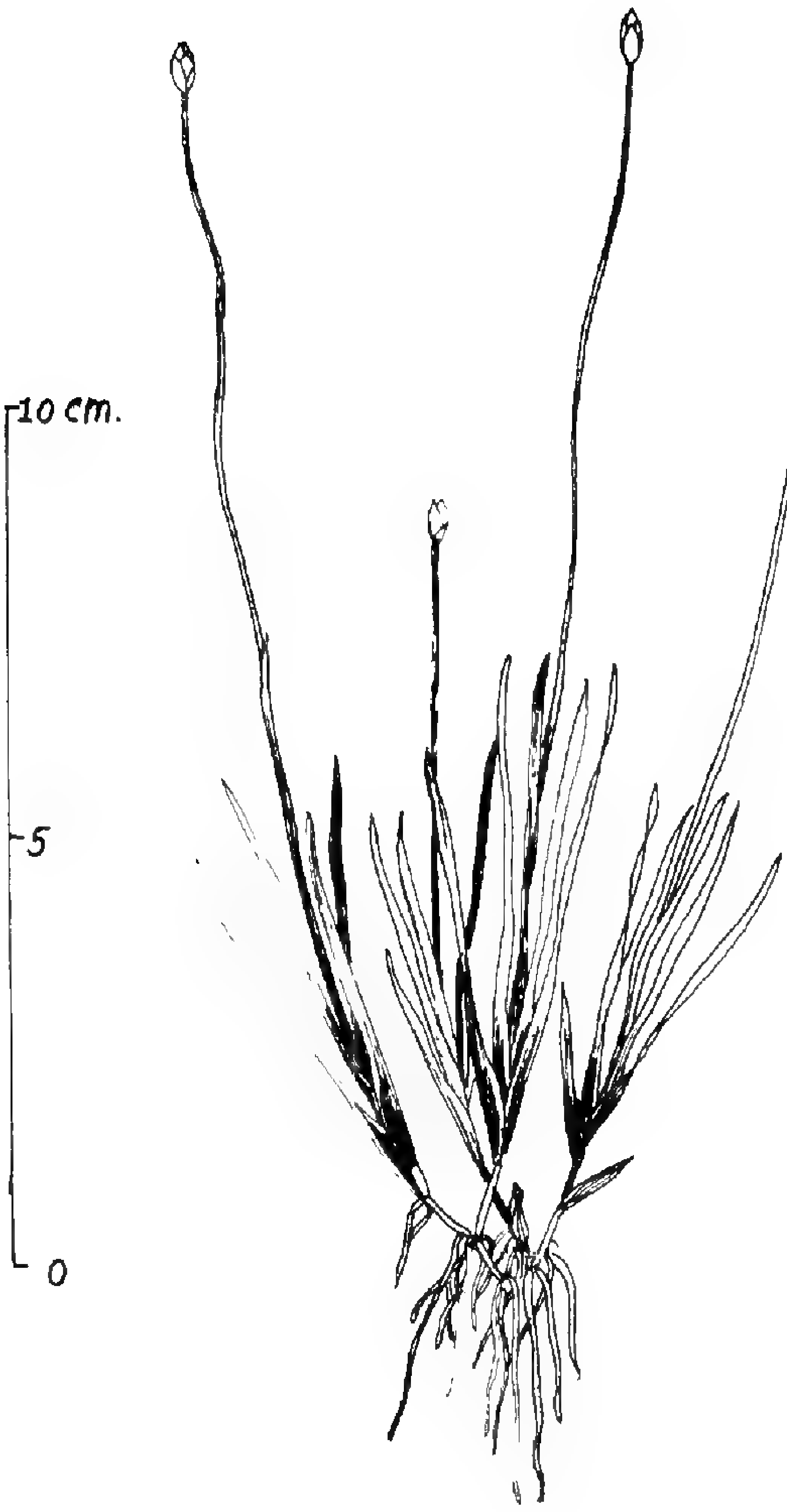
(Opposite) Xyris montana.


10 cm.
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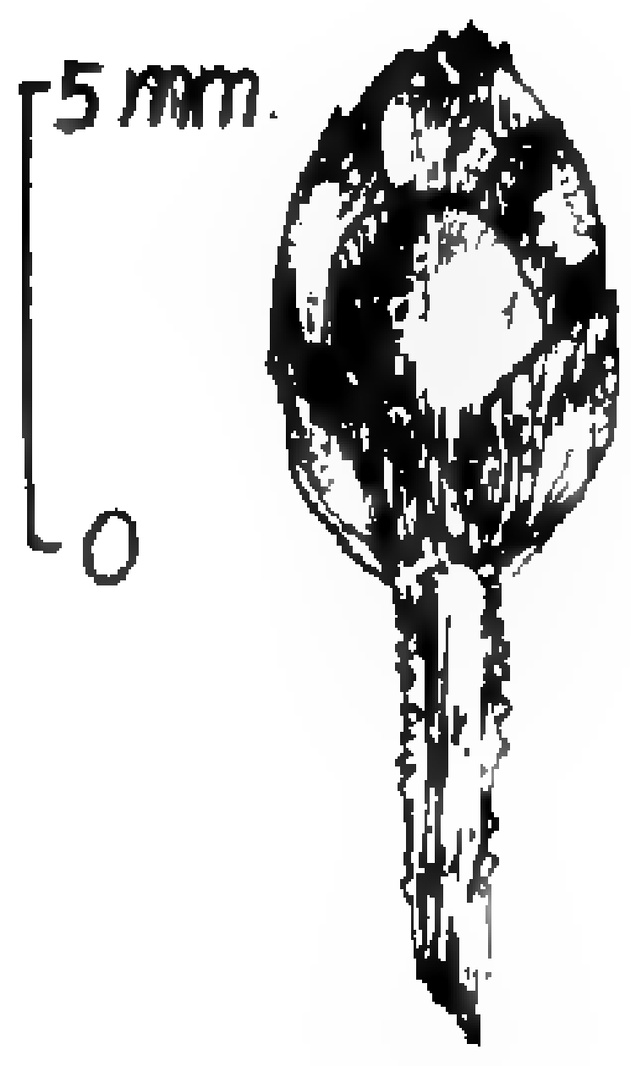
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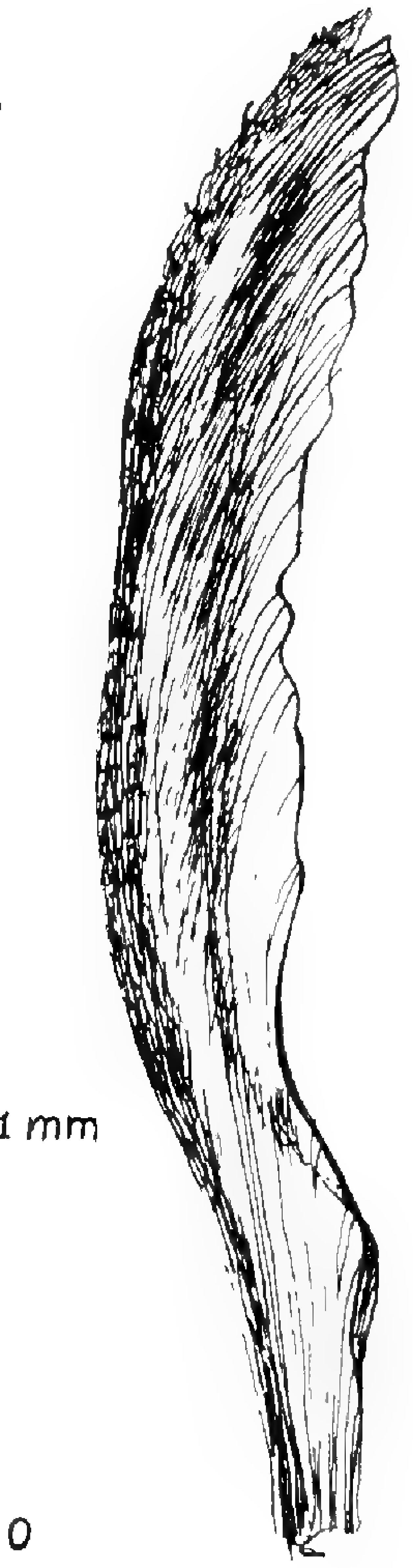
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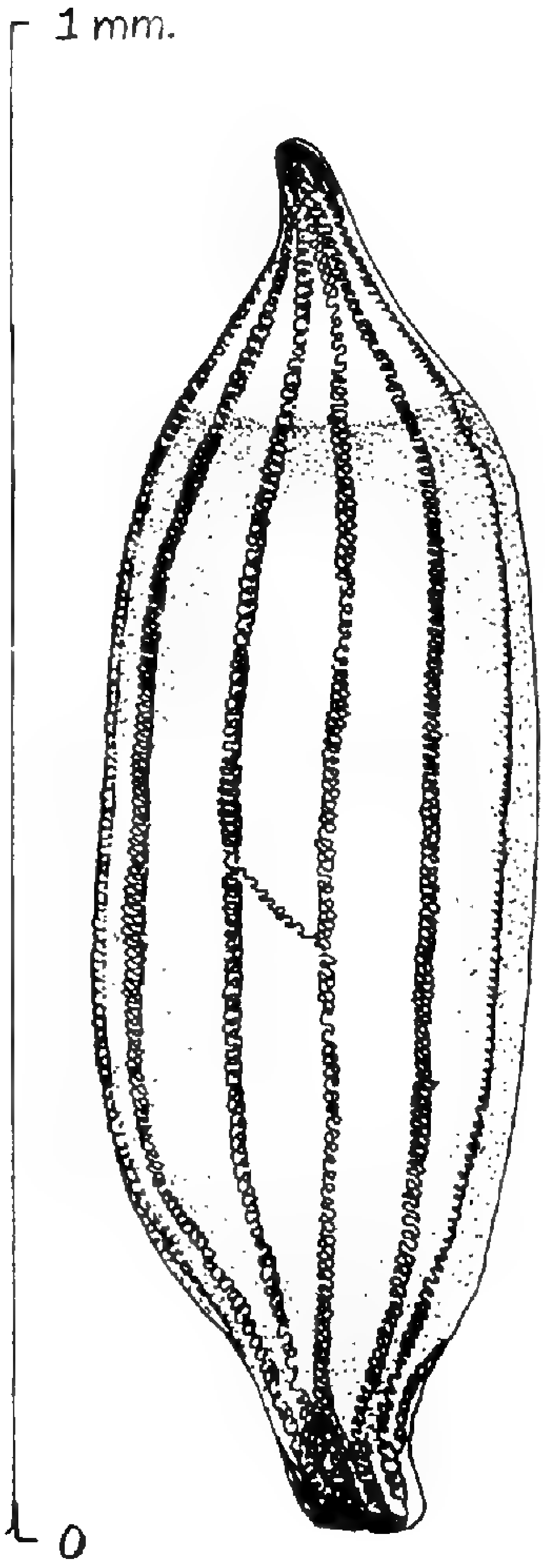
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ridges together with equally prominent, irregularly disposed vertical cross ridges, these frequently obscured by a farinose substance.

Moist sands and sandy peats of pine flatwoods, roadsides and savannas, Coastal Plain south to southern peninsular Florida and west to the Florida parishes of Louisiana.

Type. U.S.A. GEORGIA. CHATHAM CO.: 7 mi. n. Richmond Hill, *Kral 18941.* Holotype at SMU; isotypes at BM, DS, DUKE, F, FLAS, FSU, GH, IA, ILL, ISC, K, LPI, MICH, MSC, NCSC, NO, NY, PC, PH, RSA, UC, US, USF, USL, VDB.

Remarks. In most treatments the farinose seed, lacerate sepal keel, and scabrosity of this plant link it with *X. serotina.* Chapm. However one has only to read the Chapman description of *X. serotina* and to examine his material of it deposited at NY to become convinced that he was primarily referring to a rather large, broad-leaved, plant of "pine barren swamps" whose leaves are quite long in relation to the scape lengths. There is no mention in Chapman's description of what seems to me to be a salient feature of the plant here treated as *X. difformis* var. *floridana,* namely the pinkish or purplish pigmentation of the leaf bases. Thus I designated the Chapman herbarium specimens of the robust, rigid leaved plant as the type material for *X. serotina* which leaves the maroon-based material in the Chapman collections to be designated as *X. difformis* var. *floridana.* Differences between it and *X. serotina* are shown in the table below, these based upon several large population samples of each, which were collected during the summers of 1962-1963, in Louisiana, Florida, Georgia, South Carolina, and North Carolina. Exsiccatae of all these are soon to be distributed.

X. serotina	*X. difformis* var. *floridana*
Plant base greenish or stramineous, often invested in the dull brown leaf bases of the previous season; roots coarse, when fresh a good millimeter broad.	Plant base pinkish, purplish, or maroon, old leaf bases not persisting; roots finer, rarely 1 mm. broad.
The plants in large, stiff-leaved, tufts, usually on muck or in shallow water; leaves often ¾ as long as the scapes, seldom narrower than 1 cm. at their broadest point above the equitant portion, the surfaces dull yellow-green.	The plants in smaller tufts or solitary, more willowy, usually on moist or wet sands or sandy peats, but not with the bases submersed or on muck; leaves seldom half as long as the scapes, seldom as broad as 1 cm., the surfaces dull but deep green.
Spike dull, broadly ellipsoidal, blunt.	Spike a dark, lustrous brown with sharply contrasting dark green dorsal areas, ovoid, acute.
Seeds ellipsoidal, caudate at one end, over 0.5 mm. long, usually closer to 6 mm., the longitudinal lines prominent but not much raised, 20-24.	Seeds ovoid to broadly ellipsoidal, about 0.5 mm. long, the longitudinal and vertical lines raised, giving the seed a somewhat cancellate look.

22. XYRIS MONTANA H. Ries, Bull. Torrey Club 19: 38. 1892. (Figs. p. 257).

X. flexuosa var. *pusilla* A. Gray, Man. ed. 5. 548. 1867.

Tufted, the soft pinkish or purplish bases often rooted in tufts of sphagnum or in muck, often with systems of ascending, rhizome-like buried stems. Principal leaves narrowly linear, 4-15 cm. long, 1.0-2.5 mm. broad, ascending, straight or slightly twisted, a dark green save toward the pinkish, purplish or reddish base. Apex of the leaf acute, slightly incurved. Surface of the leaf papillate or tuberculate-scabrid, the papillae scattered or in short, horizontal lines. Margin of the leaf above the equitant portion usually slightly thickened, papillose. Sheaths of the scapes shorter than most of the leaves, thin, tight, save toward the slightly loosened, long-bladed, orifice. Scapes linear or linear-filiform, slightly twisted, 5-30 cm. long, terete, brownish and readily disarticulating below, usually 2-4 carinate just below the spike, the ridges papillose. Spikes at seeding time broadly or narrowly ellipsoidal or ovoid, few-flowered, the lower bracts sterile ca. 4 to 5 mm. long. Fertile bracts 3-4 mm. long, narrowly obovate, not keeled; the apex rounded, slightly lacerate or low-fimbriate and with a narrow, reddish brown colour zone; the outer surface greenish-brown with the dorsal area narrowly ellipsoidal, indistinct, or at least not in sharp contrast. Lateral sepals about the length of the bracts, linear, slightly curvate or almost straight, a lustrous brown save for the darker, reddish-brown, narrow but thickened keel whose margin is entire or slightly ragged apically. Seeds narrowly ellipsoidal 0-8-1.0 mm. long, caudate with one of the "tails" truncate, translucent with 12-14 fine, usually straight longitudinal lines of small contiguous papillae, with frequent, somewhat less distinct, vertical lines.

Peat bogs, tamarack swamps, or sphagnous lakeshores, usually the plants rooted in tufts of sphagnum, Noval Scotia south (in the Appalachians) to Pennsylvania and west in the northern U.S. and southern Canada to the longitude of Minnesota.

Type. U.S.A. "Pocono Mountain Pennsylvania." Presumably at NY, but not seen by this writer.

Remarks. A visit to NY, where a fairly large set of specimens of this diminutive species exists, was sufficient to convince me that this is indeed an entity distinct from the *X. difformis* complex. It is distinct from papillose-leaved members of that complex by its narrower leaves, its much narrower and thicker sepal keels, and its much longer seed. I have never seen living populations of *X. montana* and hence have no information as to the time of day it flowers. A very large percentage of spikes of specimens of *X. montana* have few full seeds in their capsules, a phenomenon suggesting hybrid origin.

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TWO NEW ADDITIONS TO HIDALGOA AND BIDENS (COMPOSITAE)

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Recently I was permitted by Dr. Peter H. Raven, of Stanford University, to examine a small collection of Coreopsidinae that had been obtained shortly before in the State of Chiapas, Mexico. One of these proved definitely to be a previously undescribed species of *Hidalgoa* Llave *in* Llave & Lex. It may be set forth here as:

HIDALGOA **Breedlovei** Sherff, sp. nov. Vitis sursum scandens, subglabra, altitudinis non dictae, caule ramisque tenuibus sulcatisque nodos versus hispidulis setulis pluriloculatis, internodiis saepius 1 dm. longis et sub 2.5 mm. crassis, minute plus minusve papillato-hispidulis. Folia opposita, tenerrime elongateque petiolata, normaliter estipulata, axillis interdum cum gemma minuta abortivaque; petiolis basim versus saepe tortis pampiniformibusque et minute ciliatis, plerumque 3-6 cm. longis; lamina tripartita, tenui, circumambitu deltoidea usque ad ± 1.7 dm. lata et ad 1.4 dm. longa, faciebus subglabra sed marginibus minute revolutis minutissime plus minusve ciliolata, alibi irregulariter pulverulenta vel papillata glandulosave; foliolo mediano subrhomboideo-ovato vel -obovato, ad basim vix petiolulato, ad apicem vix breviacuminatá, supra medium utroque latere aegre circ. 3-6 dentato dentibus plus minusve rotundatis et apice acriter mucronulatis, usque ad 1 dm. longo et ad 6 cm. lato; foliolis lateralibus subsessilibus, inaequaliter ovatis, paulum minoribus. Capitula radiata, pansa ad anthesin 4-5 cm. lata et circ. 1.5-1.8 cm. alta, pedunculis tenuibus usque ad ± 1.5 dm. longis, remote dispositis, sparsim hispidulis, sulculatis. Involucri bracteae exteriores plerumque 4 vel 5, patentes vel subreflexae, ovatae, 3.0-4.5 mm. longae, paucistriatae, faciebus irregulariter adpresso-setulosae; interiores angustiores, duplo longiores, apicem versus moderate attenuatae, saepe fere glabrescentes. Flores ligulati 8 (rarius 9 vel etiam 10), aurantiaci, circ. 2.0-2.2 cm. longi et 6-7 mm. lati, ligula oblonge oblineari longitudinaliter striata apice acriter breviterque 2- vel 3-denticulata; stylo biramoso. Achaenia matura non visa; unicum immaturum ex radio visum lineari-oblongum, obcompressum, atro-brunneum, utraque facie unicostatum et sursum praecipue supra setosum, circ. 1.5 mm. latum et plus 4 mm. longum, lateribus anguste marginatum, apice bidentatum dentibus crassis circ. 1 mm. longis marginibus exterioribus papillato-ciliatis, sub dentibus sursum angustissime incurvato-aristulatum. Paleae membranaceae, lineari-oblongae, apicem versus subacutae, extus glabratae vel interdum paulum albido-setulosae, 5-6 mm. longae. Flores

SIDA 2 (3): 261—263. 1966.

tubulosi elongati paleas superantes, corolla tenui-infundibuliformes, lobis 5, angustis acutisque, erectis vel patentibus, stylo simplici elongato primum flavo demum brunneo; achaeniis abortivis.

Specimens examined: *Dennis E. Breedlove 8873*, flowers orange, vine; on slope with *Pinus* and *Liquidambar* along road to Pueblo Nuevo Solistahuacán, elevation of 5600 feet, 5 miles south of Jitotol, Municipio of Jitotol, Chiapas, Mexico, Feb. 11, 1965 (type, DS; isotypes F, MICH, US, also Instituto Nacional de Investigaciones Forestales in Mexico City).

In my recent, essentially monographic treatment of *Hidalgoa* (Llave *in* Llave & Lex. Nov. Veg. Descr. 1: 15. 1824) for the North American Flora (Ser. II, part 2, pp. 59-61, 1955) a key was presented to the four species and one variety known for the genus at that time. These ranged in habitat from southern Mexico *(H. ternata* Llave and *H. pentamera* Sherff) through Guatemala *(H. Steyermarkii* Sherff), Costa Rica *(H. Wercklei* Hook. f.) and into Colombia (var. *colombiana* Sherff[1]) and into Ecuador and Peru *(H. ternata* Llave).

With the several flowering specimens of *H. Breedlovei* before me, it is now possible to present here a revised key to include all five presently known species of *Hidalgoa* and the one differing variety:

a. Lobes of disk-corollas recurved, style of disk-florets shortly bifid, stipules obvious, ray-florets about 9. . . . . *H. Wercklei*

a. Lobes of disk-corollas erect or spreading, style of disk-florets usually unbranched, stipules commonly obsolete or lacking.

  b. Ray-florets about 5.

    c. Leaves ternate with simple leaflets.

      d. Internodes of the stem or branches elongate (to ± 2 dm.); petioles 3-9 cm. long; leaflets 3-9 cm. long, 2-6 cm. wide; peduncles often 10-25 cm. long; outer involucral bracts ± 1 cm. long. . . . . *H. ternata*

      d. Internodes of the stem or branches under 1 dm. long; petioles 2-4 cm. long; leaflets 1-4 cm. long, about 1.0-2.8 cm. wide; peduncles 4-7 cm. long; outer involucral bracts about 4-5 mm. long. . . . . *H. Steyermarkii*

    c. Leaves appearing palmately 5-parted. . . . . . *H. pentamera*

  b. Ray-florets 8 or 9 or more rarely 10 . . . . . . *H. Breedlovei*

A second lot of specimens was received from the Smithsonian Institution through the kindness of Dr. John J. Wurdack. These belonged to the genus *Bidens* L. and had come from Colombia. One was referable to *B. Rubifolia* H.B.K. specifically, but displayed flowering heads varietally different, as noted below, from those of the species proper. In allusion to the especially numerous external phyllaries (fully or nearly twice as many as is characteristic for the species—i.e., var. *Rubifolia)*, I have designated it as:

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[1] Var. *colombiana* was validly published in 1947: Amer. Journ. Bot. 34: 152, but erroneously cited at the time of my revisional key's publication as "var. nov."

BIDENS Rubifolia var. **multibracteata** Sherff, var. nov. Frutex varietati *Rubifoliae* dissimilis foliis minoribus lamina tenui erugulosa ecoriaceaque; capitulis numerosiore bracteatis radiatisque; bracteis exterioribus 12-18 (non circ. 8-10), floribus ligulatis circ. 10 (non saepius 5).

Specimens examined: *Robert Merrill King 5644, cum Alvaro L. Guevara et Enrique Forero-G.*, common reclining shrubs circa 2 meters tall, open area, flowers yellow, wood voucher; common name mortiño, elevation circ. 9000 feet, circa 1 km. south of Usme, Department of Cundinamarca, Eastern Cordillera, Colombia, June 18, 1965 (type, F).

NOTES

ADDITIONS TO THE LOUISIANA FLORA.—Continued botanical exploration of Louisiana, being carried on in conjunction with the State Flora Project of the University of Southwestern Louisiana, has resulted in the following additional records to the known flora of the state. All specimens cited are on deposit in the Biology Herbarium of the University of Southwestern Louisiana (LAF).

Potamogeton crispus L. Plaquemines Parish: Goose Pond, Delta National Wildlife Refuge, soft alluvial mud bottom, associated with *Potamogeton pusillus, Sagittaria, Myriophyllum, Jacob M. Valentine, Jr. s.n.,* 28 April 1965. *Potamogeton crispus* is apparently rare in the southeast; I find it recorded only from Alabama.

Murdannia nudiflora (L.) Brenan. Lafayette Parish: weed in Thieret backyard, Lafayette, *Thieret 18474,* 4 October 1964. This species is listed by Small as *Aneilema nudiflorum* (L.) Kunth. My field notes read: "mat forming plant about 10-15 cm. high, decumbent, rooting at nodes." The Lafayette collection, past flowering, was determined by Dr. Lloyd Shinners.

Andropogon ischaemum L. St. Tammany Parish: locally abundant at roadside just east of Madisonville, *Thieret 21643,* 30 October 1965. Jefferson Davis Parish: forming conspicuous strip along both sides of roadway for several miles, ca. 4 miles south of Lacassine, *Thieret 21688,* 7 November 1965. Our plants, with prominently pubescent nodes, represent var. *songaricus* Rupr.

Corylus americana Walt. Morehouse Parish: deciduous woods along Williamson Creek, Section 10, just south of Arkansas state line, about 15 miles north of Bastrop along road to Crosset, Arkansas, *Thieret 19107,* 26 March 1965. A second collection, *Thieret 20396,* was obtained at the same locality on 7 September 1965. My attention was first drawn to the occurrence of hazelnut in Louisiana by a specimen *(John A. Moore and E. R. Andrulot 6948,* 15 September 1956) collected at Williamson Creek and deposited in the Tulane Herbarium. My specimen *19107* is leafless and bears but one staminate catkin; *20396* is in fruit.

Portulaca mundula Johnston. Allen Parish: moist sand along shore of Calcasieu River, ca. 2 miles northwest of Kinder, *Thieret 18960,* 23 October 1964. My field notes for this collection are as follows: "petals purple pink, 6.0 mm. long, 3.7 mm. wide, mucronate at apex; sepals 4.0-4.5 mm. long; capsule 2.2-2.5 mm. wide at center; seeds 0.4-0.5 mm. in diameter; branches prostrate (ascending only at the very end); leaves thickly lenticular in cross-section."

Geranium dissectum L. Ouachita Parish: on sandy clay, west side of Monroe, *Robert Kral 16644,* 10 April 1963. Rapides Parish: roadside 10 miles east of Hotwells, *Thieret 19543,* 24 April 1965.

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Bergia texana (Hook.) Seubert. Red River Parish: extensive sand bar along east bank of Red River 1.5 mile southwest of Crichton, about 9 miles northwest of Coushatta, *Thieret 20618,* 18 September 1965. Bossier Parish: sand bar along Red River, 5 miles east southeast of Hosston, *Thieret 21045,* 2 October 1965. The plant was very rare at both localities.

Jaborosa integrifolia Lamarck. Plaquemines Parish: in willow dominated area within 20 yards of Mississippi River, left descending bank, ½ mile north of Delta Wildlife Refuge, about 7 miles downstream from Venice, *Jacob M. Valentine, Jr. and Ralph Andrews s.n.,* 8 April 1964. My determination of this plant as *J. integrifolia* was verified by Dr. Carroll E. Wood. The species, an introduction from South America, has been recorded previously in North America by Small, who, on page 1117 of his *Manual,* notes that it "has been found on ballast at Mobile, Ala." The flowers are creamy white and delightfully fragrant. Illustrations of *J. integrifolia* are given in *Curtis Bot. Mag.* 63: plate 3489 (1836) and in Cabrera, *Manual de la Flora de los Alrededores de Buenos Aires* (1953).

Mecardonia peduncalaris (Benth.) Small. Pointe Coupee Parish: along Atchafalaya River, east shore, moist sandy soil in excavation, between Krotz Springs and Melville, *Thieret 18733,* 25 October 1964. This plant is similar in general aspect to our common *Mecardonia acuminata,* but its corolla is yellow instead of white.

Plantago lanceolata L. Tangipahoa Parish: railroad yard, Hammond, *Thieret 19780,* 8 April 1965. This weedy species is apparently yet local in the southeast.—*John W. Thieret, University of Southwestern Louisiana, Lafayette, Louisiana* 70501.

IPOMOEA × MULTIFIDA (RAFINESQUE) SHINNERS, COMB. NOV. (CONVOLVULACEAE).—Based on *Quamoclita ("Quamoctita"* sphalm.) *multifda* Raf., New Fl. N.A. 4: 57. 1838 ("1836"). "A curious sp. deemed a garden hybrid, produced by *Q. coccinea and Q. pinnata,* leaves variously cut, few alike . . . Seen alive in gardens, where sometimes spontaneous." No exact locality mentioned; presumably it was Philadelphia. *Quamoclit Sloteri* House ex L. H. Bailey, Gentes Herb. 1: 128. 1923. "This attractive hybrid between *Quamoclit Quamoclit* (L.) Britton and *Quamoclit coccinea* (L.) Moench, was originated by Mr. Logan Sloter of Columbus, Ohio . . . not a chance hybrid . . . The hybridization was done carefully." *Ipomoea Sloteri* House ex L. H. Bailey, l.c. *(nomen provisorium* only). *Ipomoea × Sloteri* (House) Ooststroom, Fl. Males. I. 4: 483. 1953. The plant whose seeds are sold commercially in the United States under the name "Hearts and Honey Vine" belongs here. Rafinesque's description is quite adequate, and his name, being much earlier than that of House, must be adopted.—*Lloyd H. Shinners.*

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VERBENA PULCHELLA SWEET VAR. GRACILIOR (TRONCOSO) SHINNERS, COMB. NOV. (VERBENACEAE).—Based on *Glandularia pulchella* (Sweet) Troncoso var *gracilior* Troncoso, Darwiniana 13: 476. 1964. This is the plant which has passed as *Verbena tenuisecta* Briquet in the United States. Two other transfers may be added here: *Verbena pulchella* var. **clavellata** (Troncoso) Shinners, comb. nov. *(Glandularia pulchella* var. *clavellata* Troncoso, ibid.) *Verbena* **subincana** (Troncoso) Shinners, comb. nov. *(Glandularia subincana* Troncoso, 1. c. 478-479.) —*Lloyd H. Shinners.*

PENSTEMON MORONENSIS CROSSWHITE (SCROPHULARIACEAE), A NEW SPECIES FROM MEXICO (ZACATECAS).—Fruticosa, tota albo-pubescens, eglandulosa. Caules ca. 5 dm. alti rigidi; folia isophylla lanceolata 35—50 mm. longa, 14—23 mm. lata, dentata. Corollae ca. 22 mm. longae, purpureae; calyces ca. 11—13 mm. alti, lobis caudatis. Antherae loculi in toto dehiscentes sed non peltato-explanati. Capsula seminaque ignota.

Shrubby perennial with several divergent stems from the base, pubescent throughout with spreading, white, non-glandular hairs. Stems ca. 5 dm. tall, woody at least below, apparently rigid (at least below the inflorescence); leaves more or less isophyllous, broadly lanceolate, 35—50 mm. long, 14—23 mm. wide, regularly and sharply although shallowly toothed (at least in apical half), sessile with narrow base; fascicles of small leaves present in the axils of a few of the main leaves. Inflorescence sparingly glandular and moderately pubescent with spreading white hairs, an open panicle, the peduncles ascending, 20—45 mm. long (perhaps longer in maturity), the pedicels only 5—9 mm. long, any one pedicel no longer than ¼ the length of its peduncle. Sepals 11—13 mm. long, caudate, the tips as long as the body or longer. Corollas ca. 22 mm. long (perhaps longer in full maturity), purple but drying somewhat lighter. Anther sacs completely dehiscent but not at all peltate-explanate, the median ridge quite evident, separating longitudinally into two parts. Capsule and seeds unknown. TYPE: volcanic rocky slope in oak woodland at 7500 ft. elevation in the Sierra Morones at Cerro Mixton, 23 miles from Jalpa, Zacatecas, Mexico, *H. S. Gentry 18283* (LL).

Penstemon moronensis is perhaps related to *P. hidalgensis* Straw (Brittonia 15: 51—52, 1963), but differs markedly from it in having sepals caudate rather than broadly lanceolate, and in having spreading white non-glandular hairs rather than being "densely glandular-hirsute or hispid" as the description of *P. hidalgensis* reads. Authentic material (paratypes) of *P. hidalgensis* in hand *(Lundell 1227, Straw & Forman 1802, 1803, Straw & Gregory 1149)* show that the glandular hairs of that species are yellow and erect. The leaves of the stem are 55-65 mm. long and lance-acuminate, being somewhat longer and narrower toward the tip than those of *P. moronensis.*

At least the lower peduncles of *P. moronensis* are equal to or longer than the subtending bracts. The bracts of *P. hidalgensis* are longer than the internodes they subtend, while the opposite is the case in *P. moronensis.* In the description of *P. hidalgensis, Gentry & Arguellos 18238* from "Sierra Morones (C. Mixta), Zacatecas (US)" is cited as a possible hybrid between *P. hidalgensis* and *P. kunthii.* Since this is the type locality of *P. moronensis,* the suggestion that hybridization is occurring there led to a critical comparison of *P. moronensis* with other species of the region. I can see no indication that *P. moronensis* could possibly be a hybrid of *P. kunthii, P. hidalgensis,* or any other known species.

The study of *Penstemon moronensis* is part of work supported by a grant from the Research Committee of the University of Wisconsin of funds from the Wisconsin Alumni Research Foundation to Dr. Hugh H. Iltis. I am grateful to the Texas Research Foundation for lending specimens which yielded the new species.—*Frank S. Crosswhite, Herbarium, Department of Botany, University of Wisconsin, Madison, Wisconsin 53706.*

NOTES ON THE OCCURRENCE OF THE RARE DAHLIA BARKERIAE (COMPOSITAE.)—As previously stated in my treatment of the North American species of *Dahlia* Cav. (North Amer. Flora ser. II. part 2: p. 54. 1955), Knowles & Westcott's original description and type plate of their *Dahlia Barkeriae* (Fl. Cab. 2: 28. 1838) were based on plants cultivated in England from material that had been found in the forests of Valladolid in Mexico, assumedly the Valladolid now called Morelia, in northeastern Michoacán, and not the Valladolid in Yucatán. Not until August, 1890, does this species seem to have been re-collected. At that time it was found by C. G. Pringle (no. 3164) at the not far distant locality (45 km. away), on limestone bluffs at Flor de Maria, northwestern part of State of Mexico. Apparently unfamiliar with the Knowles & Westcott treatment of *Dahlia Barkeriae,* Watson described the Pringle plants under the new name *Dahlia pubescens* (Proc. Amer. Acad. 26: p. 42. 1891; not *D. pubescens* Brongn. 1845), a name of course reducible to *Dahlia Barkeriae.*

Recently I was sent four folders of beautiful flowering material of this same species that had been cultivated in Denmark from achenes taken from *Hawkes, Hjerting & Lester* no. 1396. These collectors had obtained their feral specimens in the State of Mexico, Mexico, along the new highway 57 from Mexico City to San Juan del Rio at km. 167, Calpulalpan, San Martin, alt. 3100m.; "plant 60 cm. high, flowers bright mauve-pink." Specimens were cultivated in the Botanical Garden at Copenhagen, and one specimen was indicated on the label as having been put

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to press in August, 1965. The other three sprays were from plants cultivated in the Botanical Garden at the University of Aarhus, and bore the date September, 1965. All are being presented to the Chicago Natural History Museum, for distribution later on to various herbaria.

The field data are presented above in detail with the thought that present-day collectors may be able to revisit the native habitats and obtain additional herbarium materials. For the specimens cited as having been received from Denmark, I am indebted to Mr. Frantz Kaufmann, of the Department of Organic Chemistry at the University of Aarhus, Aarhus, Denmark, also to Dr. J. Lam of the same department, who initiated the investigative studies being pursued at Aarhus by Mr. Kaufmann. These have to do primarily with the possible occurrence of certain chemical substances in dahlias (*e.g.*, a so-called "acetylenic compound").

As the research findings of these Danish workers on *Dahlia Barkeriae* and on a number of additional species of *Dahlia* may well be published in scientific journals outside the scope of Botany, we may note here an interesting observation by Mr. Kaufmann on some of his cultivated specimens of *Dahlia coccinea* Cav. var. *coccinea*. In his letter to me of Dec. 12, 1965, he reports the achenes to be "biaristate. The same phenomenon I have observed by another, but uncertain species: *Dahlia* aff. *pinnata*." In an earlier paper (Bot. Gaz. 89: 365, footnote 3. 1930; cf. N. Amer. Fl. *loc. cit.* 46, footnote 1), I reported similarly biaristate achenes, "presumably of *D. pinnata* Cav., *the aristae naked, almost capilliform, and mostly 6—10 mm. long.*" In the packet of some thirty *D. coccinea* achenes sent me by Mr. Kaufmann, the achenes are similar, but with aristae only about 5-—6 mm. long.—*Earl Edward Sherff, Department of Botany, Chicago Natural History Museum, Chicago 5, Illinois.*

SIDA CONTRIBUTIONS TO BOTANY

VOLUME 2 **NUMBER 4** **JULY 1966**

CONTENTS

SIDA is privately published by Lloyd H. Shinners, SMU Box 473, Dallas, Texas 75222, U.S.A. Subscription price $6 (U.S.) per volume of about 360—400 pages, parts issued at irregular intervals.

TAXONOMY OF PASPALUM SETACEUM (GRAMINEAE)[1]

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The *Setacea* paspalums, which are included in the *Monostachya* group of the section *Eupaspalum* by Pilger (1940), comprise ten species according to Chase (1929). They are most abundant in the southeastern United States and are of minor economic importance.

The most recent and comprehensive revision of North American species of *Paspalum* is Chase's (1929) in which she acknowledged taxonomic difficulty with *Setacea* taxa: "Some, such as the allies of *Paspalum setaceum,* form a network of closely related species . . . Most of the species of this group are rather poorly defined and appear to intergrade."

Previous studies were made with less material than is presently available and they utilized a morphological approach based largely on herbarium specimens. This revision, utilizing more material, is based on observations and data obtained on the anatomy, cytology, and morphology of the taxa from field, greenhouse, and herbarium investigations.

I wish to thank all of the persons from whom I received much valuable assistance during the course of this study. I specifically wish to thank the following persons: Dr. Wilbur H. Duncan, who served as my major professor, for advice, encouragement, and guidance throughout the study; Dr. Charles W. James, and Dr. Glenn W. Burton, committee members, for valuable suggestions; Dr. Jonathan J. Westfall and Dr. Ian Forbes, Jr. for advice on the cytological investigations. Thanks are due Dr. Alicia Lourteig of the Paris Museum and Dr. W. D. Clayton of Kew Gardens for important information about Michaux's Type Specimens of *Setacea* taxa. I also wish to thank the curators of the following herbaria for loan of specimens and photographs: AUA, Auburn University; DUKE, Duke University, FLAS, University of Florida; FSU, Florida State University, G, Conservatoire et Jardin Botaniques, Geneva, Switzerland; GA, University of Georgia; GH, Gray Herbarium; IA, University of Iowa; MO, Missouri Botanical Garden; NCU, University of North Carolina; NO, Tulane University; NY, New York Botanical Garden; OKLA, Oklahoma

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[1] Contribution No. 65 from the Stephen F. Austin State College Department of Biology. This paper is based on portions of a dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at the University of Georgia, May, 1963. Publication of this information was made possible by a Faculty Research Grant, Stephen F. Austin State College and a Grant-in-Aid of Research from the Society of Sigma XI.

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State University; P, Museum National d'Histoire Naturelle, Paris, France; PH, Academy of Natural Sciences, Philadelphia; SMU, Southern Methodist University; TAES, Texas A & M University; TEX, University of Texas; UARK, University of Arkansas; US, U. S. National Museum; USF, University of South Florida. Abbreviations are from Lanjouw and Stafleu (1964).

HISTORICAL ACCOUNT

The oldest legitimate names of *Setacea* taxa are *P. setaceum*, *P. debile*, and *P. ciliatifolium* of Michaux (1803). Type specimens of these taxa are in the Michaux herbarium at Paris. Since 1803 at least 26 specific epithets have been applied to *Setacea* taxa. Author's concepts of the taxa show some trends in the classification of this group.

Chase acknowledged difficulty with *Setacea* in her revision and the complexity of the taxa was re-emphasized by her note attached to *P. ciliatifolium (Swallen 10443*, Rapides Parish, Louisiana [US]) that reads, "This 'ciliatifolium' is either a most variable species or *several* species. I struggled with it for N. Am. Pasp. and keep on struggling."

The most widely used manuals which include the majority of *Setacea* taxa are those of Small (1933), Fernald (1950), Hitchcock (1951), Gleason (1952), and Gleason and Conquist (1936). Hitchcock's Manual is the most inclusive in regard to *Setacea* and Chase's concept is followed in it and in Small's Manual. Fernald's concept differs from Chase's primarily in recognizing some taxa as varieties. An excellent account of Fernald's views about the *Setacea* taxa is recorded in Rhodora (Fernald, 1934). However, Shinners (1954) expressed dismay in trying to follow Fernald's treatment of *Paspalum ciliatifolium* for delimiting the Texas material. Gleason's and Cronquist's concepts appear to be intermediate between the concepts of Chase and Fernald.

TAXONOMIC TREATMENT[2]

My studies have indicated that *Setacea* is a complex, highly variable group of plants which possess intergrading characters. Chase (1929) used spikelet length, leaf blade width, foliage pubescence, and growth habit

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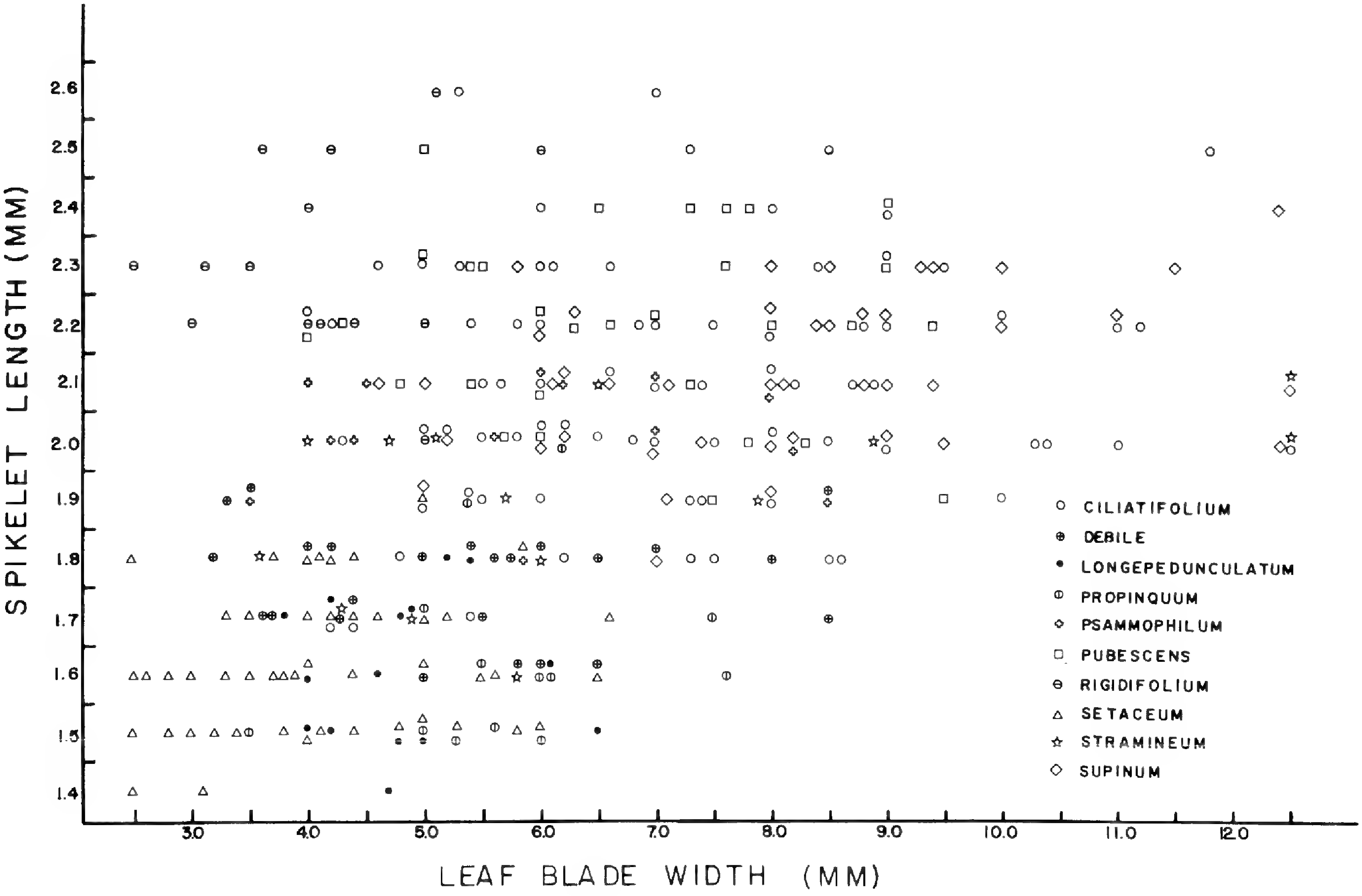
[*] A table comparing treatments by Chase, Michaux, Flügge, Poiret, LeConte, Elliott, Kunth, Gray, Wood, Vasey, Chapman, Nash, Fernald, and Gleason and Cronquist has been omitted on account of length and difficulty of fitting into our small page size. (*Editor's note.*)

[2] To conserve space, the lists of specimens examined are omitted. They were annotated and I have a list. I will be glad to furnish further information about them on request.

Figure 1. Scatter diagram of spikelet length and leaf blade width data of *Setacea* taxa from randomly selected herbarium specimens. Spikelet length computed by averaging the length of five primary spikelets from the middle of terminal racemes. Leaf blade width measured at the midpoint of mid-culm leaves. The specific names applied are according to Chase's (1929) concept as best as I could determine.


SPIKELET LENGTH (MM)
2.6
2.5
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
LEAF BLADE WIDTH (MM)
○ CILIATIFOLIUM
⊕ DEBILE
● LONGEPEDUNCULATUM
⦶ PROPINQUUM
✧ PSAMMOPHILUM
□ PUBESCENS
⊖ RIGIDIFOLIUM
△ SETACEUM
☆ STRAMINEUM
◇ SUPINUM

as principal characters for separating most species of *Setacea*. My studies have shown that spikelet lengths and leaf blade widths of the taxa are variable and frequently overlap. See Figure 1. Leaf pubescence appears to be fairly consistent and is often a good character for separating some taxa, but because of our knowledge of the inheritance of pubescence in other plant groups its value for specific recognition is questionable. Likewise, growth habit, which is variable, is questionable as a specific criterion.

Since the characters used most often to differentiate the taxa show various stages of intergradation, there seems to be justification for treating the group as a single variable species. The stronger trends that are defined more or less geographically might be treated better as varieties. Fernald (1934) proposed changes in the rank of some of the *Setacea* taxa based on the same reasons. This procedure has also been supported by Benson (1962). Apparently, Chase considered the possibility of reducing some of the species to lower rank because she remarked, "The entire *Setacea* group might be reduced to one or two species with subspecies, varieties, subvarieties, and forms, and the *Laevia* to another, but I do not see that greater definiteness would be gained thereby."

Because of the preponderance of evidence indicating the close relationships of the *Setacea* taxa and because of the intergradation of characters that best separate them, I believe it is best to rcognize the *Setacea* group as a highly variable, polymorphic species consisting of several varieties showing some geographical trends. I have chosen to call the taxa varieties rather than subspecies. I have not felt the need to formally recognize any categories below variety. It should be noted however, that all the varieties are not necessarily of equal biological rank, but sufficient evidence as to the number and kinds of subgroups and their exact relationships is lacking at the present time. I have referred intergrading forms, which are numerous, to the varieties to which most of their characters correspond.

PASPALUM SETACEUM Michx. Fl. Bor. Amer. 1: 44 1803[3]

Yellowish green to green to purplish perennials with culms tufted, prostrate, spreading, ascending, or erect from a knotty base or short rhizomes, up to 90 cm tall; inflorescence terminal and axillary; racemes 3-17 cm long, slender, 1-5 on the terminal peduncles, usually single on the axillary ones, sometimes hidden in the leaf sheaths; spikelets usually in pairs, the lower sometimes absent, planoconvex, glabrous or pubescent, sometimes spotted, straw-colored to green to brownish to purple, elliptic to orbicular, 1.4-2.7 mm long, 1.0-2.0 mm wide; sterile lemma nerveless

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[3] Apparently, Flügge (1810) was the first author to unite Michaux's *P. setaceum*, *P. debile*, and *P. ciliatifolium* under one binomial, *Paspalus setaceus*. Therefore, if one accepts the concept that these taxa belong to a single species, the correct binomial becomes *Paspalum setaceum* Michx.

TABLE 1
VARIETIES OF PASPALUM SETACEUM

1. Var. *setaceum*	2. Var. *longepedunculatum*	3. Var. *villosissimum*
Grayish green, erect to spreading.	Yellowish green, erect to slightly spreading.	Grayish green, erect.
Leaf blades usually conspicuously erect or ascending, 2-7 mm wide, villous.	Leaf blades conspicuously basal, recurved, 3-8 mm wide, usually glabrous.	Leaf blades conspicuously basal, recurved, 3-10 mm wide, villous-hirsute.
Spikelets elliptic to suborbicular, 1.4-1.9 mm long, glabrous or pubescent, pale yellow to light green, sometimes spotted. Midnerve of sterile lemma often absent. (Figure 2)	Spikelets elliptic to obovate, 1.4-1.9 mm long, usually glabrous, brownish yellow to light green. Midnerve of sterile lemma absent. (Figure 3).	Spikelets elliptic to obovate, 1.5-1.9 mm long, pubescent, often spotted, brownish yellow to light green. Midnerve of sterile lemma absent. (Figure 4).
Coastal Plain; open ground, Massachusetts to Florida, westward to Texas.	Coastal Plain; open ground, North Carolina, Georgia, Florida, Alabama, and Mississippi.	Sandy fields and flatwoods, Florida and Cuba.

to prominently nerved, first glume usually absent; fertile floret about the same size and shape as the spikelet, smooth and shining; leaf blades flat, ascending to spreading, glabrous to puberulent to coarsely pubescent, flexuous to rigid, 5-30 cm long, 2-20 mm wide; ligule a minute membrane with long white hairs back of it; leaf sheaths glabrous or pubescent, the lower ones often purplish brown..

Cytological evidence suggests that the species reproduces sexually. Meiosis in pollen mother cells is usually regular and the gametic chromosome number is 10 (Banks, 1964).

Paspalum setaceum is a variable, polymorphic species consisting of numerous races and forms. It is distributed in central and eastern United States, Mexico, Central America and the West Indies.[4] Its greatest diversity of form is found in Florida.

Benson (1962) has suggested using a table rather than keys to segregate varieties of a species. Table 1 shows the characteristics of the best marked varieties of *P. setaceum*.

1. PASPALUM SETACEUM Michx., Fl. Bor. Amer. 1: 44. 1803. var SETACEUM.

[Type: South Carolina, *Michaux*, (P) not examined. Photograph (GA!)].

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[4] *Paspalum arenarium* Schrad. from South America appears to be a close ally of *P. setaceum* and may be only a variety. I have seen only a few herbarium specimens of it and do not feel qualified to pass judgment as to its proper disposition. Of the North American varieties of *P. setaceum* it appears to be closest to *longepedunculatum* and *villosissimum*.

TABLE 1 (Continued)
VARIETIES OF PASPALUM SETACEUM

4. Var. *psammophilum*	5. Var. *stramineum*	6. Var. *ciliatifolium*
Grayish green, spreading to prostrate.	Yellowish green to dark green, erect to spreading.	Dark green to purplish, erect to spreading.
Leaf blades 3-12 mm wide, densely puberulent, sometimes slightly pilose.	Leaf blades 3-15 mm wide, almost glabrous to puberulent and often pilose.	Leaf blades 3-20 mm wide, glabrous or essentially so.
Spikelets suborbicular, 1.8-2.2 mm long, pubescent, usually spotted, pale yellow to light green. Midnerve of the sterile lemma absent. (Figure 5).	Spikelets mostly suborbicular, 1.6-2.2 mm long, glabrous or pubescent, sometimes spotted, pale yellow to light green. Midnerve of the sterile lemma usually absent. (Figure 6).	Spikelets elliptic to suborbicular, 1.7-2.6 mm long, glabrous or pubescent, sometimes spotted, light green to green. Midnerve of the sterile lemma present or absent. (Figure 7).
Sandy soil; Massachusetts to District of Columbia.	Sandy soil; Minnesota to Michigan, to Arizona and Texas, along the coast to Florida, Black Belt of Mississippi and Alabama; Mexico to Panama; Bermuda and the West Indies.	Usually sandy soil, open ground; New Jersey to Florida, westward to Texas and Oklahoma; Bermuda and West Indies.

?*Paspalum dissectum* Walt., Fl. Carol. 75. 1788. Not *P. dissectum* L. 1762.
Paspalum debile Michx., Fl. Bor. Amer. 1: 44. 1803.
Paspalum hirsutum Retz. Misapplied by Poir. in Lam. Encycl. 5. 28. 1804.
Paspalum dubium DC., Cat. Hort. Monsp. 130. 1813.
Paspalum leptostachyum DC., Cat. Hort. Monsp. 130. 1813.
Paspalum infirmum Roem. and Schult., Syst. Veg. 2: 307. 1817.
Paspalum incertum Roem. and Schult., Syst. Veg. 2: 308. 1817.
Paspalum eriophorum Willd. ex Nees., Agrost. Bras. 56. 1829.

In regard to most characters, this variety is usually the smallest. Robust, usually somewhat spreading plants, occurring throughout the range, are the form described as *P. debile*. Examples of these robust forms are: Ahles and Leisner 32807 (NCU), Scotland Co., North Carolina; Blomquist 13523 (DUKE), Carteret Co., North Carolina; Chase 6136 (US), Calvert Co., Maryland; Fernald and Long 10094 (US), Southampton Co., Virginia; Fults 1813 (US), Brunswick Co., North Carolina; Kral 7419 (FLAS, FSU, USF), Hernando Co., Florida; Latham 1 Sept. 1925 (US), Suffolk Co., New York; McFarlin 5121 (US), Polk Co., Florida; Nash 5 Sept. 1894 (NY), Washington D.C.; Norton 13 Aug. 1908 (US),

TABLE 1 (Continued)
VARIETIES OF PASPALUM SETACEUM

7. Var. *muhlenbergii*	8. Var. *supinum*	9. Var. *rigidifolium*
Light green to dark green, mostly erect.	Yellowish green, stout, widely spreading.	Dark green to purplish, erect to spreading, conspicuously rigid.
Leaf blades 3-10 mm wide, pilose.	Leaf blades 4-15 mm wide, hirsute.	Leaf blades 2-6 mm wide, conspicuously rigid, glabrous or slightly puberulent.
Spikelets suborbicular, 1.8-2.5 mm long, usually glabrous, light green to green. Midnerve of the sterile lemma usually present. (Figure 8).	Spikelets elliptic to obovate, 1.8-2.4 mm long, glabrous or pubescent, light green. Midnerve of the sterile lemma present or absent. (Figure 9).	Spikelets elliptic to obovate, 2.0-2.6 mm long, glabrous or slightly pubescent, pale yellow to light green, sometimes purplish. Midnerve of the sterile lemma present or absent. (Figure 10).
Various provinces; New Hampshire to Florida, Iowa to Texas.	Coastal Plain; North Carolina to Florida to Mississippi.	Sand barrens, high pine land and flat woods; Georgia and Florida; Cuba.

Dorchester Co., Maryland; Pearce 9 Aug. 1884 (US), Monmouth Co., New Jersey; Schallert 16184 (NCU), Seminole Co., Florida; Silveus 4556 (TEX), Camden Co., New Jersey; Wurzlow 13 Sept. 1914 (US), St. Tammany Parish, Louisiana.

Some intergrading forms resembling var. *muhlenbergii* occur scattered throughout the range but are most prevalent in the Carolinas. Examples are: Blomquist 10153 (DUKE), Robeson Co., North Carolina; Fredholm 6387 (GH, US), Hillsborough Co., Florida; Hitchcock 2343 Amer. Gr. Nat. Herb. No. 925 (GH, US), Orangeburg Co., South Carolina; Hitchcock 2446 (US), New Hanover Co., North Carolina; Oosting 2327 (DUKE), Carteret Co., North Carolina; Tracy 1890 (NY), Harrison Co., Mississippi.

Plants appearing to be intergrades of var. *setaceum* and var *supinum* are especially notable in Florida. Examples are: Banks 1306 (GA), Lake Co.; Banks 1625 (GA), 1633 (GA), 1639 (GA), Santa Rosa Co.; Banks 1728B (GA), Taylor Co.; Banks 1754 (GA), Citrus Co.

In southeastern Texas there are plants which I have referred to var. *stramineum* that approach var. *setaceum* in general appearance. Examples of these plants are discussed under var. *stramineum*.

2. PASPALUM SETACEUM Michx. var. LONGEPEDUNCULATUM (LeConte) Wood, Class-book. 782. 1861.

Paspalum longepedunculatum LeConte, Jour. Phys. Chym. 91: 284. 1820. [Type: North Carolina, *LeConte*, (PH!)].

This variety is characterized by its small, usually glabrous, spikelets, and basally clustered, recurved, glabrous (except for the conspicuous ciliate margins) leaf blades. Many intergrading forms between this and var. *ciliatifolium* exist. These forms have been referred to var. *ciliatifolium* and will be discussed there as well as the forms described as *P. kentuckiense* having some of the characteristics of var. *longepedunculatum*.

Var. *villosissimum* appears to be closely related to var. *longepedunculatum* and some intergrades occur in Florida. The specimen Ray, Lakela, and Patman 10169 (US, USF), Manatee Co., Florida, with pubescent leaf blades appears to be an intergrade of these varieties.

3. PASPALUM SETACEUM Michx. var. **villosissimum** (Nash) D Banks, comb. nov.

Paspalum villosissimum Nash, Bull. Torrey Club. 24: 40. 1897.

[Type: Eustis, Lake Co., Florida, *Nash* 946 (NY!). Isotypes (GH! MO! NY! US!)].

This variety resembles var. *longepedunculatum* in most respects except it tends to be coarser, has more strongly developed rhizomes, and has villous-hirsute leaf blades. In the past, plants of this variety have been referred to *P. debile* which Michaux reported from Carolina and Georgia. I have referred these plants to var. *setaceum*, believing them to be robust forms of the latter. Plants resembling the type of *P. villosissimum* have not been collected north of Florida as far as I can determine. Therefore, it seems unlikely that *P. debile* and *P. villosissimum* could be synonymous.

4. *PASPALUM SETACEUM* Michx. var. **psammophilum** (Nash) D. Banks, comb. nov.

Paspalum prostratum Nash *in* Britton, Man. 74. 1901. Not *P. prostratum* Scribn. and Merr. 1901.

Paspalum psammophilum Nash *in* Hitchc., Rhodora 8: 205. 1906.

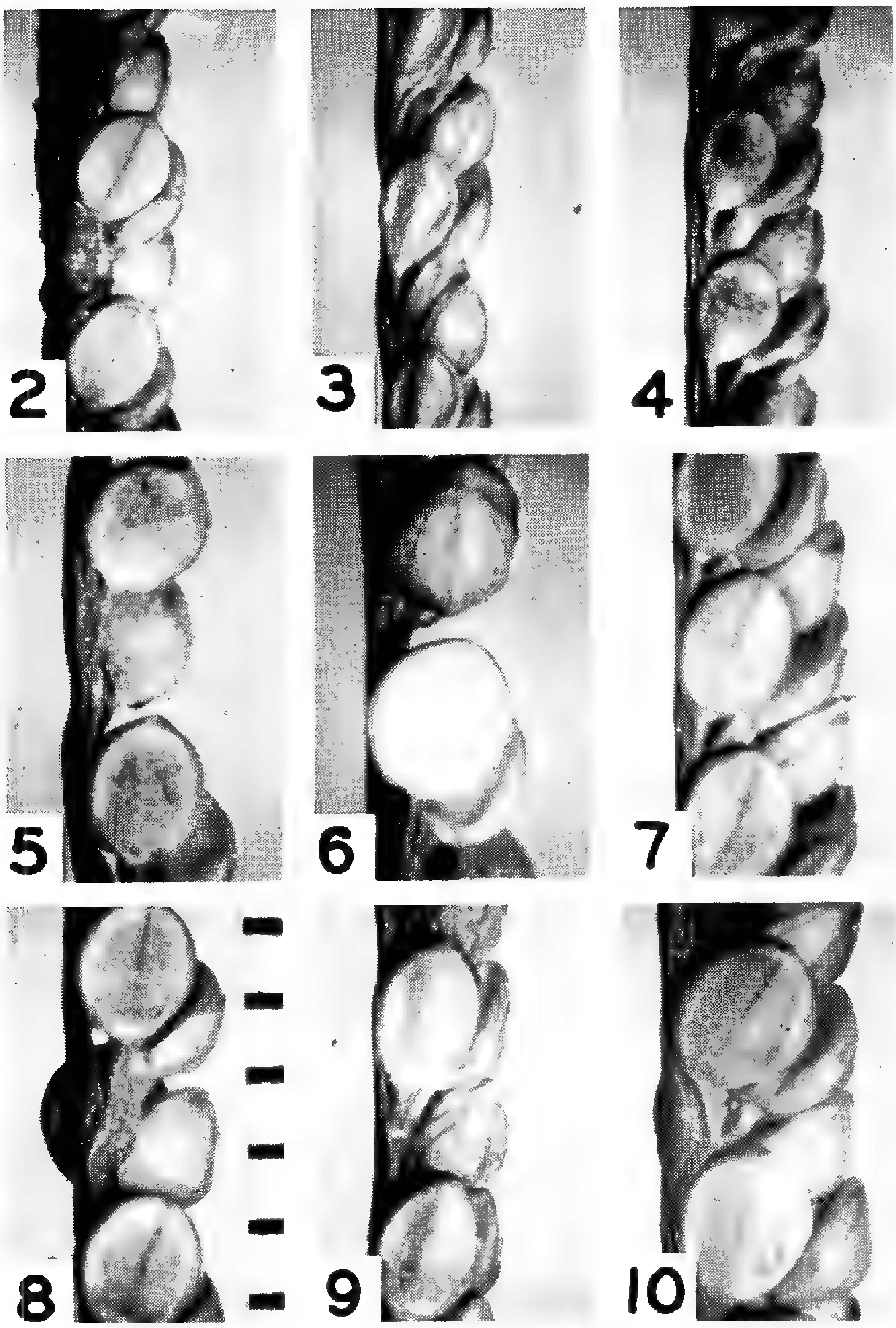
[Type: Kingsbridge, Bronx Co., New York, *Nash* 514 (NY!). Based on *P. prostratum* Nash].

This variety is characterized by its densely puberulent foliage and prostrate habit. Its northeastern distribution and its similarity to var. *stramineum* suggests that it is probably a disjunct from the latter possibly due to pleistocene glaciation. It appears to intergrade, but rarely, with var. *muhlenbergii*. Examples are: Bicknell 14 Sept. 1907 (NY), Nantucket Co., Massachusetts; Fernald and Long 17889 (GH), Barnstable Co., Massachusetts; and Scribner 16 July 1894 (US), Brookland, District of Columbia.

5. *PASPALUM SETACEUM* Michx. var. **stramineum** (Nash) D. Banks, comb. nov.

Paspalum chapmani Nash, Bull. N. Y. Bot. Gard. 1: 290. 1899.

Paspalum eggertii Nash, Bull. N. Y. Bot. Gard. 1: 434. 1900.



Figures 2-10. Spikelets of varieties of *Paspalum setaceum*. Scale in 1 mm graduations shown in Fig. 8. Fig. 2. *setaceum* (Banks 563, Dublin, Ga.). Fig. 3. *longepedunculatum* (Banks 1145, Eustis, Fla.). Fig. 4. *villosissimum* (Banks 1747, Lebanon, Fla.). Fig. 5. *psammophilum* (Banks 1459, Atsion, N. J.). Fig. 6. *stramineum* (Sander in 1962, Central City, Nebr.). Fig. 7. *ciliatifolium* (Banks 924, Wacissa, Fla.). Fig. 8. *muhlenbergii* (Banks 994, Echols Mill, Ga.). Fig. 9. *supinum* (Banks 910, Tallahassee, Fla.). Fig. 10. *rigidifolium* (Banks 1314, Silver Springs, Fla.).

Paspalum stramineum Nash *in* Britton, Man. 74, 1901.

[Type: Mullen, Hooker Co., Nebraska, *Rydberg* 1582 (NY!). Isotype (NY!)].

Paspalum bushii Nash *in* Britton, Man. 74. 1901.

Paspalum ciliatifolium Michx. var. *stramineum* (Nash) Fernald, Rhodora 36: 20. 1934.

Paspalum separatum Shinners. Rhodora 56: 32. 1954.

This variety is quite variable in regard to size and pubescence. Plants nearly always have some puberulent hairs on the upper leaf blade (at least near the tip) and may or may not have pilose hairs as well. Chase (1929) referred the nearly glabrous forms to *P. ciliatifolium*, into which it appears to pass. She referred the smaller forms that extend into Mexico, Central America, and the West Indies to *P. propinquum*. To me, *P. propinquum* (which I have referred to var. *ciliatifolium)* appears to be an intergrade between var. *longepedunculatum* and var. *ciliatifolium*.

A few local intergrades between var. *stramineum* and var. *muhlenergii* occur. Examples are: Langdon 245 (OKLA), Comanche Co., Oklahoma; and Schendel 170 (OKLA), Creek Co., Oklahoma.

In southeastern Texas some plants of var. *stramineum* resemble var. *setaceum* in appearance. Examples are: Bain 1068A (TAES), Brazos Co.; Griffiths 6383 (US), La Salle Co.; Hitchcok 5442 (US), Kenedy Co.; Johnson 930 (TAES, TEX), Karnes Co.; Owens 162 (US), Fayette Co.; Swallen 1469 (US), Cameron Co.; Swallen 1592 (US), Starr Co.; Swallen 10023 (US), Duval Co.; Swallen 10131 (US), Kleberg Co.; Swallen 10291 (US), Aransas Co.; Tharp 24 June 1941 (MO), Frio Co.; Tharp 3223 (TEX), Webb Co.; Tharp 5235 (US), Zavala Co.; Tharp 7653 (MO, NY, TAES, TEX, US), Calhoun Co.

6. PASPALUM SETACEUM Michx. var. CILIATIOFOLIUM (Michx.) Vasey, Contr. U. S. Natl. Herb. 3: 17. 1892.

Paspalum ciliatifolium Michx. Fl. Bor. Amer. 1: 44. 1803.

[Type: Carolina, *Michaux* (P) not examined. Photograph (GA!)].

Paspalum debile Muhl. Cat. Pl. 8. 1813. Descr. Gram. 91. 1817.

Paspalum spathaceum Desv. ex Poir. *in* Lam. Encycl. Sup. 4: 314. 1816.

Paspalum latifolium LeConte, Jour. Phys. Chym. 91: 284. 1820.

Paspalum ciliatifolium Michx. var. *brevifolium* Vasey, Proc. Acad. Phila. 1886: 285. 1886. Not synonymous with *P. setaceum* var. *brevifolium* Mertens ex Doell 1877—*P. arenarium* Schrad .

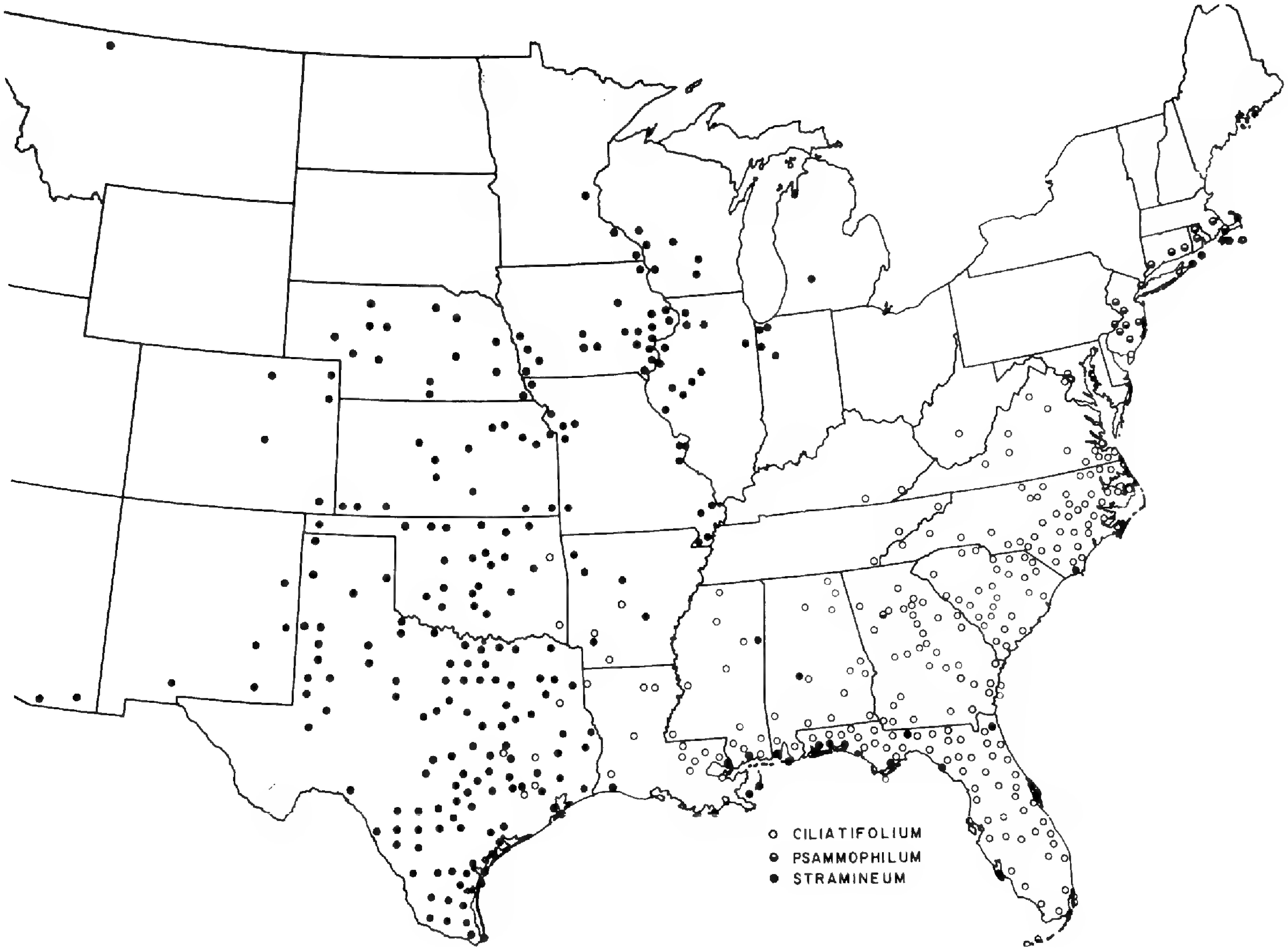
Paspalum propinquum Nash, Bull. N. Y. Bot. Gard. 1: 291. 1899.

Paspalum kentuckiense Nash *in* Britton, Man. 1039. 1901.

Paspalum blepharophyllum Nash *in* Small, Fl. Southeast. U. S. 71, 1326. 1903.

Paspalum epile Nash *in* Small, Fl. Southeast. U. S. 72, 1326. 1903.

This variety is the most variable. Some plants collected at the northern limit of its range are the form described as *P. kentuckiense*. These plants


○ CILIATIFOLIUM
● PSAMMOPHILUM
● STRAMINEUM

resemble var. *longepedunculatum* because of their small spikelets and basally clustered leaves, but their ranges do not coincide. Examples are: Brown 22 Aug. 1942 (GH), Cape May Co., New Jersey; Chase 3009 (US), Arlington Co., Virginia; Fernald, Griscom, and Long 6469 (GH, USF), Isle of Wight Co., Virginia; Hitchcock Amer. Gr. Nat. Herb. No. 916 (GH, MO, NY, US, USF), Carter Co., Tennessee; Kearney 26 (GH, US), 56 (GH, MO, NY, US), Harlan Co., Kentucky; Killip 13244 (US), Orange Co., Virginia; Nuttall 4 Aug. 1892 (DUKE), Fayette Co., West Virginia.

The infrequent form described as *P. propinquum* appears to be an intergrade between var. *ciliatifolium* and var. *longepedunculatum*. Examples closely resembling the type specimen are Banks 1726 (GA), Taylor Co., Florida and Banks 1733 (GA), Dixie Co., Florida.

Intergrading forms between var. *ciliatifolium* and var. *rigidifolium* occur. Examples are: Banks 823 (GA), 826 (GA), 827 (GA), Santa Rosa Co., Florida; Banks 877 (GA), Walton Co., Florida; Banks 1362 (GA), Wheeler Co., Georgia; Banks 1617 (GA), 1630 (GA), Santa Rosa Co., Florida; Banks 1675 (GA), 1676 (GA), 1678 (GA), Baldwin Co., Alabama.

Some robust, spreading forms resembling var. *supinum*, except for their glabrous foliage, occur in Florida. These forms frequently grow sympatrically with var. *supinum*. Examples are: Banks 1720 (GA), Wakulla Co.; Banks 1723 (GA), 1730 (GA), 1731 (GA), Taylor Co.; Banks 1771 (GA), 1774 (GA), Pinellas Co.

7. PASPALUM SETACEUM Michx. var. **muhlenbergii** (Nash) D. Banks, comb. nov.

Paspalum pubescens Muhl. *in* Willd. Enum. Pl. 89. 1809.

Paspalum muhlenbergii Nash *in* Britton, Man. 75. 1901.

[Type: Van Cortlandt Park, Bronx Co., New York, *Bicknell* in 1896 (NY!)].

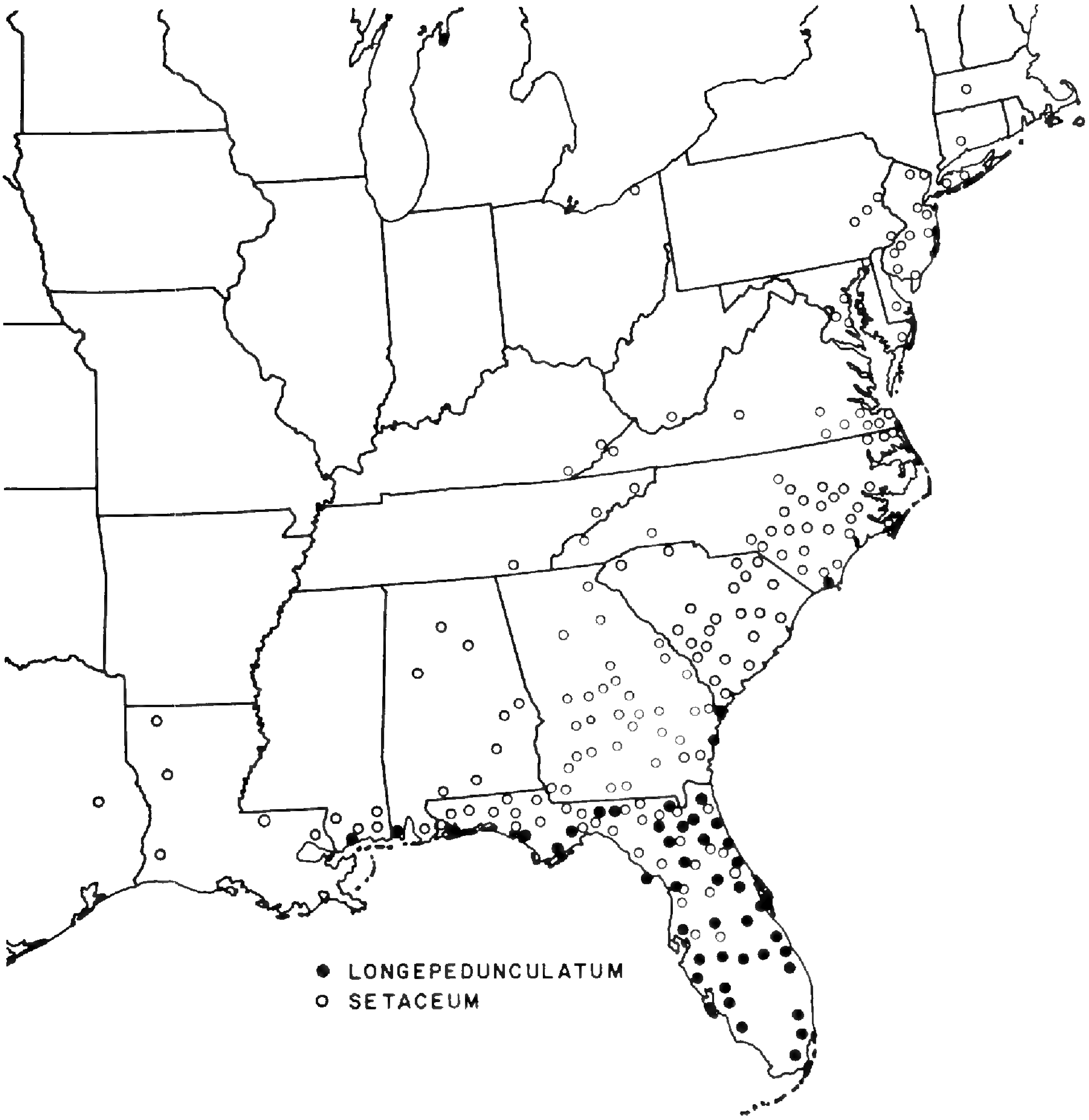
Paspalum pubescens Muhl. var. *muhlenbergii* House, Bull. N. Y. State Mus. 243-244: 39. 1923.

Paspalum ciliatifolium Michx. var. *muhlenbergii* (Nash) Fernald, Rhodora. 36: 20. 1934.

Paspalum setaceum Michx. var. *calvescens* Fernald, Rhodora. 49: 121. pl. 1057. 1947.

This variety closely resembles var. *ciliatifolium* except for its pubescent foliage. Their ranges overlap and if it were not for the more northern extension of var. *muhlenbergii* I would have united them.

Although most specimens have glabrous spikelets, some, like Mohr Sept. 1878 (US), Mobile Co., Alabama and Radford 35789 (NCU), Pamlico Co., North Carolina, have pubescent spikelets. The midnerve of the sterile lemma is characteristically present but the following have the midnerve absent: Blomquist 7461 (DUKE), Currituck Co., North Carolina; Blomquist 7481 (DUKE), Dare Co., North Carolina; Blomquist 10336 (DUKE), Carteret Co., North Carolina; Oosting Oct. 1934 (DUKE),



Durham Co., North Carolina; Radford 19425 (NCU), Montgomery Co., North Carolina.

Smaller plants of boggy areas, such as Fernald's type of var. *calvescens*, Fernald, Long, and Clement 15191 (GH), closely resemble var. *setaceum*.

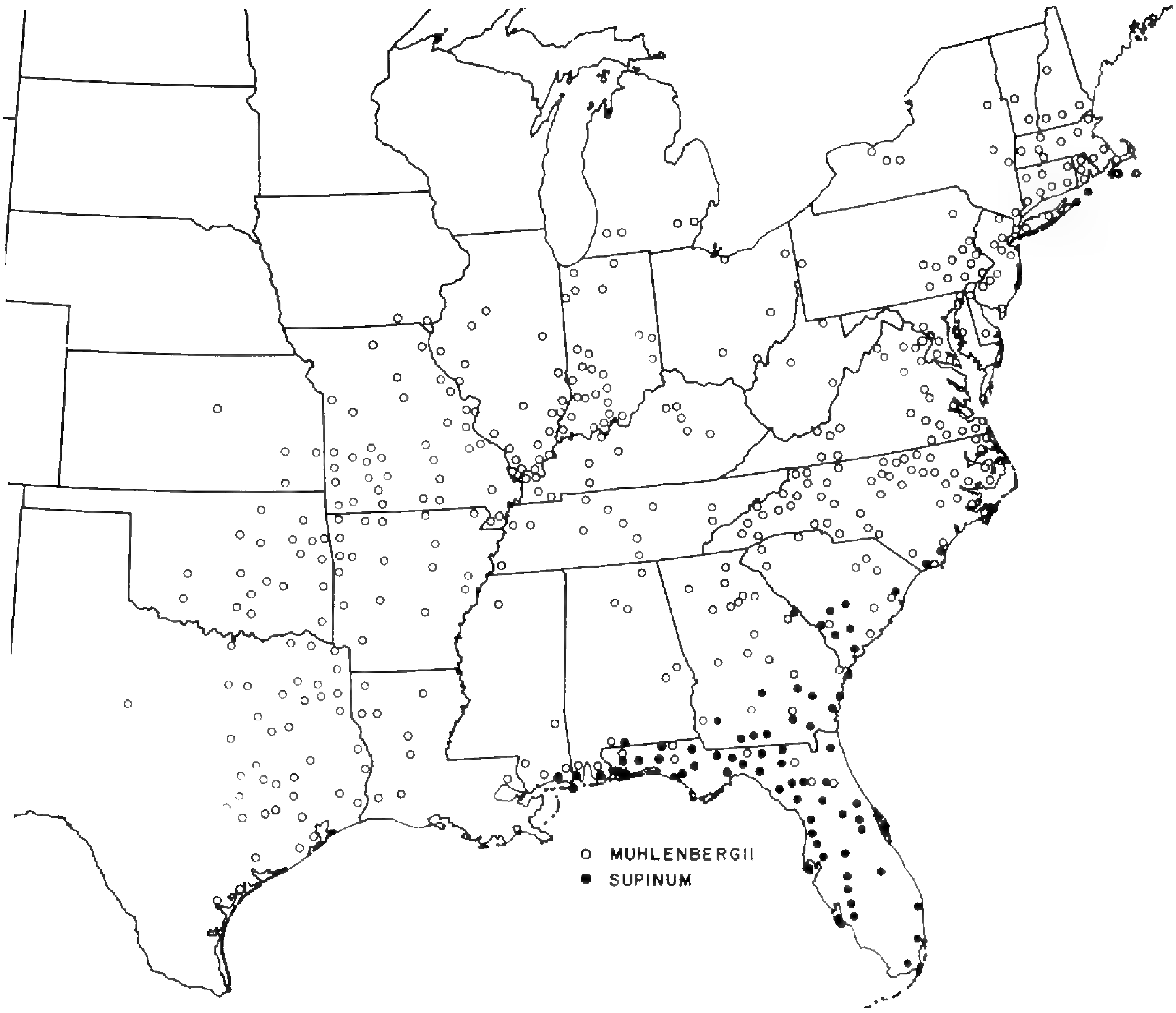
A few plants occur that resemble var. *rigidifolium*. For example: Kearney 292 (NY), Jackson Co., Mississippi; Pennell 4786a (NY), Ware Co., Georgia; Thorne 6438 (IA), Early Co., Georgia; Tracy and Ball 37 (TAES, US), Harrison Co., Mississippi.

8. PASPALUM SETACEUM Michx. var. SUPINUM (Bosc) Trin., Gram. Icon. 2: pl. 130. 1828.

Paspalum supinum Bosc ex Poir. *in* Lam., Encycl. 5: 29. 1804.

[Type: Carolina, *Bosc*, (P) not examined. Isotype (P!)].

Paspalum dasyphyllum Ell. Bot. S. C. and Ga. 1: 105. 1816.



Paspalum ciliatifolium Michx. var. *dasyphyllum* (Ell.) Chapm. Fl. South. U. S. ed. 3. 578. 1897.

This variety is best characterized by its coarse appearance, spreading habit, and hirsute pubescence.

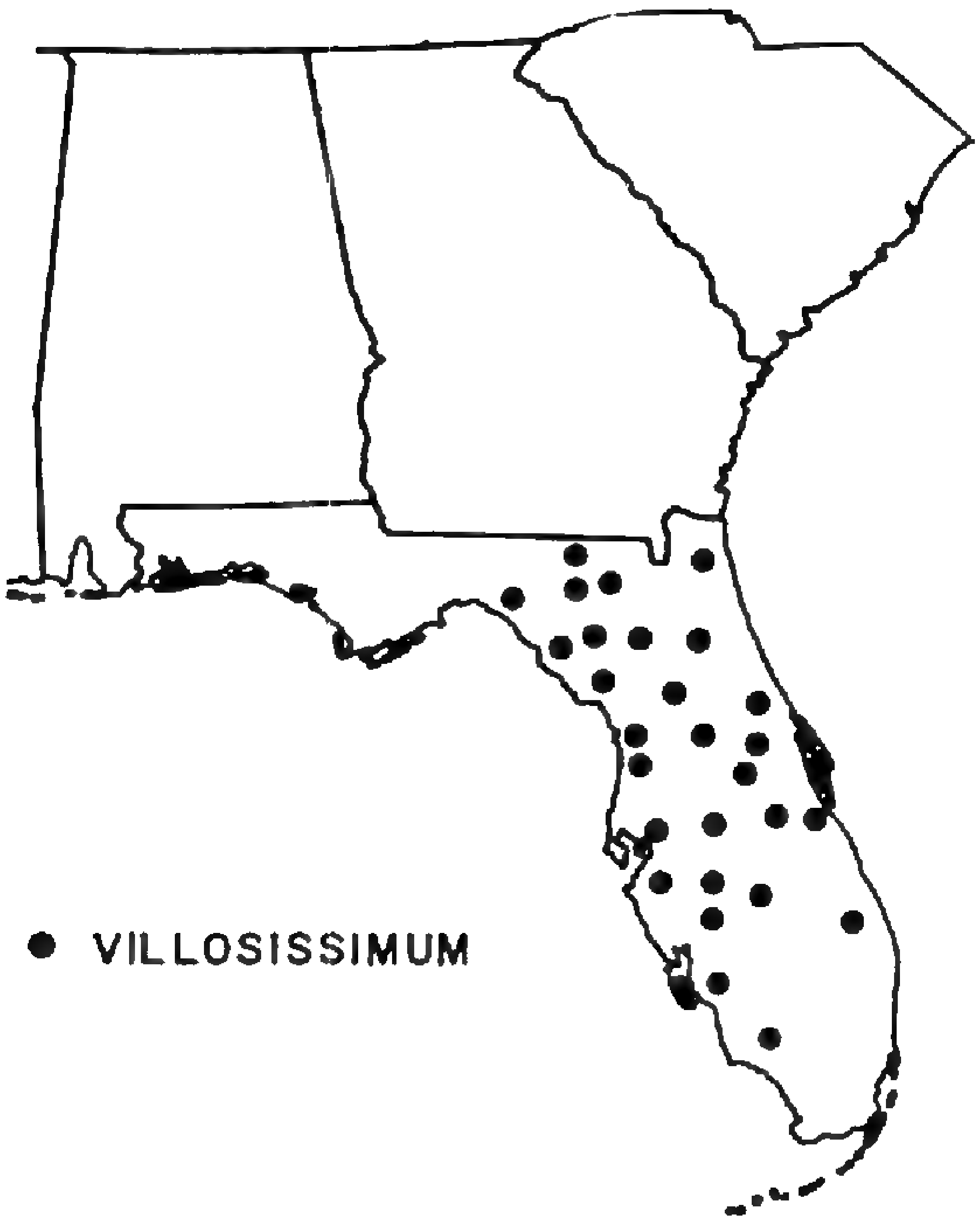
Although most plants of this variety tend to be spreading, some nearly erect forms scattered throughout the range occur. Examples are: Banks 1161A (GA), Hardee Co., Florida and Banks 1668 (GA), Jackson Co., Mississippi.

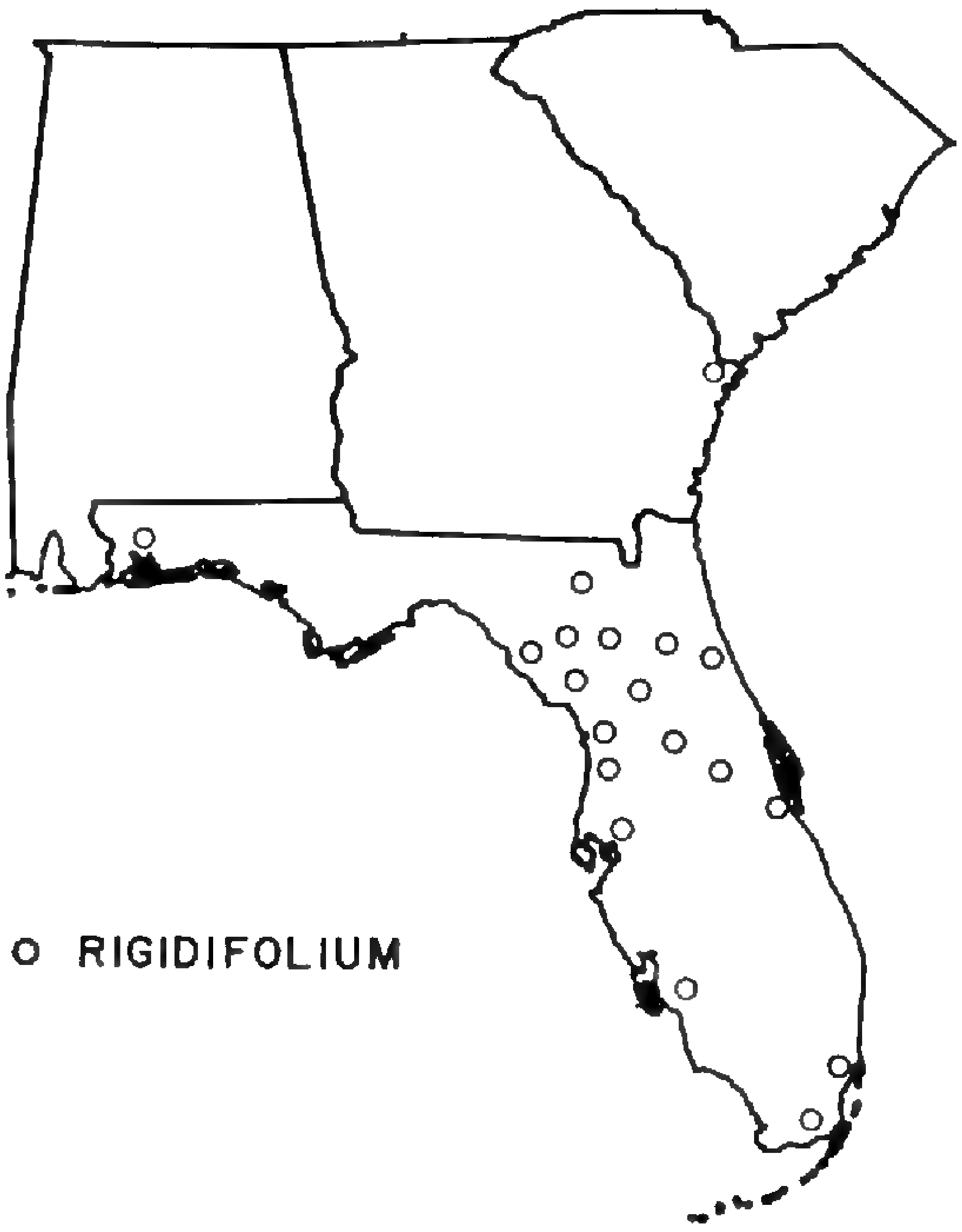
There are a few plants that are just slightly hirsute, resembling var. *ciliatifolium* in other respects. Examples are: Banks 962 (GA), Alachua Co., Florida; Banks 1261 (GA), 1262 (GA), Dade Co., Florida; Banks 1714 (GA), Calhoun Co., Florida.

Intergrading forms of var. *supinum* and var. *setaceum* have been observed. These were discussed under var. *setaceum*.

9. PASPALUM SETACEUM Michx. var. **rigidifolium** (Nash) D. Banks, comb. nov.

Paspalum rigidifolium Nash, Bull. N. Y. Bot. Gard. 1: 292. 1899.





[Type: Eustis, Lake Co., Florida, *Nash* 629 (NY!). Isotypes (MO! NY! US!)].

This variety is conspicuous because of its rigid habit, long narrow leaf blades, and large spikelets. Intergrades between var. *ciliatifolium*, var. *muhlenbergii*, and this variety occur. These intergrades have been discussed under the former varieties.

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ERIOCAULACEAE OF CONTINENTAL NORTH AMERICA NORTH OF MEXICO

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The Eriocaulaceae comprise 12 genera and more than 1200 species, predominantly tropical American. Of these, but three genera and sixteen species are presently known to occur in continental America north of Mexico (*Eriocaulon,* 10 species; *Lachnocaulon,* 5 species; *Syngonanthus,* 1 species). The warmer and more humid parts of the southeastern United States, with their vast acreages of wet, acid, arenaceous soils provide especially favorable habitats, with the state of Florida leading in number of species (10). All of the species not found in Florida are Eriocaulons. Two *(Eriocaulon cinereum, E. microcephalum)* are representatives of Australasia and continental Latin America respectively, two *(E. parkeri E. septangulare)* are primarily of the east-central and northeastern United States and Maritime Provinces, and two *(E. texense, E. kornickianum)* are of the Gulf Coastal Plain, with the latter extending northward into the Interior Highlands. It is of interest to note that *E. septangulare* occurs in Great Britain and is the sole European representative of the family. Cain (1944) and other plant geographers opine that the species represents further evidence of a Tertiary land bridge between northern Europe and America.

In both Mexico and the Caribbean Islands there are many species of Eriocaulaceae, some very similar in morphology to certain of our own species, and one is led to assume a migration into the continental United States from both of these regions.

Many of the species of the Coastal Plain of the United States show weedy tendencies, quickly occupying mechanically disturbed (wet) soils, they produce heavy quantities of seed, they are essentially heliophytes, and they therefore tend to be crowded out by later successional levels of herbs. In short most of these species exhibit sufficient vigor to maintain or even increase their areas in the face of disturbance providing there is no excessive drainage. I have seen very heavy developmnt of Eriocaulads on such areas as wet ditchbanks, roadbanks, bulldozed pine flatwoods and savannas, or particularly on recently burned low, acid savanna.

Thus far I have not observed insect pollination of the flowers in Eriocaulaceae. In most of the species the anthers are well exserted from the heads by flowering time, as are the elongated style branches. Probably most, if not all, of the species are wind pollinated.

Few organisms appear to feed heavily upon Eriocaulaceae. I have ob-

SIDA 2 (4): 285-332. 1966.

served what appears to be a smut fungus in the capsules of *Eriocaulon texense* and *E. compressum*, and puparia of dipteran insects are frequently found in the seedheads. Therefore the limited economic utility of the family is not surprising. A few species of tropical American *Syngonanthus*, because of the durable, lustrous character of their chaffy heads, are gathered, dyed, and sold in commercial quantity as "everlasting" flowers.

Fossil evidence of the Eriocaulaceae is extremely limited. Moldenke (1949) cites one species, *Eriocaulon porosum* Lesq., from Eocene deposits in Colorado.

ACKNOWLEDGEMENTS

It is a pleasure to acknowledge the help and encouragement of Dr. R. K. Godfrey of Florida State University, at whose suggestion this study was instigated. I am also indebted to Dr. Norlan Henderson for his very thorough follow up of my own observations, particularly in regard to the morphology of the flower, which saved me from making at least two serious mistakes. (A drawing of an insect puparium very nearly served as an example for the seed of *Eriocaulon compressum!!)*. I also wish to thank curators and staffs of the following institutions for their kindness in providing loans of Eriocaulaceae for study (abbreviations in accordance with J. Lanjouw and F. A. Stafleu, 1964): DS, Dudley Herbarium, Division of Systematic Biology, Stanford University; FLAS, The Herbarium, Agricultural Experiment Station, the University of Florida, Gainesville; FSU, the Herbarium, Florida State University, Tallahassee; NY, the New York Botanical Garden; SMU, the Herbarium, Southern Methodist University, Dallas, Texas; TEX, the Herbarium, the University of Texas, Austin; VDB, the Herbarium, Department of General Biology, Vanderbilt University, Nashville, Tennessee.

During the summer of 1962, this investigation was supported by a research grant GB-6305 to Dr. Godfrey from the Division of General Medical Sciences, Public Health Service. Subsequent field work was supported by a research grant G8-159 to the writer from the National Science Foundation.

MORPHOLOGY OF THE ERIOCAULACEOUS FLOWER

All of the Eriocaulaceae of North America are easily recognized by their star-like rosettes of linear leaves surmounted by slender but rigid scapes which terminate in chaffy, button-like heads. Common names applied to these plants (Bog-batchelor's-buttons, Pipewort, Hat-pin, Shoe-button, Bantam-button, Button-rod) are at once indicative of a conspicuous and fairly uniform habit.

The Head. In the Eriocaulaceae the inflorescence is directly subtended by and usually invested in involucral bracts which are in few to several, imbricate series and chaffy. The very outermost are often the smallest and hardest but these grade into broader and thinner bracts which in turn grade into narrower, equally thin receptacular bracts. All are achlorophyllous, usually somewhat transluscent and scarious at least toward their margins. If trichomes are present they are usually more abundant on the inner bracts and appear to represent terminal, multicellular, strandlike outgrowths of the chains of cells making up the matrix of a bract. Often the uppermost few cells will be more swollen than the basal cells, and the hairs are clavate. Sometimes a mealy, whitened substance accumulates in such trichomes and is of considerable diagnostic value by the extent and location of its occurrence. The surface of the receptacle supports large numbers of chaffy, unisexual flowers, each usually subtended by a receptacular bract or two, these characteristically narrower and darker than the outer, involucral, bracts. The development of flowers in the heads is progressive toward the centre of the inflorescence. Actually, a series of flat spirals of flowers of one sex will be in almost simultaneous bloom, this followed by a series of flowers of the other sex in the same inflorescence.

The Flower of Eriocaulon. The greatest diversity of form of male flowers appears in *Eriocaulon.* The parts appear in twos or threes or small multiples thereof. The sepals are two, with divergent lobes save for the short-tubular base *(E. decangulare, E. septangulare, E. kornickianum, E. lineare, E. texense, E. parkeri, E. ravenelii)* or three and joined into a 3-lobed spathelike scale *(E. microcephalum, E. cinereum).* The male corolla of *Eriocaulon* is primarily of two or three units fused about a central stalk which bears the anthers; this stalk terminates in two or three lobes, which may be almost equal or very dissimilar in size, shape and indument. Toward the apex of the inner face of each petal lobe is a dark gland. The stamens are four in number (save for *E. microcephalum, E. cinereum* which have six) and arise from the summit of a claviform structure called an "androphore" which is seemingly a combination of androecium and corolla tube. The longer filaments are opposite petals. All filaments terminate in short-oblong, two-chambered anthers which split longitudinally. The colour of the anthers is jet black in all species treated here save one *(E. cinereum)* and in that regard are very similar to the glands of the petals. At the very center and apex of the androphore are located two or three sessile or short-stalked glands, coloured the same as the stamens and petal glands. By their location they are suggestive of either an internal, reduced cycle of stamens or of a vestigial gynoecium.

The female flower of *Eriocaulon* shows less diversity between species. The calyx is comprised of two or three, usually curvate-and-keeled, scales which are joined at their bases into a very short tube. The petal scales, of the same number as the sepals, but usually paler in colour and narrower, are distinct for most of their length but do join below into a short tube which surrounds the stipe-like base of the ovulary (called "gynophore" by some). The female petals are sparingly or densely hairy, usually with white-mealy matter in the trichome tip, usually without prominent keels, and bear subapical glands similar to those on the male petals. As mentioned above, the gynoecium is raised above the perianth tube by a stalk. The ovulary is two or three-locular, the style two or three-branched. There is, in the Eriocaulaceae, but one ovule per locule, this dangling from the roof of each chamber.

The Flower of Lachnocaulon. Less diversity appears to exist between flowers of species of *Lachnocaulon.* The male flowers are comprised of three, chaffy, almost distinct sepals which are usually curvate and dark coloured. The receptacle of the flower is pilose with the same sort of multicellular, uncongested hairs that appear densely on the receptacle of the head; groups of these which alternate with the sepals have sometimes been referred to petals but, in view of the fact that there exist many more hairs identical to these save in position would make such proof difficult without internal anatomical study. An androphore exists in this genus also, this terminating in two or three stamens, and having two or three, usually appendaged (fimbriate) appendages at the very central portion of its apex. The anthers, at anthesis exserted from the head, are usually yellow in colour. The femal flower has the same number of sepals, and a carpel number corresponding to the number of stamens. Its sepals are characteristically keeled and curvate, approximately equal, and usually connivent about the ovulary. In at least one species (E. anceps) they are definitely accrescent. The gynoecium is elevated above the sepals on a short, usually pilose, stalk (the gynophore) and from the summit of two or three-lobed ovularly there arises a slender style which has two or three branches which may be branched themselves. The character of the seeds is similar to that of Eriocaulon. Both male and female sepals may be smooth or equipped with clavate, multicellular hairs. The degree of clearness of these cells, and the relative copiousness and size of hairs comprise important distinguishing characters. Central appendages exist in both male and female flowers of Lachnocaulon; those in the centre of the male flower are usually fimbirate-glandular, those in the centre of the female are unappendaged.

The Flower of Syngonanthus. Only one species of this rather large tropical genus exists within the area here treated and therefore any comments about *Syngonanthus* are extremely limited in scope. The flower of Syngonanthus flavidulus essentially differs from both Lachnocaulon Eriocaulon in that it has an inner male perianth which is corona-like, and its three style branches are simple. Vegetative differences serve at least as well to distinguish it.

Remarks on Classification. This writer finds it difficult to locate a genuine basis for distinguishing between the three genera of Eriocaulaceae here treated. For one matter, he has studied specimens of but 16 species, these representing the very uppermost branches of a huge, circumtropical base. Next to no cytological studies are in progress with any of the genera. Thus the genetic basis for genera remains unknown and a conservative treatment appears in order until such evidence is consulted. It might be appropriate here to cite some existing morphological problems which crop up within our few species. It is difficult to find sufficient morphological differences between certain *Lachnocaulon* and *Eriocaulon*. *Lachnocaulon digynum* is two-carpellate, a characteristics supposedly of *Eriocaulon,* while certain Eriocaulons such as *E. microcephalum, E. cinereum* are three-carpellate. Some *Eriocaulon (E. parkeri, E. ravenelii)* have such reduction of petal blades in the male flowers that the glands which ordinarily distinguish petals are not evident. If the tufts of hair between the sepals of Lachnocaulon are indeed to be interpreted as petals, another hitherto accepted generic difference from Eriocaulon is reduced to inconsequence. Cogent interpretation must properly be the role of the tropical botanist.

ERIOCAULACEAE (PIPEWORT FAMILY)

Rosulate, monoecious or dioecious, biennial or perennial, the roots fibrous, thickened-spongy, or thickened-septate, the stems short, simple or sparingly branched, the leaves linear, often long-tapering. Inflorescense capitate, involucrate, the head terminating a sheathed, fluted scape, the receptacle of the head smooth, hairy, or chaffy; flowers unisexual, actinomorphic or zygomorphic, the perianth members chaffy; sepals 2 or 3, distinct or fused; petals 2 or 3, usually fused at least at the bases, sometimes fused to the apices. Androecium of 2 to 4 (-6) stamens, the anthers introrse, splitting longitudinally, the filaments epipetalous (their bases plus the petal bases comprising an androphore); gynoecium of 2 to 3 carpels, the ovary superior, the locules 2 or 3, raised upon a gynophore and with style branches equalling or doubling the carpel number, the style branches themselves often branched; ovules pendulous, one per locule. Fruit a thin-walled loculicidal capsule. Embryo small, apical in copious endosperm.

KEY TO GENERA

1. Lacunar tissue (air spaces) in the leaves evident to the naked eye; the larger roots thickened, pale, septate, appearing unbranched; perianth parts in 2's (3's in the two California species), the sepals distinct or united into a spathe, the petals united for most of their length into a corolla tube which is 2 (-3) lobed above, each lobe adaxially bearing a jet black gland; trichomes of the perianth clavate, multicellular, at least some of the cells congested with a white, mealy substance; stamens (3-) 4 (-6), the ripe anther surfaces of all the native species black; carpels 2, styles 2-branched, the gynoecium on a conspicuous gynophore (carpels

3, styles 3-branched in the California species) . . . *Eriocaulon,* p. 290

1. Lacunar tissue of the leaves not evident to the naked eye; roots either fibrous and evidently branched or, if thickened and fleshy, not septate or evidently branched; perianth parts in 3's the petals if present eglandular; stamens 2 or 3, yellowish or pale; carpels 2 or 3, most commonly 3, the gynophore conspicuous or inconspicuous.

2. Roots dark, slender, fibrous, evidently branched; scapes smooth or hairy, the hairs neither swollen nor glandular apically; rosette leaves ascending or spreading; inflorescence in the bud turbinate or subglobose, pale gray or whitened; inflorescence when expanded globose or short-cylindrical, the outermost involucral bracts reflexed and obscured by the rest of the inflorescence; corolla lobes absent or vestigial; trichomes of the perianth tips clavate; filaments of the yellowish anthers fused to the rim of an androphore; style branches bifid. *Lachnocaulon,* p. 315.

2. Roots pale, thickened, spongy, appearing unbranched; scapes hairy, at least some of the hairs swollen at the tips; rosette leaves forming a recurved mat on the substratum; inflorescence in the bud ellipsoidal or narrowly ovoid, flavescent; inflorescence when expanded hemisphaerical, the straw-coloured outer bracts not obscured by the rest of the inflorescence; corolla and calyx both evident, the male corolla tubular, lacerate-dentate at the apex; trichomes of the perianth tapering, acute, not clavate; filaments of the pale anthers separating from the tubular corolla below its rim; style branches simple. . . . *Syngonanthus,* p. 327.

ERIOCAULON L. Sp. Pl. 87. 1753; Gen. Pl. ed. 5. 38. 1754.

Rosulate, scapose, often tufted, herbs, the roots evidently cross-partitioned, the leaves linear, arranged in a close spiral toward the apex of a short or elongated, sometimes sparingly branched stem. Perennation by means of lateral offshoots or by rhizomes or stolons (the latter two most often observed when plants are submersed). Inflorescence an involucrate head or contracted spike comprised of an outer involucre and a bracteate mass of scaly, unisexual flowers, the plants being either monoecious or dioecious. Leaves linear, often linear-attenuate, gradually or abruptly flaring toward a clasping base, pale and noticeably aerenchymatous basally, greener and less distinctly lacunate above, the chlorenchymatous proportion of the leaves increasing with extent and duration of emergence. Outer bracts of the inflorescence of few to several imbricate series, broad, green, gray-green or paler, at least the margins transluscent. Bracts within the inflorescence usually 1 per flower, chaffy or almost membranaceous, pale to brownish, greenish, or gray, entire or ciliate, the surfaces glabrous or producing multicellular trichomes at least the terminal cells of which are usually congested with a farinose, white material. Sepals 2, scarious, pale or coloured, often translucent, boat-shaped, often covered toward the tips with farinose or clear, multicellular trichomes. Petals 2, fused at least toward the bases, equal or unequal, similar to the sepals but generally narrower and separated from them by a pronounced tubular stalk (which is partly petal and, in staminate flowers, partly stamen) and distinguished from the sepals by a dark gland on the inner, distal surface of each; outer and sometimes inner surfaces frequently with multicellular, clear or congested, trichomes; the margins frequently ciliate; distal end of the male perianth tube concave, sometimes bearing 2-3 dark coloured glands in its centre, these suggestive of the glands of the corolla lobes. (Sepals and petals 3 in California species). Stamens 3 to 4 or 6, 2 or 3 opposite the petals, introrse, but versatile, the anthers dehiscing longitudinally and well-exserted from the inflorescence at anthesis. Carpels 2, locules 2, the ovary stipitate (on a gynophore), the style 2-branched (carpels 3, locules 3 in the California species); ovules 1 per locule, pendulous from the summit of the locules. Fruit a loculicidal capsule, the pericarp thin, often velum-like, the style persisting on the fruit. Seeds ovoid, ellipsoidal or broadly fusiform, variously lined, ridged or papillate; embryo small, at the funicular end; endosperm copious, mealy.

Primarily plants of wet, acid situations with most of the species confined, within the area treated, to the Atlantic or Gulf coastal plain. Of the 10 species described here, two are adventive in California, two are on the western Gulf coastal plain, two are of the northeastern United States and southeastern Canada, and the remainder of the southeastern United States.

One species, *E. decangulare* may be found on relatively dry soils of pine flatwoods as well as in wet situations; the rest are efficient indicators of boggy, very high hydroperiod soils. Of the native species *E. compressum, E. ravenelii,* and *E. texense* are winter or spring bloomers while *E. lineare, E. decangulare, E. septangulare, E. parkeri, E. kornickianum* are summer and fall bloomers.

Eriocaulon may be distinguished in the rosette stage from either *Lachnocaulon* or *Syngonanthus* by the coarsely lacunar character of its leaf bases and by the septate character of its roots, both of which may be associated with the definitely more aquatic habitat.

KEY TO ERIOCAULON

1. Surface of the receptacle and/or the bases of the florets copiously trichomiferous; some or most of the receptacular bractlets and perianth parts with chalk-white trichomes, thus the heads very conspicuously white; diameter of the heads, when in full flower or fruit, at least 0.5 cm., usually more.
    2. Heads, soft, much compressed in drying; sheathes of the scape seeming to exceed all or most of the leaves in length; involucral

bracts usually grayish, rounded, the receptacular bractlets grayish and acute; inner surface of the female petals villous; all cells of the clavate trichomes of the perianth whitened, opaque; winter, spring or early summer flowering and fruiting species of aquatic or wet situations.

3. Heads seldom less than 1 cm. broad at flowering time on scapes seldom shorter than 2 dm. which are subtended by leaves seldom shorter than 5 cm., thus the plants robust; roots seldom less than 1 mm broad; lobes of staminate corolla conspicuously unequal. . . . . 4. *E. compressum*, p. 299
3. Heads usually between 0.5 and 1.0 cm. broad at flowering time on scapes seldom as long as 2 dm. which are subtended by leaves seldom as long as 5 cm., thus the plants low; roots seldom 1 mm. broad; lobes of staminate corolla subequal, though inconspicuous. . . . . 6. *E. texense*, p. 305
2. Heads hard, very slightly compressed in drying; sheathes of the scape usually exceeded in length by most of the leaves; involucral bracts stramineous, acute, the receptacular bracts pale, acuminate; inner surfaces of the female petals smooth; terminal cells of the clavate trichomes of the perianth whitened, but some or all of such hairs with basal cells uncongested, transparent; flowering in late spring, or summer and fruiting in summer and fall; a plant of moist but seldom aquatic or permanently wet situations. . . . . . 5. *E. decangulare*, p. 302

1. Surface of the receptacle of the head lacking trichomes or but sparingly trichomiferous; receptacular bractlets and/or perianth parts smooth or clavate-hairy, thus the heads either dark gray or white; diameter of the heads, when in full flower or in fruit, seldom more than 0.75 cm.
   4. Stamens 6, carpels 3 on an elongate gynophore.
      5. Anthers yellow, receptacular bractlets acute. . . . . . . 9. *E. cinereum*, p. 311
      5. Anthers black, receptacular bractlets obtuse. . . . . 10. *E. microcephalum*, p. 312
   4. Stamens 4, carpels 2, on a short gynophore.
      6. Heads between 0.5 cm. and 1 cm. broad at maturity, the outer involucral bracts usually reflexed and hidden by the conspicuously white-hairy bractlets and perianth parts.
         7. All outer involucral bracts and all bracts and sepals save for sepals of male flowers and receptacular bractlets of some populations whitened or stramineous, thus the heads appearing very pale even when young; seed faintly rectangular-reticulate, often with longitudinal lines of papillae; sandy or peaty lakeshores, ditches or pondshores, southern Georgia,

Florida, west to southern Alabama. . . 7. *E .lineare*, p. 307

7. All bracts and perianth parts save for outermost involucral bracts and petals darkened, usually gray to almost black, thus the young heads dark; seed very faintly reticulate, not at all papillate; bogs, sandy or peaty lakeshores, banks or ditches, eastern Canada south in the mountains to North Carolina. . . . . 8. *E. septangulare*, p. 309

6. Heads seldom as broad as 0.5 cm., the outer involucral bracts, if reflexed, not hidden by conspicuously white-hairy bractlets and perianth parts.

   8. Bractlets very dark, very lustrous, all subentire and narrowly acute; scapes filiform; plants of the southeastern U. S. or the southwestern U. S.

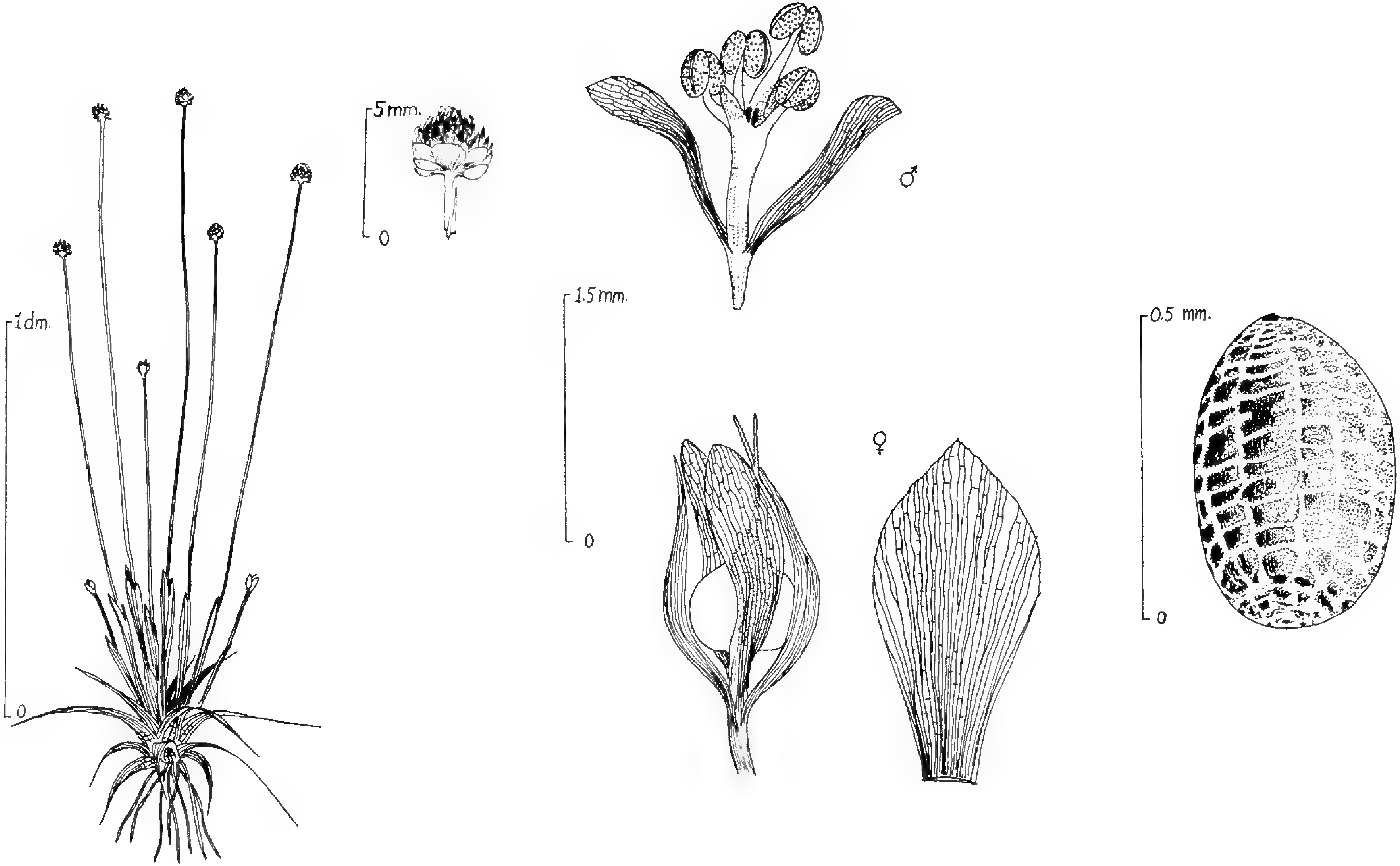
      9. All perianth parts dark, usually smooth; seed coat conspicuously rectangular-reticulate, the lines made up of close-et diagonal bars of a white mealy substance. (Occasionally the inner surface of the linear female petals have a few white, clavate trichomes); plants of disturbed sandy peats toward the coast, S. C. to Fla. . . . . . . 1. *E. ravenelii*, p. 293

      9. All perianth parts, often bractlets, with some white-clavate hairs at least on the margins, thus imparting a dark and *white-banded* appearance to the mature heads; inner surface of the broadly spatulate female petals hairy; plants of the interior highlands and the southwestern gulf coastal plain. . . . . 3. *E. kornickianum*, p. 297

   8. Bractlets stamineous or gray, dull, often evidently erose or lacerate, broadly acute to obtuse; scapes linear; plants of marshy, estuarine areas of the central or northern Atlantic coasts. . . . . 2. *E. parkeri*, p. 295

1. ERIOCAULON RAVENELII Chapm., Fl. S. US. 503. 1860.

Perennial (biennial?), glabrous, the stem short and unbranched, the plants low, with scapes seldom exceeding 2 dm. Leaf bluish-green, linear-attenuate (save on drier situations where leaves become shorter, more acute-tipped), aerenchymatous tissue evident almost to the tip, 3.0-7.0 (15.0) cm. long. 3.0-5.0 mm. broad at the base, longer than the sheath of the scape. Sheath of the scape loose, gradually widening above to a deeply slit apex. Scape 10-20 cm. long, slightly twisted, 4-5 (-6) ribbed. Head gray-brown, rarely charcoal gray, subglobose, 3-4 mm. broad. Receptacle of the head smooth or with sparse, clear trichomes. Outer bract oblong-ovate or broadly cuneate, 2 mm. long, pale gray, translucent, rounded to acute. Inner bract and receptacular bractlet cuneate, ca. 2 mm. long, a darker gray, translucent, shining, acute to acuminate or lacerate. Male flower: sepals separate, oblong to oblanceolate, gray, usually acute; corolla tubular, very slightly expanded



Eriocaulon ravenelii

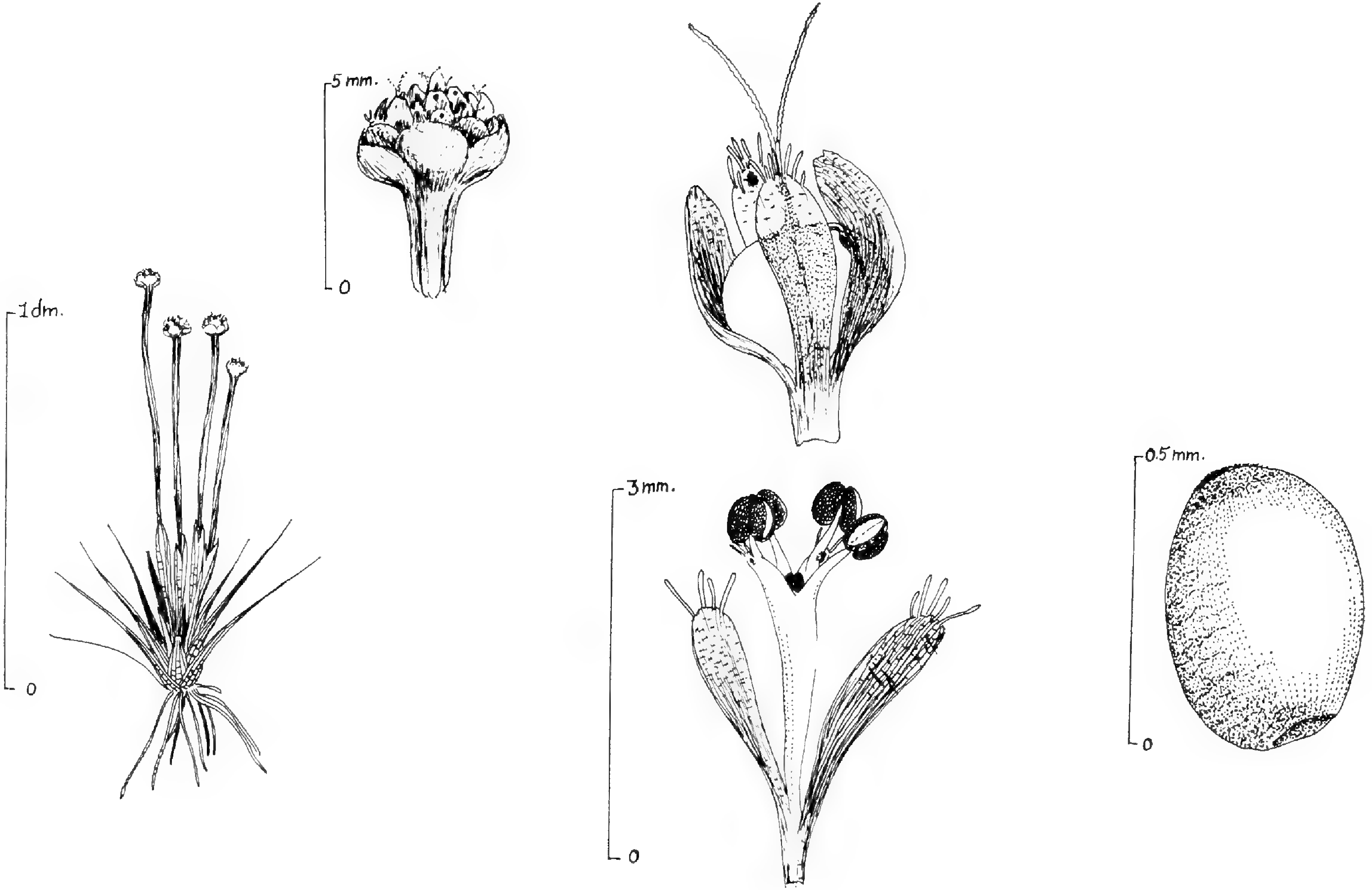
above, the two corolla lobes very small, pale, scale-like, with inconspicuous glands; anthers 4, round, black, about the same length as the filaments. Female flower: sepals narrowly oblong, narrowly cuneate, or linear, the apex acute to mucronate; petals narrowly cuneate or oblanceolate or oblong, acute, smooth or with a few trichomes on the inner surface or terminally, the glands inconspicuous; ovary on a short gynophore. Seeds dark brown, somewhat lustrous, broadly ellipsoidal, ca. 0.5 mm. long, irregularly alveolate, the individual alveolae mainly rectangular.

Mildly acid sandy pineland swamps, particularly on wet disturbed areas toward the Atlantic coast, eastern South Carolina south to Florida, west to Mississippi.

Type. Wet places, Northampton Field, St. John's, Berkeley Co., South Carolina, Ravenel. At NY.

Eriocaulon ravenelii appears to be one of the rarer species of Eriocaulaceae of the southeastern United States; at least it is scarce in the larger collections. However, it is locally abundant in the lower peninsula of Florida, generally being found on sweeter soils than those occupied by the other Eriocaulons of the area. I have seen it in but three localities and in each case it was growing on moist exposed pine flatwoods sands bordering *Typha-Cladium-Spartina* marsh near the Florida coast. It actually seems to occupy the ecotone between the two abovementioned vegetational types. It comes in quickly on disturbed sands or sandy peats but appears not to compete well with the grasses and sedges which also rapidly invade such areas; therefore it does not persist long on a site. It appears to be most abundant on intermittently but shallowly flooded sands and, where I have seen it, is associated with such herbs as *Cyperus flavescens, C. haspan, C. odoratus, C. polystachos* var. *texensis, Lipocarpha maculata, Hemicarpha micrantha, Eleocharis albida, E. geniculata, E. atropurpurea, Fimbristylis caroliniana, F. diphylla, F. schoenoides, Rhynchospora inundata, R. microcarpa, R. schoenoides, R. tracyi, Dichromena colorata, Fuirena breviseta, F. scirpoidea, Psilocarya nitens, P. schiediana, Panicum hemitomon* (and several *Dichanthelium* panicums), *Manisuris rugosa, Juncus megacephalus, J. scirpoides, Asclepias lanceolata, Proserpinaca pectinata, Amannia latifolia, Lythrum lanceolatum, Rhexia cubensis, Sabatia grandiflora, Hydrolea corymbosa, Litrisa carnosa, Liatris garberi, Flaveria linearis, Coreopsis leavenworthii* and *Cacalia lanceolata,* etc. Even when present in abundance *E. ravenelii* is seldom conspicuous, being a low plant and lacking the startling white masses of trichomes possessed by some of the other Eriocaulons. Both in habit and in its ecology it appears to be very similar to *E. parkeri,* a coastal species further north, this fact commented on sometime ago by B. L. Robinson (1903).

While all descriptions of this species contain no definitive statement



Eriocaulon parkeri

about trichomes, there are some examples in which a very few trichomes are present on bractlets and perianth parts. When such do appear, they are similar in shape, size and colour to those of *E. lineare.*

2. ERIOCAULON PARKERI B. L. Robinson, Rhodora 5: 175. 1903.

Low plants, solitary or in small tufts from short lateral offshoots. Leaf linear attenuate, 2-6 cm. long, tapering to a filiform-terete tip, pale green. Sheath of the scape somewhat shorter than to the same length as the leaves, inflated, bifid-acute. Mature scape filiform, to 30 cm. long, ca 1 mm. broad, very slightly twisted, 4-5 ridged. Mature heads hemisphaerical, dull gray or stramineous, 3-4 mm. broad. Outer involucral bract ovate to suborbicular or obovate, ca. 2 mm. long, scarious, stramineous to lead coloured, glabrous. Inner involucral bract cuneate to narrowly obovate, ca 2 mm. long, acute, gray-scarious, translucent, smooth or with white-clavate trichomes on the back of the apex. Surface of the receptacle of the head smooth. Male flower: sepals linear-curvate, keeled, ca. 2 mm. long, gray, translucent, smooth or with a few white trichomes on the back apically; petals fused into a narrowly obcylindrical, yellowish-white, tube, the corolla lobes reduced to 2 very small triangular, white-hairy appendages. Female flower: sepals oblong or oblanceolate, ca. 2 mm. long, curvate keeled, gray, translucent; petals about the length of the sepals, spatulate, yellowish-white, smooth or with a very few white-clavate hairs apically and on the inner surface. Seeds ovoid, ca. 0.5 mm. long, rarely to 0.7 mm. long, the base truncate, reddish-brown, with a very delicate reticulum of horizontally oriented rectangles.

Muddy tidewater riverbanks, southeastern Canada to eastern North Carolina.

Type. Shore of Delaware River near Cooper's Creek, New Jersey, T. P. James. At GH.

This species has been most often confused with *E. septangulare* but may be distinguished from it by the following criteria:

a. Scape tending to be straight rather than twisted, and with fewer ridges.
b. Head narrower (seldom more than 0.4 mm.), hemisphaerical, the outer involucral bracts a very pale, dull-gray or stramineous, in contrast to the broader, when mature subglobose, heads of *E. septangulare* the outer involucral bracts of which are much darker and more lustrous.
c. Bracts and perianth parts sparingly clavate-hairy, often some perianth parts smooth, in contrast to the more pubescent perianth and bractlets of *E. septangulare.*
d. Involucral bracts tending to remain ascending even on the fruiting heads, thus mainly concealing the bractlets and florets while, on *E. septangulare*, the involucral bracts tend to be reflexed in the

Eriocaulon kornickianum

flowering and fruiting heads and are themselves partly concealed by the hairy florets.

3. ERIOCAULON KORNICKIANUM, Van Heurck & Muell.-Arg. in Van Heurck, Obs. Bot. 101. 1870.

Solitary or in small tufts, reproducing vegetatively by short lateral offshoots. Leaf pale green, very thin, linear-attenuate, 1-5 cm. long, tapering evenly from a thin, pale, aerenchymatous base, the margin slightly incrassate. Sheath of the scape about the length of most of the leaves (ca. 2-3 cm.) loose, somewhat inflated and scarious above, bifid. Mature scape filiform, 5-8 cm. long, about 0.5 mm. broad, twisted, 3-4 ridged. Mature head subglobose or short-oblong, 3-0-4.0 mm. broad, dark gray or gray-green save for pale "rims" of the white-ciliate perianth parts and bracts and the pale, scarious, outer bracts. Outer involucral bracts broadly oblong to suborbicular, reflexed at maturity, 1.0-1.25 mm. long, smooth, very thin, stramineous, translucent, the apex rounded. Receptacular bractlet oblong to cuneate, ca. 1.5 mm. long, gray or gray-green, acute to obtusely angled, translucent, acute to obtusely angled, concave and unequilaterally keeled, smooth save for a scattering of white, clavate, trichomes along the somewhat erose upper margin. Surface of the receptacle of the head smooth. Male flower: sepals linear-curvate, concave, ca. 1 mm. long, grayish-translucent, with a few white, clavate, trichomes on the backs apically. Corolla members subequal, yellowish, primarily consisting of a narrowly obpyramidal androphore which terminates in two low, glanduliferous, tooth-like lobes whose apices have a few white-clavate trichomes. Female flower: sepals linear-curvate, ca. 1 mm. long, gray-translucent save for the pale, clawed bases, smooth or with a scattering of hairs on the backs apically; petals spatulate, curvate, the blades broadly rhombic and opaque, the bases clawed, ca. 1 mm. long or slightly longer, yellowish-white, the inner surface and upper margin with white-clavate trichomes. Seeds broadly ovoid, ca. 0.5 mm. long, deep reddish brown, the surfaces papillate or rugose.

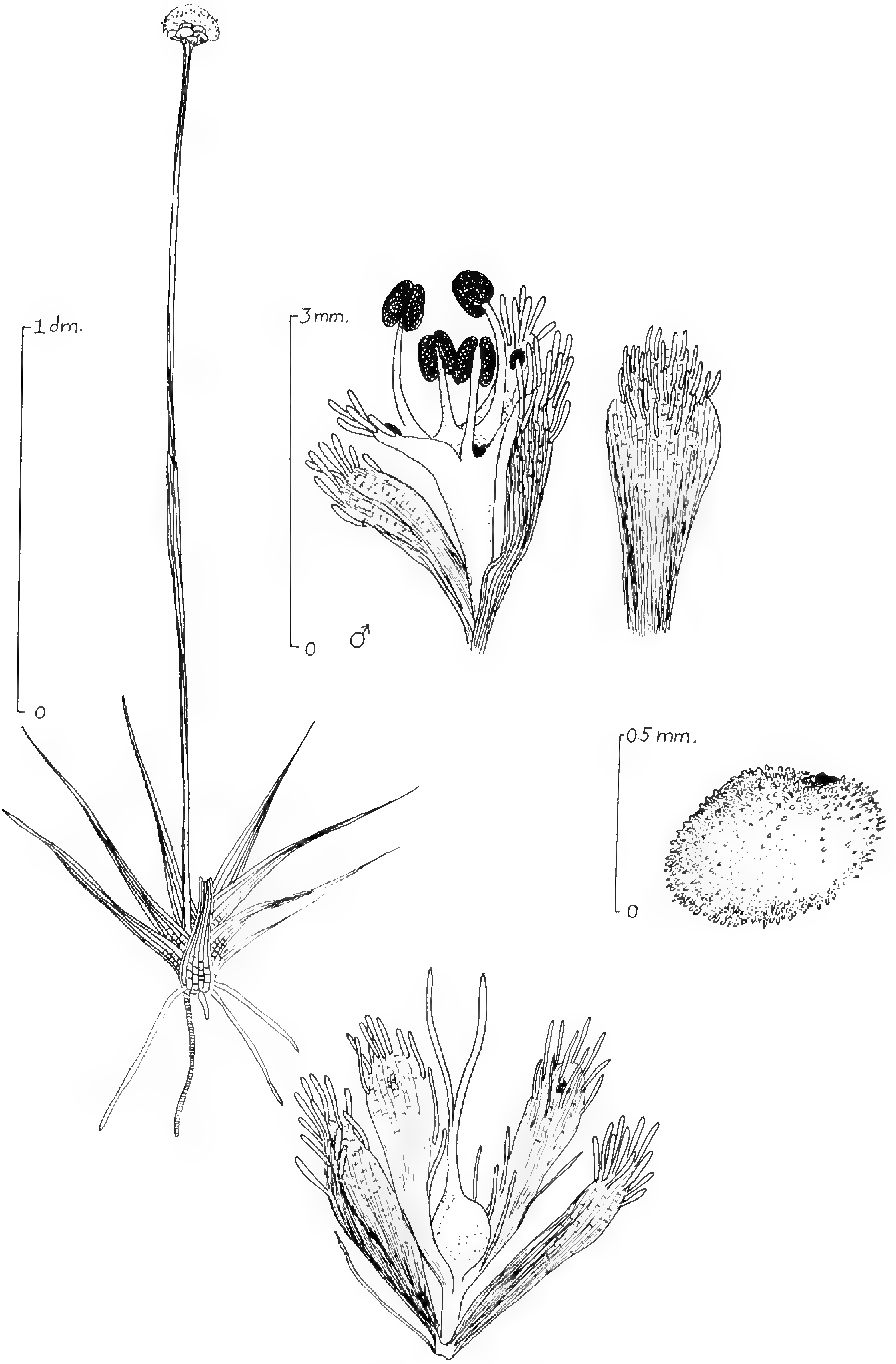
Upland seepage areas and bogs, from the Interior Highlands (Magazine Mt., Arkansas) south and west to Oklahoma and Texas.

I have never seen living examples of this apparently rare, diminutive, *Eriocaulon*. Superficially it is closest to *E. ravenelii* of the eastern Coastal Plain, differing from it primarily in its smaller stature, its trichomiferous bractlets and parianth parts, and its smaller, rugose rather than alveolate, seeds.

4. ERIOCAULON COMPRESSUM Lam., Encycl. 3: 276. 1789.

Eriocaulon gnaphalodes Michx. Fl. Bor. Am. 2: 165. 1803.

Perennial, flaccid-leaved, sometimes tufted, reproducing vegetatively either by short lateral offshoots or by pale, short rhizomes or by leafy stolons (stolons most often produced in summer). Leaves pale green,



Eriocaulon compressum

linear-attenuate, 5.0-30.0 cm. long, tapering rather evenly from the broad (1.0-4.0 cm.) pale, evidently lacunate, base, smooth. Mature scapes usually solitary, 20.0-70.0 cm. long, pale green, 1.0-3.0 mm. broad just below the head, glabrous, twisted, with several ridges, the tissue of the grooves very evidently lacunary. Sheath of the scape very loose, usually longer than the mature leaf, slightly flaring above toward the bifid, acute or acuminate apex. Mature head hemisphaerical or globose, 1.0-2.0 cm. broad, soft, tending to contain flowers of but one sex, chalk-white save for the dark gray or almost blackish exserted tips of the receptacular bracts and anthers. Receptacle of the head with multicellular, narrow, translucent trichomes. Outer involucral bracts grayish-translucent (sometimes the very outermost flavescent), 2-3 mm. long, broadly ovate or oblong or elliptic, the tips rounded or obtusely angled, frequently squarrose; bracts within the inflorescence (receptacular bractlets) a dark gray, 2-3 mm. long, spatulate-linear or oblong, acute with clavate white trichomes on the dorsal apical surface. Male flower: sepals separate, translucent, linear or linear-spatulate, smooth and pale basally, the apex acute to acuminate, with a scattering of white, clavate trichomes on the back; corolla tube clavate, with 2 unequal oblong lobes, the larger of which has an apical fringe of white clavate trichomes and the smaller of which is either smooth or with a very few clavate trichomes on the tip; stamens 3 or 4, the anthers black, ca. 0.5 mm. long, on filaments of unequal lengths but usually slightly exserted at anthesis; central glands (staminodia?) 3 or 4, sessile or short-stalked, short-oblong, black, slightly shorter than the anthers. Female flowers: sepals oblong-spatulate, acute, translucent but dark, the outer and inner surfaces smooth or hairy, the inner hairs long, multicellular, transparent, the outer ones (particularly toward the sepal tip) clavate, white; corolla tube short, the two petal lobes subequal, oblong-spatulate, acute, pale, translucent, the inner surface with long, filiform, multicellular clear trichomes, the outer surface with white, clavate, trichomes, particularly toward the apex. Seeds broadly ovoid to almost as broad as long, ca. 0.5 mm. long, slightly compressed, a dark and lustrous brown, the surface sometimes echinate.

Sands or sandy peats of shallow pineland ponds, lakeshores, seepage bogs, savannas, ditches or low flatwoods, coastal plain, eastern Texas e. to Florida and n. to New Jersey.

Type. South Carolina, Fraser. (At P?).

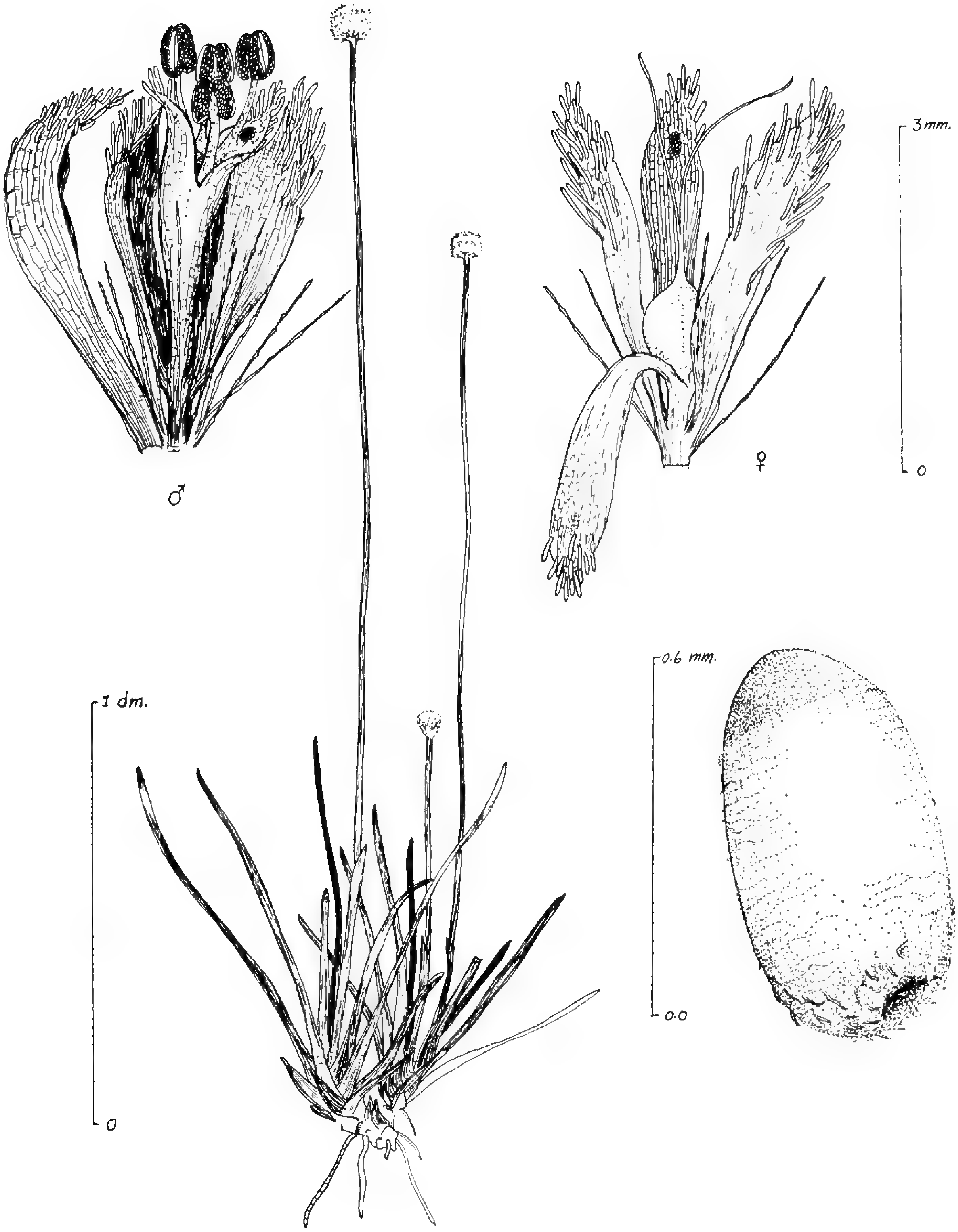
In stature and habit *E. compressum* somewhat resembles *E. decangulare*, a tall summer and fall flowering *Eriocaulon*, but differs from it in having a more spongy foliage, softer heads, a less-hairy receptacle, and darker coloured bracts the tips of which are acute or rounded rather than acuminate. In fact, it is closest in appearance to a shorter plant, *E. lineare*, which also has soft, white, usually hemisphaerical heads, but differs from that species in having larger, often unisexual (rather than bisexual) heads, the receptacular surfaces of which have at least sparse hairs (those of *E. lineare* are smooth). Also, the surface of the seed of *E. compressum* is smoothish while that of the seed of *E. lineare* is indistinctly cancellate, sometimes papillate.

This is perhaps the showiest of all the Eriocaulaceae of the southeastern United States, in springtime so abundantly decorating the shallow waters of pinelands as to appear like a shower of white confetti.

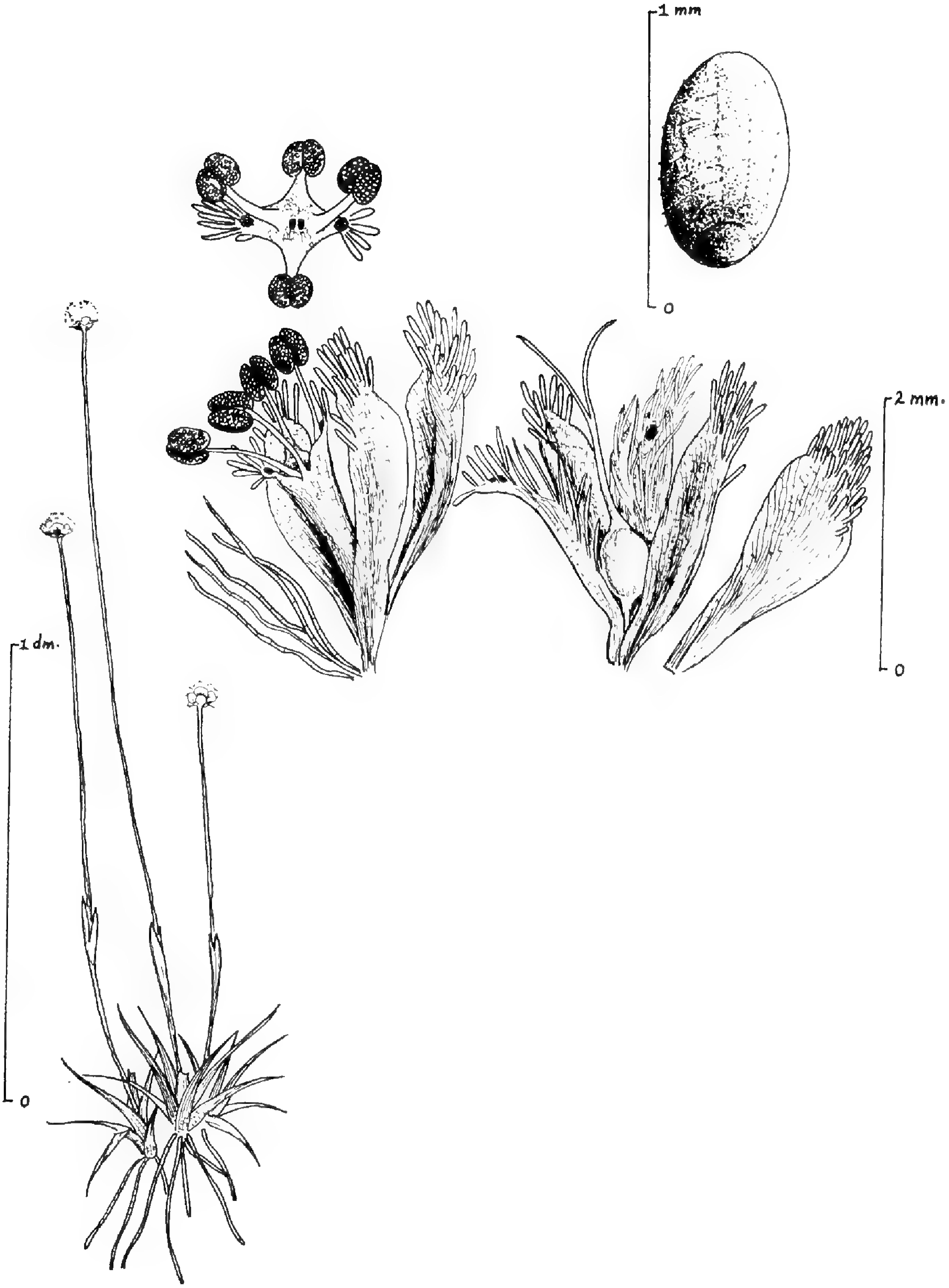
5. ERIOCAULON DECANGULARE L., Sp. Pl. 87. 1753.

Eriocaulon serotinum Walt., Fl. Car. 83. 1788.

A clump former, but reproducing vegetatively either by short lateral offshoots or by very stout, branching rhizomes. Leaf linear-attenuate to linear-acute (the wetter the site, the greater the taper), 10.0-40.0 cm. long, smooth, a rich green, tapering evenly from the broad (1.0-4.0 cm.) pale green or yellowish, spongy, translucent base into a narrow but blunt, sometimes callused, tip. Sheath of the scape loose, shorter than the leaves, flaring slightly toward the bifid orifice (which, when young, is oblique and acute). Mature scape 30.0-110.0 cm. long, 1.0-3.0 mm. broad just below the head, twisted, with several (8-12) pale green ridges, the grooves a paler green and narrower than the ridges. Mature head subglobose, 1 to 2 cm. broad, hard (little compressed in pressing), a dull white, the lowermost flowers and bractlets reflexed, thus obscuring the subtending involucral bracts. Surface of the receptacle villous, the trichomes long and multicellular, usually clear. Outer involucral bracts narrowly ovate to lanceolate, 2.0-4.0 mm. long, stramineous, acute, with clavate white hairs on the backs apically. Bracts of the receptacle linear to oblong-lanceolate, 3.0-4.0 mm. long, pale, narrowly acute to acuminate, sometimes exserted enough to give the head a slightly echinate appearance, with clavate white hairs on the backs or glabrous at the exserted tips. Male flower: sepals linear, about 3.0 mm. long, yellowish-white, translucent, slightly curvate, narrowly keeled, the keel and apex with white-clavate trichomes the basal cells of which are clear; petals fused into an elongate tube 2/3 the length of the sepals but produced ultimately into 2 triangular or linear lobes about 1 mm. long, translucent, whitish-yellow; each bearing a small tuft of white and clavate hairs on the back apically; anthers broadly ellipsoidal, exserted on filaments about 3 mm. long. Female flower: sepals linear, 2.0-3.0 mm. long, keeled, yellowish-white, slightly curvate, acute, clavate-hairy on the backs toward the apices; petals spatulate or with narrowly elliptic blades on claws about half the length of the blades, pale, glabrescent or with long clear hairs on the backs basally, short-clavate hairs on the backs terminally; seeds ellipsoidal, 0.75-1.0 mm. long, very finely cancellate or sometimes the cancellate concealed by rows of delicate subappressed hairs.



Eriocaulon decangulare



Eriocaulon texense

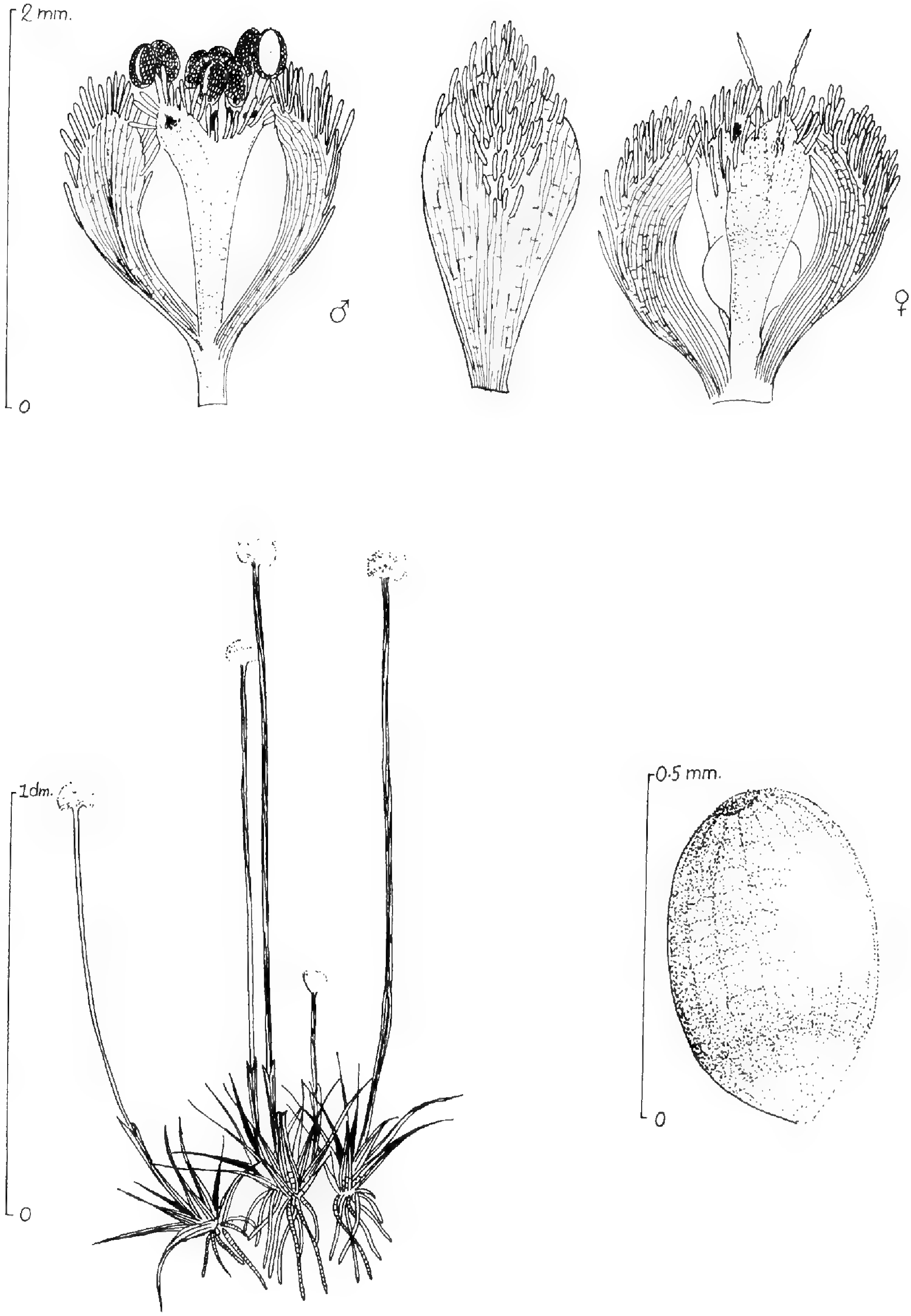
Sandy or peaty lakeshores, pine flatwood, ditches, margins of cypress domes, or savannas, primarily in the coastal plain, Florida north to New Jersey, west to eastern Texas.

Type. In Swamps, North America. Not seen by this writer.

This is the most robust of the Eriocaulons of the southern United States and it is certainly one of the more conspicuous floral elements in the midsummer and fall savannas, its white "buttons" providing a pleasing contrast in a sea of grass and sedge. It is also to be distinguished from sympatric Eriocaulons by its narrowly acute to acuminate receptacular bractlets, the pale tips of which are noticeably exserted from the heads, and by the firmer character of its foliage and inflorescences. The stature, leaf length and breadth, and the head size of *E. decangulare* all tend to be less as one travels west toward Texas or north along the Atlantic coastal plain. The largest examples of this species are to be found in northwest Florida (*E. decangular* L. var. *latifolium* Chapm. ex Moldenke).

6. ERIOCAULON TEXENSE Korn., Linnaea 27: 494. 1856.

A clump former, perennating by means of short lateral offshoots. Leaf pale green, linear-attenuate, 1.0-5.0 cm. long, tapering evenly from a fleshy, pale, often trichomiferous, aerenchymatous base, the inner surfaces often noticeably papillose. Sheath of the scape usually about the length of the leaf or somewhat longer (on drier sites very conspicuously longer), 3-5 cm. long, the orifice expanded oblique, bifid. Mature scape 5-30 cm. long, slightly twisted, 4-7 ridged. Mature head hemisphaerical, ca. 5 mm. broad, rarely subglobose, gray save for the white exserted trichomes of the bractlets and perianth parts and for the outer bracts of the involucre which are stramineous. Surface of the receptacle densely beset with long tapering, clear, sometimes exserted, multicellular trichomes. Outer involucral bracts suborbicular to broadly obovate, apiculate to rounded, ca. 1.5 mm. long, stramineous, smooth, scarious, reflexed at maturity and usually hidden by the florets, grading gradually into the dark gray, translucent, narrowly obovate to cuneate, acute, receptacular bractlets whose margins are ciliate, with white-clavate trichomes. Male flower: sepals 2, linear-spatulate, keeled, scarious, pale and translucent basally, dark gray and opaque apically, ca. 1.5 mm. long, acute, white-clavate-hairy on the backs and margins apically. Petals 2, largely fused into a clavate-cylindrical yellowish structure (the androphore), the base of which has long, tapering, transparent multicellular trichomes and apex of which is divided into 2 unequal, narrowly triangular lobes whose apices are primarily made up of clavate, white hairs. Anthers black, broadly ellipsoidal, ca. 0.5 mm. long, exserted at anthesis from the heads on yellowish filaments about 1.0 mm. long. Female flower: sepals narrowly oblong-obovate, ca. 1.5 mm. long, sharply curvate-keeled, dark gray, the backs white-clavate



Eriocaulon lineare

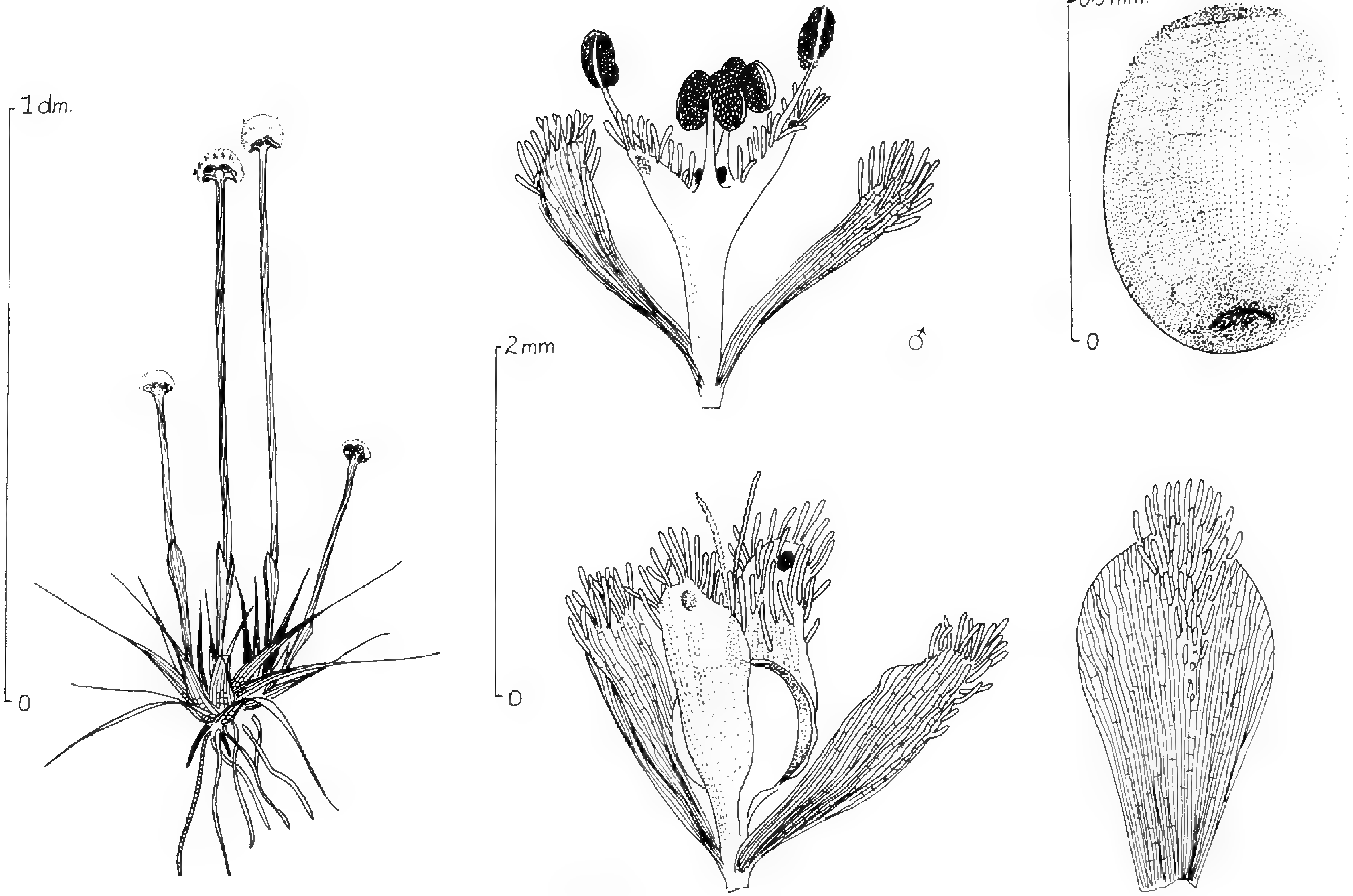
hairy apically along the keel, the margin eciliate; petals equal or unequal, linear to oblong or obovate, ca. 1.0-1.5 mm. long, yellowish-white, acute, the inner surfaces pilose with a mixture of clear tapering and opaque-clavate, multicellular trichomes, the outer surface sparingly clavate-hairy, the margin clavate-hairy. Seeds ovoid, ca. 0.6 mm. long, obscurely and shallowly alveolate, brownish with frequent, pale, narrow tubercles along the low ridges.

Acid, sphagnous (*Sarracenia*-type) bogs, coastal plain, southwestern Alabama west to eastern Texas.

This rather rare *Eriocaulon* is part of the complex including *E. lineare, E. septangulare* (see discussion under those species). I have not seen it in other than sphagnous *Sarracenia*-type bogs, and hence have no idea what habital changes it expresses when submersed. It is locally abundant in central Louisiana, coating bog potholes with its small but showy white heads. Unlike the two other species of the complex, this *Eriocaulon* is a spring bloomer; by early summer no trace of it is to be seen, even the leaves appearing to vanish. The type locality for this species is Texas (Drummond 409, an isotype at NY) where it often is to be found in association with *E. decangulare*. In fact small specimens of Texas *E. decangulare* are often identified as *E. texense*. However, the heads of *E. texense* are soft in contrast to the harder heads of *E. decangulare;* the involucral bracts of *E. texense* are rounded to acute, sometimes squarrose, and quite dark in contrast to the more rigid, stramineous, narrowly acute to acuminate, bracts of *E. decangulare;* the scapes of *E. texense* are more slender and with less ridges than those of *E. decangulare; E. texense* has usually flowered, set fruit, and is dying back by the time the heads of *E. decangulare* are full.

7. ERIOCAULON LINEARE Small, Fl. SE. U.S. 236. 1328. 1903.

A clump former, but reproducing vegetatively either by short lateral offshoots (on moist situations) or by pale, elongated, leafy rhizomes (on submersed or wet situations). Leaf bluish-green, linear attenuate, 1.0-10.0 cm. long, tapering evenly from a fleshy, pale, aerenchymatous base 1.5-4.0 mm. broad. Sheath of the scape slightly longer than or about as long as the leaf, the oblique orfice acute or bifid-acute. Mature scape 6.0-15.0 (-40.0) cm. long, about 1 mm. thick below the head, (longest and thickest when the plants are submersed), slightly twisted, with 4 to 7 slightly elevated, dark green ridges, the shallow grooves yellowish or at least a paler green. Mature heads hemisphaerical or globose, rarely short-cylindical, 4.0-6.0 mm. broad, whitish. Surface of the receptacle of the head smooth. Outer involucral bracts orbicular or ovate, 2.0-2.5 mm. long, pale, the tips rounded, entire, sometimes squarrose, the margin often scarious. Receptacular bractlets obovate or cuneate, ca. 2 mm. long, the bases scarious save for a slightly darkened midrib, the apices hairy on the backs with white, clavate hairs. Male flower: sepals translucent,



Eriocaulon septangulare

grayish, concave-curvate, oblong-linear, 1.5-2.0 mm. long, acute, the outer surfaces with white-clavate hairs apically; petals largely fused into a narrowly cylindrical structure 1.0-1.5 mm. long, solid at the basal, slightly narrower end, gradually broadened above at which point the two short (ca. 0.5 mm.) ciliate corolla lobes depart, and on the concave inner surface of which are two sessile black glands; anthers black, broadly ellipsoidal, ca. 0.5 mm. long, exserted from the heads on white filaments 1.0-1.5 mm. long. Female flower: sepals oblanceolate, ca. 2 mm. long, keeled, curvate, greenish or grayish-brown, the apices rounded and with a covering or fringe of white-clavate hairs on the backs; petals spatulate, 1.5-2.0 mm. long, flat, yellowish-white, the apices rounded and white-hairy on both sides, the inner surfaces often with a mixture of clear and opaque hairs. Seeds ovoid or ellipsoid, 0.5-0.75 mm. long, indistinctly longitudinally lined with fine connecting striae.

Sandy or peaty lakeshores, margins of pineland ponds, ditches, and savannas, coastal plain, Florida north to North Carolina, west to Alabama.

Type. Eocene geologic formation overlain by Lafayette and Columbia, Bullock County, Georgia, *R. M. Harper 830.* At NY.

This species is locally anundant, being commonest in the limesink country of northern Florida, where in midsummer its white "buttons" ring the sandy sinkhole lakes and ponds. Length and breadth of leaf and scape vary drastically within the species, this directly related to degree or extent of submersion. Thus, a perfect continuum of habit may be found if one would run a cross contour line through a population. Those furthest from the shore would be the shortest leaved and have the shortest, narrowest scapes, while submersed forms have extremely elongated, spongy, leaves and scapes. Difficulties in identification of *E. lineare* stem from partial samples from such populations, the larger specimens having some resemblance to *E. compressum.*

Cursorily, *E. lineare* most closely resembles *E. septangulare,* whose range it may contact to the north and northwest, and *E. texense,* whose range it does contact to the west. A detailed examination of the Eriocaulons comprising this complex may well result in a far more conservative treatment of them than now exists. *E. lineare* is the only one of the three to have a perfectly smooth receptacular surface and flavescent outer bracts. On the other hand, *E. septangulare* has some populations in which the surface of the receptacle has trichomes, others in which it does not.

8. ERIOCAULON SEPTANGULARE With., Arr. Veg. Brit. 784. 1776.

Nasmythia articulata Huds., Fl. Angl. ed. 2,415. 1778.

Eriocaulon pellucidum Michx., Fl. Bor. Am. 2: 166. 1803.

Ericaulon articulatum Morong., Bull. Torrey Club 18: 353. 1891.

A clump former but reproducing vegetatively either by short lateral offshoots (on moist situations) or by pale, elongated, leafy rhizomes

Eriocaulon cinereum

(on submersed or wet situations). Leaf pale green, linear-attenuate, 1.0-8.0 cm. long, tapering evenly from a fleshy, pale, aerenchymatous base. Sheath of the scape usually shorter than the leaf if the plant is submersed, longer than the leaf if the plant is emergent, 2.0-6.0 cm. long, the orifice oblique, bifid. Mature scape 4-21 (-100 submersed) cm. long, about 1 mm. broad, slightly twisted, (4-) 5-7 ridged. Mature heads hemisphaerical or globose, 4.0-5.0 mm. broad, gray save for the exserted white-hairy tips of perianth parts and bractlets. Surface of the receptacle of the head smooth or very rarely with a few tapering multicellular, clear trichomes. Outer involucral bracts broadly oblong, narrowly ovate or broadly obovate, 1.0-1.5 mm. long, smooth, dark gray, the tips rounded to obtusely angled and often scarious. Receptacular bractlets about 1.5 mm. long, oblanceolate or cuneate, slightly and unequilaterally keeled, whitish or yellowish basally, becoming dark gray apically, the apical portion white-clavate-hairy on the backs. Male flower: sepals gray-translucent, oblong-linear or linear-oblanceolate, ca. 1.5 mm. long, concave-curvate with an obscure keel, acute to rounded, the outer apex and upper margin white clavate hairy. Petals subequal, pale, largely fused into a narrowly cylindrical structure about 1.2 mm. long, acute, the inner surfaces around the glands and upper margin of the petal lobes with white-clavate hairs. Anthers black, broadly ellipsoidal, ca. 0.5 mm. long, very slightly exserted or not at all exserted from the head on short white filaments. Female flower: sepals oblong to narrowly obovate, prominently curvate-keeled, ca. 1.5 mm. long, gray-translucent or almost opaque save for the pale base, white-clavate hairy on the backs distally and often ciliate. Petals linear-oblong or linear oblanceolate, ca. 1.5 mm. long, acute to obtuse, the upper inner surfaces and upper margins white-clavate hairy. Seeds ovoid, ca. 0.5 mm. long, obscurely longitudinally lined with fine connecting striae or very obscurely and shallowly alveolate.

Sandy or peaty lakeshores, margins of ponds, ditches, muskeg, and sphagnous bogs, the Canadian Shield of southern Canada, the Great Lakes region, New England, and south in the Appalachians into mountainous North Carolina.

Type locality: Lakes on the Island of Skye, Scotland, Walker.

In habit, habitat, and floral character this species most closely resembles *E. lineare* and *E. texense*, entities with which it may someday be considered as identical. However, it does differ from *E. lineare* by its darker, grayish or sooty bracts, bractlets, and sepals and from *E. texense* by its much smoother receptacle.

9. ERIOCAULON CINEREUM R. Br., Prodr. 254. 1810.

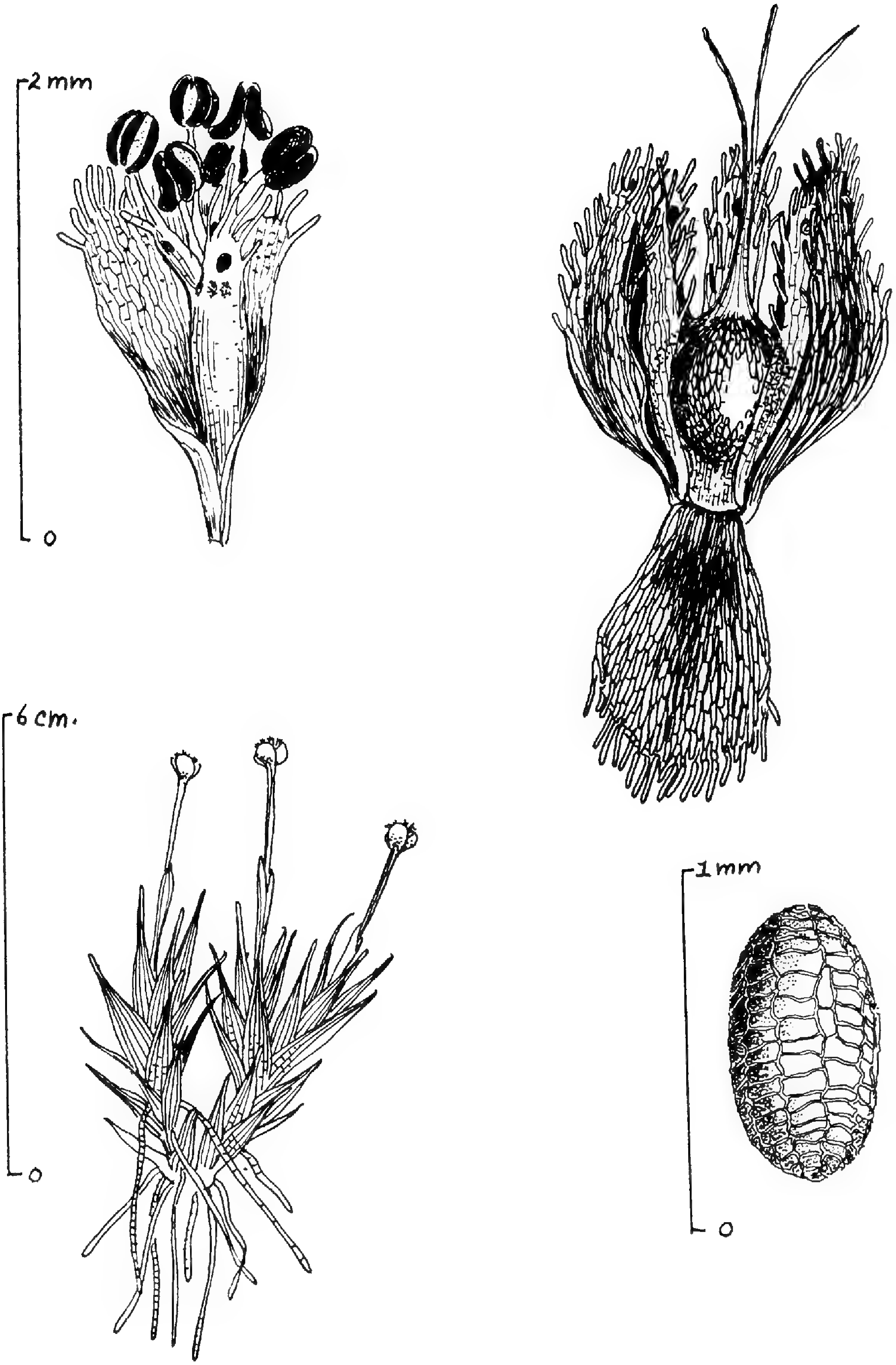
Solitary or in small tufts, the leaves narrow, linear-attenuate, to 9 cm. long, green, thin, tapering very gradually to a filiform tip. Scape of the sheath 2-4 cm. long, definitely shorter than the leaves, scarious and bifid-acute above. Mature scape filiform, 15-30 cm. long, slightly twisted, 6-8 ridged. Mature head subglobose to very broadly ovoid, about 4 mm. broad, silvery-gray, somewhat chaffy in appearance. Outer involucral bracts ranging from obovate to lanceolate, ca. 2 mm. long, scarious, pale, the tips acute, often lacerate or erose. Receptacular bractlets linear-oblong, ca. 2 mm. long, scarious, pale save for a grayish mid-region, the tips acute. Surface of the receptacle of the head with a few long, very slender, transparent, multicellular trichomes. Male flower: sepals united into a single spatulate, lustrous, scarious, 3-lobed scale which is gray-translucent toward the apex, pale toward the clawed, tubular base, glabrous save for a few white, short-linear trichomes at or toward the tip. Petals 3, joined into a yellowish tubular-clavate androphore ca. 2 mm. long whose base is enveloped by the calyx tube and whose apex is divided into 3 small, scale-like, white-hairy (the hairs tapering) glanduliferous lobes. Central glands 3, white or yellowish-white. Stamens six. Anthers broadly ellipsoidal, ca. 0.25 mm. long, yellow, on white filaments about as long as the corolla lobes. Female flowers: perianth consisting of 2 or 3 (if 3, one much narrower and shorter) linear, flat, pale, translucent scales ca. 1.5 mm. long whose margins or connivent, acute tips may bear a few multicellular clear trichomes. Gynophore at least 1 mm. long, usually somewhat longer, smooth. Gynoecium 3-carpellary; style branches 3. Seeds ovoid, slightly less than 0.5 mm. long, pale brown, reticulate, the rectangular compartments of the reticule oriented perpendicularly to the axis of the seeds.

Adventive in rice paddies, Stanislaus County, California. Reported as native in northern Australia and in the rice growing regions of the south Pacific.

I have so far examined only one U.S. collection of this species, the citation for it being: "Krause rice fields, Modesto. Plants submersed except for upper part of flowering stems, Stanislaus County, California, *Basil G. Markos,* Sept. 18, 1947". I visited the rice areas around Modesto during the summer of 1964 but was unable to find the plants.

10. ERIOCAULON MICROCEPHALUM H.B.K., Nov. Gen. & Sp. I: 253. 1816.

A clump-former, each clump composed of many, short-ascending, densely leafy, frizzly-pilose shoots, the leaves stubby and overlapping in close spirals. Leaf pale green, narrowly triangular-acuminate, 1.5-3.0 cm. long, the broad base pale, with a very evident reticulum of air spaces, sometimes hairy on its inner surface, the apex acuminate terminating in a blunt tip whose upper surface is spooned-out and whose lower surface bears a lustrous callus. Sheath of the scape shorter than the longer leaves and often concealed by them, the orifice loose, thin, papillose, usually bifid. Mature scape to 5 cm long, usually shorter, slightly twisted, 4-5 ridged. Mature heads hemisphaerical, ca. 3-4 mm.



Eriocaulon microcephalum

broad, pale, the surface of the receptacle smooth or with a very few long, slender, multicellular trichomes. Outer involucral bracts broadly obovate to suborbicular, ca. 2 mm. long or slightly less, smooth, thin, yellowish-white or yellowish-brown, the apex rounded, sometimes squarrose, the margin entire (aging erose) and very thin, grading into somewhat narrower, darker (usually obovate) inner bracts whose apices are obtusely angled and whose backs and margins bear a scattering of pale, stubby but multicellular trichomes. Male flower: Asymmetrically curvate; sepals 3, joined into a cuneiform, gray spathe-like, trifid blade, ca. 2 mm. long whose apex shows three nerves, each forming a low ridge which terminates in a low sepal-point, the apex ciliate and the backs hairy toward the tips with white, stubby, multicellular trichomes; (these conceal all of the rest of the flower save for the tips of the petals and the exserted anthers); petals 3, unequal, tubular for most of their length, pale yellow or dull white, terminating in 3 unequal short-linear or oblong lobes, two of which bear a few multicellular hairs apically and all of which have conspicuous dark, subapical glands; stamens 6, the 3 longest opposite the petals, the anthers dark, well exserted at anthesis. Central glands 3, dark, short-oblong. Female flower: slightly asymmetrical, the very conspicuously keeled sepals connivent about and concealing the developing ovulary and petals save for the petal trichomes and the exserted styles; sepal curvate-keeled, obovate, ca. 2 mm. long, grayish-translucent, the margin and back toward the apex with a scattering (particularly along the keel) of white, multicellular, blunt trichomes, the apex itself rounded and slightly apiculate; petal oblong or spatulate, about the length of the sepal but flat, a dull yellowish-white, glanduliferous, the inner surface pilose with clear, multicellular hairs, the margin of the rounded apex ciliate with white trichomes; carpels 3, the styles 3, branched from above the middle; seeds ovoid, ca. 0.6-0.8 mm. long, a rich reddish-brown with a pale gridwork of faintly raised rows of horizontally aligned rectangles.

Moist, boggy upland meadows, Kern Co. California s. through Mexico into Costa Rica, Equador.

Type. Between Loja and Mt. Pulla, at 2770 meters altitude, Loja, Ecuador. Humboldt & Bonpland. (According to Moldenke, 1937). The writer has not seen the type.

I have seen only one specimen from the United States. This, collected by L. J. Xantus de Vesey in 1857-58 in the vicinity of Fort Tijon (now called "Tejon") in what is presently Kern County, California, differs in no evident way from material from far to the south in America. I visited the area during the summer of 1964 in hopes of finding this population but a search of the marshy ground about springs in that area was fruitless. The station may well have been destroyed, since the Fort has become considerable of a tourist attraction and much of the stream which used to provide water for the soldiers at the old fort has been "landscaped."

The most characteristic features of the plants which I have examined appear to be the densely caespitose habit, the stubby, rigid, ascending and imbricate leaves whose bases are partly concealed by ramentum, and the spathe-like character of the male sepals.

LACHNOCAULON Kunth, Enum. Pl. 3: 497. 1841

Perennial, rosulate, scapose, often tufted, herbs, the roots branched, slender, fibrous, the leaves linear, arranged in a close spiral toward the apex of a short, or elongated, sparingly-branched, stem on which the old leaf bases persist as scales. Perennation by means of lateral offshoots or by short-ascending rhizomes. Leaves linear, acute or attenuate, spirally arranged, the bases clasping, crowded, none of the leaf evidently lacunate. Inflorescence and involucrate head or contracted spike comprised of an outer involucre of few to many series and of a bracteate mass of scaly, unisexual flowers. Receptacle of the inflorescence covered by pale or yellowish, multicellular, filiform trichomes. Each flower subtended by, and partly enfolded by, a scarious bract (or two), the tip of which is sparingly equipped with translucent or opaque, usually clavate, multicellular trichomes. Sepals 3, distinct, scarious, smooth or sparingly clavate-hairy, particularly toward the apex. Petals absent or reduced to hairs or small scapes. Stamens 2-3, elevated upon a tubular, stipe-like androphore which is at least the length of the stamens; filaments linear, anthers oblong-linear, 2-locular, yellowish or pale, exserted from the heads at flowering time; staminodia 3, lance-ovoid or peg-like, often with fimbriate appendages. Gynoecium on a short, usually comose, gynophore, 3-carpellate, 3-locular, 3-ovulate (2-merous in *L. digynum)*, the ovules attached distally in the locules; styles (2-) 3, joined for more than half their length; ovary wall thin, velum like. Fruit a (2-) 3-chambered, loculicidal capsule. Seeds ellipsoidal, striate or reticulate or papillose.

Dr. Moldenke (1937) treats 8 species for the United States. However, species such as *L. floridanum* Small, *L. glabrum* Korn, and *L. eciliatum* Small are based on such intrapopulation variables as sepal length (accrescence is here suspected), peduncular trichomes, and amount of pubescence on bracts and sepals. Therefore, in this work, such entities are treated as extremes of either *L. anceps* or *L. minus* which appear to be the two nuclei for all these variants.

In the United States, *Lachnocaulon* may be distinguished readily from either *Eriocaulon* or *Syngonanthus* by its fine, evidently branched root system in contrast to the relatively unbranched-septate systems of *Eriocaulon* and the unbranched and fleshy systems of *Syngonanthus.*

Lachnocaulons of the United States may be divided into two groups on the basis of habitat. One, comprised of *L. engleri* and *L. minus*, is usually found on such ephemeral habitats as fluctuating lake and pondshores, roadbank seepage, borrow pits, ditches, spoilage, and geologically recent sandy sloughs, particularly along the seacoast. Thus such species tend to be aspect dominant one summer in a given locale, seemingly absent the next. It would appear in such case that their seeds must have to remain viable over extended periods of time, for some of the ephemeral Florida lakes about which they often abound are periodically bone dry. The other group, comprised of *L. anceps*, *L. beyrichianum*, and *L. digynum*, appears in more stable situations inland within the coastal plain province as well as along the coast and on disturbed situations. They usually are on what appears to be much more acid substrata such as those provided by hillside bogs in the longleaf pine hills, peaty savannas, pine-palmetto flatwoods, and sphagnous bogs. Both *L. beyrichianum* and *L. anceps* have a wide range of tolerance to soil moisture in that they may be found on quite dry sandy sites, sometimes even in association with turkey oak *(Quercus laevis)*.

KEY TO LACHNOCAULON

1. Trichomes of the apices of the receptacular bractlets and perianth parts congested with a milk-white substance, this imparting a pale gray or whitish colour to the heads; plants very often long-lived, forming large convex mats of hairy-leaved rosettes, each rosette terminating an elongate-ascending, scaly stem; scapes hairy.
    2. Leaves narrowly linear; mature heads seldom broader than 4 mm.; seeds dark reddish-brown, very lustrous, the longitudinal ribs obscure. . . . . 1. *L. beyrichianum*, p. 317
    2. Leaves linear; mature heads seldom as narrow as 4 mm. and usually paler than the above; seeds not as lustrous, the longitudinal lines evident. . . . . 2. *L. anceps*, p. 319
1. Trichomes of the apices of the receptacular bractlets and perianth parts not congested with a milk-white substance, thus translucent so that the brown bractlets and/or perianth parts impart their own colour to the heads; the plants either relatively short-lived and short-stemmed or, if long-stemmed, with diminutive, *Polytrichum*-like leaves.
    3. Scapes with ascending hairs; heads a dull gray-brown, the hairs of the receptacle and of the flowers so copious as to at least partly obscure the florets (old heads may lose some of their hairs). . . . . . . 3. *L. minus*, p. 321
    3. Scapes smooth; heads either chocolate brown or dull brown, but, if dull brown, with female sepals yellowish-white and hardly obscured by the receptacular hairs and with the gynoecium 2-carpellary.

4. Heads dark chocolate-brown or reddish brown, usually oblong by seeding time; gynoecium 3-carpellate; leaves seldom shorter than 2 cm., the sheathes of the scapes shorter than to about the length of, the leaves. . . . . 4. *L. engleri,* p. 323
4. Heads pale brown, usually globose by seeding time; gynoecium 2.carpellate; leaves seldom as long as 2 cm., the sheathes of the scapes longer than the leaves or at least rising above them. . . . . . . 5. *L. digynum* Korn., p. 325

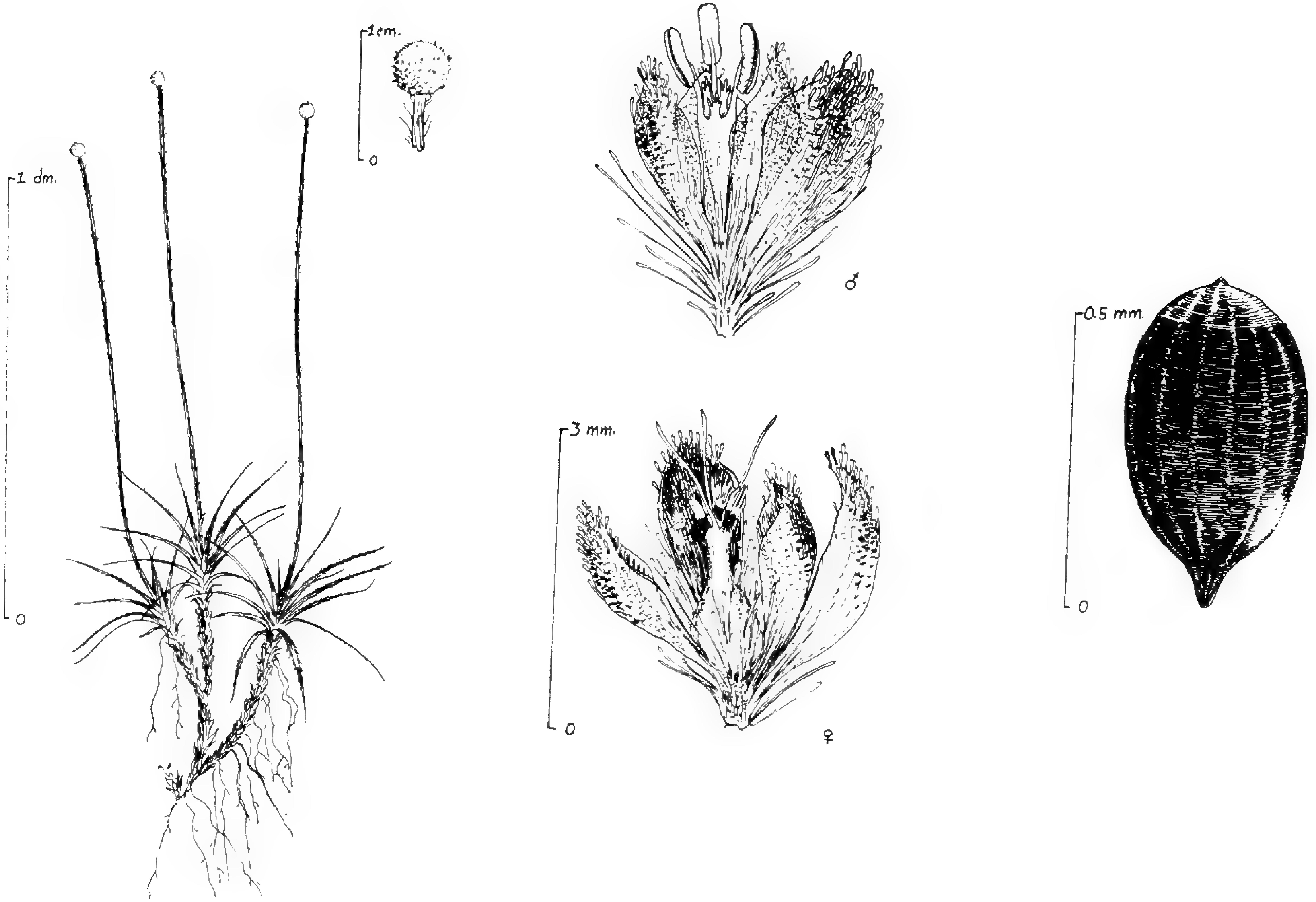
1. LACHNOCAULON BEYRICHIANUM Sporleder ex Korn., Linnaea 27: 567. 1856.

A clump-former, the tufts of leaves aggregated into dense mats of rosettes, the length of the subterranean, ascending stems chaffy with persistent old leaf bases (those plants on driest sites having the longest stems). Leaf narrowly linear-attenuate, 1.5-4.0 cm. long, grayish-green, gradually broadening, then abruptly flaring to a sheathing base 2.5-4.0 mm. broad; upper and lower surfaces pilose, the margins hairy or smooth. Sheath of the scape attenuate-tipped, pilose, slightly longer or slightly shorter than the leaves. Scale 15.0-23.0 cm. long, twisted, obscurely ridged, pilose, with long, ascending, transluscent, multicellular trichomes. Mature heads globose or short-oblong, pale-gray, 3.5-4.0 (-5.0) mm. broad Outer involucral bracts ovate, about 1 mm. long, castaneous, glabrous or sparingly clavate-ciliate on the backs toward the apex. Receptacular bracts pandurate, 1.5-2.0 mm. long, obtuse, brownish, smooth toward the base, hairy on the back distally, the hairs clavate, milk-white. Male flower: sepals linear-spatulate, 1.5-2.0 mm. long, obtuse, castaneous or paler brown, smooth basally, white-hairy on the back and margin distally, the hairs clavate; androphore smooth, clavate, as long as or slightly longer than the sepals; anthers yellowish, short-oblong, on filaments slightly exserted from the head. Female flower: sepals linear or linear-spatulate, about as long as but broader than the male sepals, obtuse, tan or pale brown, the backs and margins pilose, the hairs toward the apex white and clavate; gynophore short, subtended by a dense coma; gynoecium, 3-carpellate, 3-locular, 3-ovulate, the styles 3, bifid. Seeds ellipsoidal, somewhat flattened, reddish-brown, about 0.5 mm. long, the longitudinal and connecting striae faint, the seed coat therefore highly lustrous.

Sands, sandy peats and peat of pine flatwoods, moist pineland savannas, pineland pond margins, lakeshores and rather dry oak-pine barrens, central Florida north to southern North Carolina (Bladen Co.).

Type. "edges of a swamp near Ebenezer, Effingham Co., Georgia, Beyrich".

The affinities of this species to *L. anceps* are at once evidenced by its habit, habitat, leaf and scape indument and, especially by its white-clavate perianth trichomes. Yet the leaves of *L. beyrichianum* are con-



Lachnocaulon beyrichianum

sistently narrower, and its seeds comparatively smooth and lustrous. Such differences, though seemingly minor, appear to hold even in mixed populations of the two.

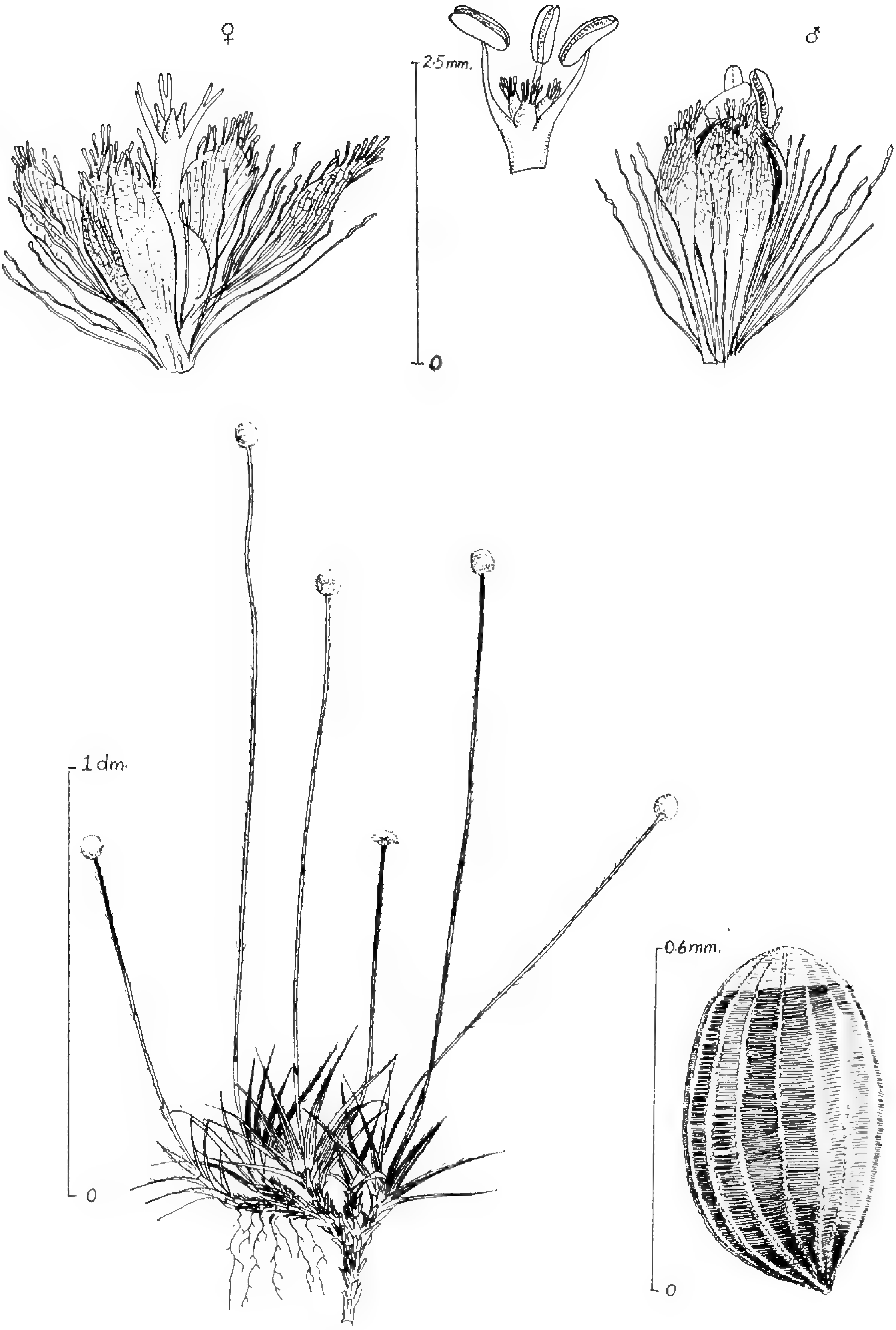
2. LACHNOCAULON ANCEPS (Walt.) Morong, Bull. Torrey Bot. Club 18: 360. 1891.

Eriocaulon anceps Walt., F. Car. 82. 1788.
Eriocaulon villosum Michx., Fl. Bor. Am. 2: 166. 1803.
Lachnocaulon michauxii Kunth., Enum. Pl. 3: 397. 1841.
Lachnocaulon glabrum Korn., Linnaea 27: 568. 1856.
Lachnocaulon floridanum Small, Fl. SE. U.S. 235, 1328. 1903.

A clump former, the tufts of leaves aggregated into mats of rosettes, the length of the subterranean stems which support the rosettes variable with age of the plant and conditions of soil texture and moisture, but stems closely beset by fibrous, overlapping old leaf bases, these often bearing hairs. Fresh leaves narrowly to broadly linear, attenuate or acute, 2.5-5.5 mm. long, broadening evenly to a sheathing base 2.0-3.5 mm. broad, pale green or gray-green; leaf surfaces smooth, ciliate or with a scattering of multicellular, translucent trichomes. Sheath of the scape acuminate, slightly shorter or slightly longer than the leaves, smooth to pilose. Scape 15.0-40.0 cm. long, twisted, obscurely ridged, smooth or sparingly to densely ascending-pilose. Mature head globose to short-cylindric, 4.0-7.0 mm. broad, whitish or pale gray. The longer of the outer involucral bracts brownish, oblong or obovate, 1.0-1.5 mm. long, obtuse, the upper margin characteristically fringed with white clavate hairs. Receptacular bracts narrowly pandurate, spatulate or oblanceolate, 1.5-2.0 mm. long, obtuse or acute, slightly curvate, brownish or grayish, smooth toward the base, white clavate-hairy on the backs distally or at least ciliate. Male flower: sepals linear-spatulate, slightly curvate-concave, 1.5-2.0 mm. long, acute and with white, clavate hairs on the backs toward the apex; receptacle comose, with translucent trichomes; androphore smooth, narrowly obpyramidal; anthers yellowish or pale, oblong, very slightly exserted on short filaments. Female flower: sepals oblong to linear, 2.0-3.0 mm. long, acute, scarious, yellowish or pale brown, smooth or pilose on the backs distally, the trichomes clavate, white; receptacle and base of gynophore copiously pilose with pale, linear, translucent hairs, the gynophore short; gynoecium 3-carpellate, 3-locular, 3-ovulate, the styles 3, bifid. Seeds ellipsoidal, 0.5 mm. or slightly longer, pale to dark brown, longitudinally lined with pale or sharp ridges, these connected by less conspicuous cross-lines.

Moist to fairly dry sands, sandy peats or peat of pine flatwoods, savannas, upper edges of pinelands, pond margins, ditchbanks, lakeshores, and bogs, coastal plain, Florida north to New Jersey, west to eastern Texas.

Type. "Carolina" Walter.



Lachnocaulon anceps

There are difficulties in distinguishing smaller-headed versions of *L. anceps* from *L. minus* or from *L. beyrichianum*. These, however, will have the clavate-whitened, hair on the bracts and sepals to distinguish them from the former, and a definitely ridged-and-striate seed to distinguish them from the latter. Also, none of the other Lachnocaulons have, in their older, "seeding" heads, the property of well-exserted bracts and female sepals. This imparts a "chaffy" look to late summer inflorescences.

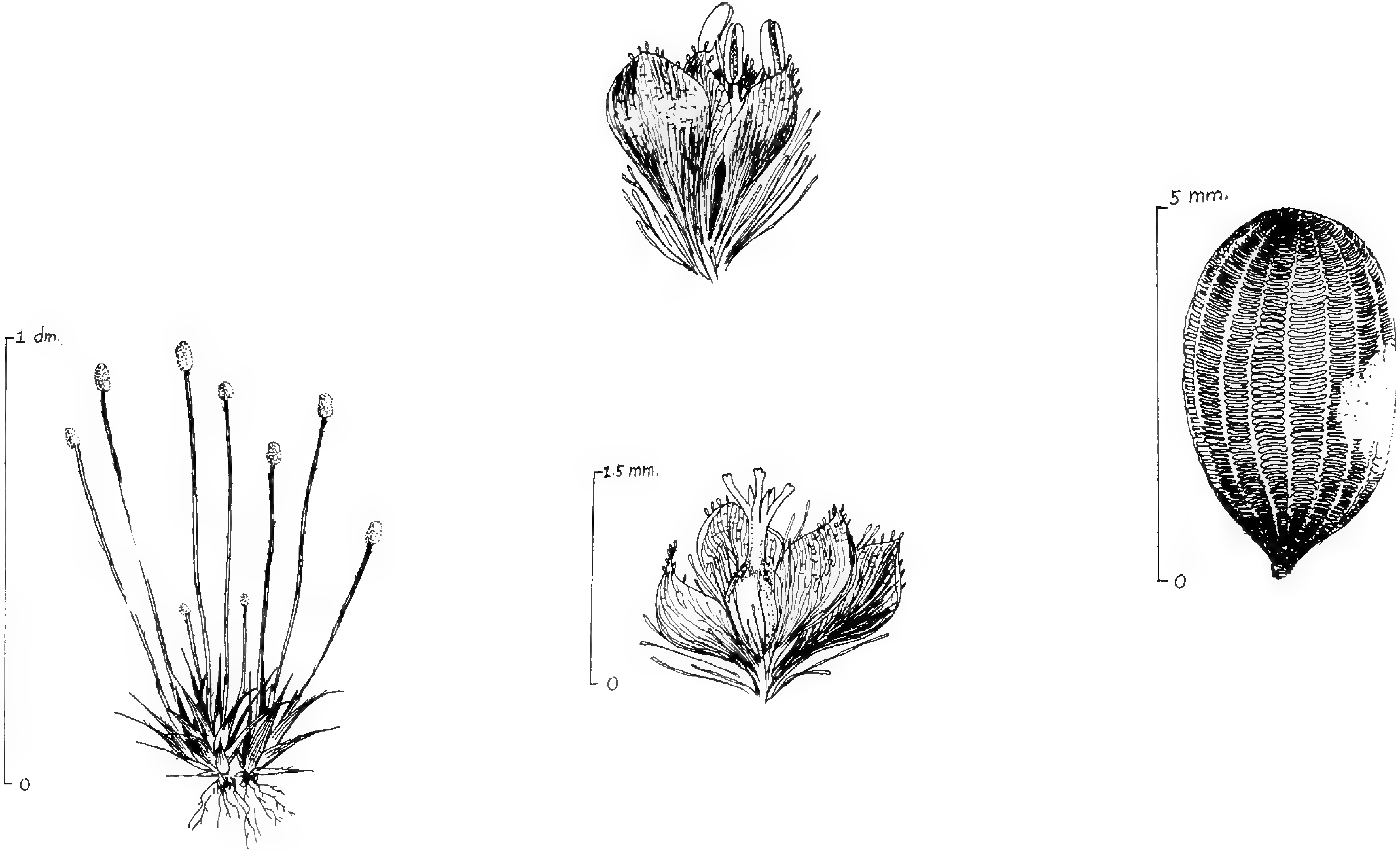
J. K. Small (1903) described *L. floridanum* as a species distinct from *L. anceps* on the basis of its glabrous scapes and smaller, grayer, heads. Examination of specimens so identified as well as the type ("Fla. Lake Co.: lake, Eustis, *Nash 1981")* together with a field study of populations of south Florida *Lachnocaulon* have served to convince me that such differences are not consistent, in that they may vary broadly within a single population. Such is the case in populations of these in Manatee, Martin, Sarasota, St. Lucie, De Soto and Charlotte counties in peninsular Florida. The type specimen is itself an immature example, hence the anther measurements which are used as one basis for distinguishing the species are of young, accrescent, structure. The glabrous peduncles which are supposed to distinguish *L. glabrum* from *L. anceps* are not consistently glabrous in the above mentioned counties of Florida.

3. LACHNOCAULON MINUS (Chapm.) Small, Fl. SE. U.S. 235, 1328. 1903.

Lachnocaulon michauxii Kunth var. *minor* Chapm., Fl. S. U.S., ed. 3. 531. 1897.

Lachnocaulon eciliatum Small, Fl. SE. U.S. 235, 1328. 1903.

A clump former or solitary, the tufts of leaves developing from short lateral offshoots. Leaf yellowish-green, linear-acute or linear-attenuate, 2.0-3.0 cm. long, evenly narrowing from a base 2.0-4.0 mm. broad, smooth or with a scattering of multicellular, filiform, trichomes. Sheath of the scape acuminate, slightly longer or shorter than the leaf, pilose, at least toward the orifice. Mature scape 6.0-15.0 cm. long, twisted, obscurely 3-ridged, with ascending, dense or scattered, multicellular trichomes or smooth. Mature head globose to cylindrical, 4.0-6.0 mm. long, 3.0-4.0 mm. broad, grayish or pale gray-brown. The longer of the outer involucral bracts ovate, 1.0- mm. long or slightly longer, obtusely angled, pale brown, somewhat scarious, ciliate with clavate, translucent hairs. Receptacular bracts broadly spatulate or pandurate, 1.0 mm. long or slightly longer, slightly rounded or obtusely angled, curvate, sometimes slightly keeled, pale brown to castaneous, the surfaces smooth and scarious basally, hairy on the backs apically or ciliate, at least some of the hairs clavate and all of the hairs translucent. Surface of the receptacle densely comose, with linear, long, multicellular and translucent hairs. Male flower: sepals broadly spatulate, curvate, about 1.0 mm.



Lachnocaulon minus

long or slightly longer, the apex rounded or obtusely angled, castaneous, sparingly to copiously clavate-hairy on the backs, the base greenish or pale, smooth; receptacle hairy; androphore obpyramidal, smooth, about the length of the sepals; anthers barely exserted on filaments shorter than themselves or of about the same length, oblong, pale or yellowish. Female flower: sepals broadly linear or narrowly spatulate, approximately the length of the male sepals, scarious and pale or greenish-tan below, dark to pale brown and sparingly clavate-hairy or ciliate (rarely smooth) on the back above. Receptacle and gynophore densely pilose with stramineous hairs, the gynophore very short. Gynoecium 3-carpellate, 3-locular, 3-ovulate, the styles 3, bifid. Seeds ellipsoidal, about 0.5 mm. long, a deep clear brown, longitudinally striate with pale lines, the connecting striae evident.

Sands, sandy-peats and peatmuck of margins of pineland ponds, ditchbanks, lakeshores, or moist exposed sands of mildly acid seepage areas and mildly acid marshes along the seacoast, coastal plain, Florida, n. to North Carolina.

Type. "low pine barrens, Bristol, Liberty Co., Florida, Chapman." At NY.

This species may occur in mixed populations with *L. anceps* or *L. engleri.* It is distinguished from the former by its smaller stature, smaller, darker heads, and by the translucent rather than white-opaque, clavate trichomes on bracts and sepals. It is distinguished from the latter by its paler-brown heads and by its usually hairy scapes. *L. minus* appears to require more moisture than *L. anceps;* I have yet to find it in drier flatwoods localities in which *L. anceps* may abound.

Examination by this writer of the type of *L. eciliatum* Small *(Curtiss,* N.A. Pl., no. *3022)* resulted in a decision to treat such material as *L. minus,* in that the only difference appears to be one of degree of pubescence on bracts and sepals of female flowers together with slight differences in length of parts (all of which are accrescent in Eriocaulaceae).

4. LACHNOCAULON ENGLERI Ruhl. in Engler, Pflanzenreich 430: 241. 1903.

A clump former or solitary, the tufts of leaves developing from short lateral offshoots. Leaf linear-acute to linear-attenuate, yellowish-green, 2.0-3.0 cm. long, evenly narrowing from a clasping base 2.5-4.0 mm. broad, the upper and lower surface smooth or with a very distant scattering of clear, multicellular, filiform trichomes. Sheath of the scape acuminate, smooth, sometimes split, the same length as or slightly shorter than, the leaf. Mature scape 6.0-15.0 cm. long, twisted, evidently 3-carinate, smooth. Mature head globose to short-cylindric, 3.0-8.0 mm. long, 3.0-4.0 mm. broad, dark brown, appearing smooth in contrast to the heads of other *Lachnocaulon.* The longer of the outer involucral bracts

Lachnocaulon engleri

broadly ovate, 1.0-1.5 mm. long, obtuse or broadly acute, ciliate, castaneous or light brown. Receptacular bractlets oblong or obovate, 1.0-1.5 mm. long, concave-curvate, pale below and translucent, castaneous distally, the obtuse tips smooth or with a few stramineous, clavate, clear hairs. Surface of the receptacle of the head pilose, the hairs filiform, translucent, yellowish. Male flower: sepals linear or oblong-curvate, about 1.0 mm. long, concave, glabrous and pale toward the narrowed bases, the lateral sepals evidently keeled, rounded or obtusely angled, dark brown and with a few stramineous, clavate hairs on the backs distally; receptacle comose, with filiform trichomes; androphore smooth, obpyramidal, slightly shorter than the sepals, rarely tipped with small, clavate hairs; anthers 2 or 3, short-oblong, very slightly exserted from the head at anthesis, yellowish. Female flower: sepals oblong, about the same length as the male sepals, concave-curvate and smooth or with a few multicellular, clavate trichomes on the backs distally, brownish; receptacle and gynophore copiously pilose with pale brownish, filiform hairs; gynoecium 3-carpellate, 3-locular, 3-ovulate, the styles 3, bifid. Seed ellipsoidal, about 0.5 mm. long, a rich transparent brown, the longitudinal lines conspicuous, the cross lines evident to form narrowly oblong cancellae.

Moist sands, sandy-peats or peat-muck of pineland pond margins, lakeshores, and mildly acid marshes along the seacoast, coastal plain, the lower Pleistocene terraces, Florida.

Type: Ditches and lakeshores in the vicinity of Eustis, Lake Co., Florida, Nash 1184.

The dark brown inflorescence, glabrous scape, and deep-brown, lustrous seed of this species distinguish it from all others of the genus that have been found in Florida.

The almost "spontaneous" development of large numbers of this species on recently disturbed wet sands or upon the drying peat left by fluctuating lake and pond margins in Florida makes one wonder whether any habitat of relative permanence is occupied by this species. Certainly its seed must have an inherent capacity to remain dormant for such extended periods of times as necessary for such ephemeral habitats to recur. A similar behavior is noted for *L. minus,* a species with which *L. engleri* most frequently is found.

5. LACHNOCAULON DIGYNUM Korn., Linnaea 27: 570. 1856.

Lachnocaulon diandrum Van Heurck & Muell.-Arg. in Van Heurck, Obs., Bot. 1: 108. 1870.

A clump former, dense tufts of rosettes forming from slender ascending rhizomes which develop from axillary buds. Leaf linear-acute, 0.6-1.0 (2.0) cm. long, bright yellowish-green, evenly narrowing from a clasping base 1.0-2.5 mm. broad, almost smooth or with a scattering of multicellular trichomes, these usually most abundant toward the margins. Sheath

Lachnocaulon digynum

of the scape acute, or bifid, longer than the leaves, smooth or sparingly ciliate toward the orifice. Scape 5.0-10.0 cm. long, slightly twisted, 3-ridged, smooth or with a distant scattering of filiform, multicellular trichomes. Head grayish or dull gray-brown, globose, or hemisphaeric, 2.0-3.5 mm. broad. The longer of the involucral bracts triangular, ca. 1.0 mm. long, brownish, with translucent clavate trichomes on the backs distally. Receptacular bracts spatulate, 1.0-1.3 mm. long, acute or obtusely angled, a rich brown, clavate-hairy on the backs apically. Receptacular surface densely hairy, but the hairs not so long as to obscure the female sepals. Male flower: sepals linear-spatulate, ca. 1.0 mm. long, curvate, a rich brown, sparingly clavate-hairy on the backs apically; receptacle hairy; androphore smooth, obpyramidal, about the length of the sepals, the apices oblique; anthers 3, yellowish, oblong, slightly exserted on filaments about as long as themselves. Female flower: sepals broadly spatulate to narrowly obovate, ca. 1.0 mm. long, keeled, and curvate, hence connivent over the ovulary, whitish-yellow, smooth or with a few marginal hairs distally; receptacle and short gynophore copiously pilose with pale, translucent, multicellular, slightly clavate, trichomes; gynoecium 2-carpellate, 2-locular, 2-ovulate, the styles 2, bifid. Seeds ovoid to ellipsoidal, about 0.5 mm. long, longitudinally striate, the connecting striae finer, almost obscure.

Wet acid exposed sands and sandy peats or seepage bogs, pineland pond margins, ditches and roadbanks, coastal plain, northwestern Florida west to southern Mississippi.

Type: Alabama.

This species, which is particularly abundant in the wet pine flatwoods country about Pensacola, Florida, has the smallest leaves of all the *Lachnocaulon* of the United States. The small rosettes, densely aggregated on slender ascending rhizomes into bright green, convex tufts of sometimes hundreds of individuals, remind one of some of the larger Polytrichums. The 2-carpellate condition of the gynoecium is consistent throughout all samples of this species so far examined, there being no evidence at all of any aborted third carpel either in the ovulary or in the style branching. The only other species of *Lachnocaulon* which I have found in association with this one is *L. anceps*, from which it is readily distinguished in the field by its glabrous or almost glabrous scapes, its shorter stature, and its darker, smaller heads.

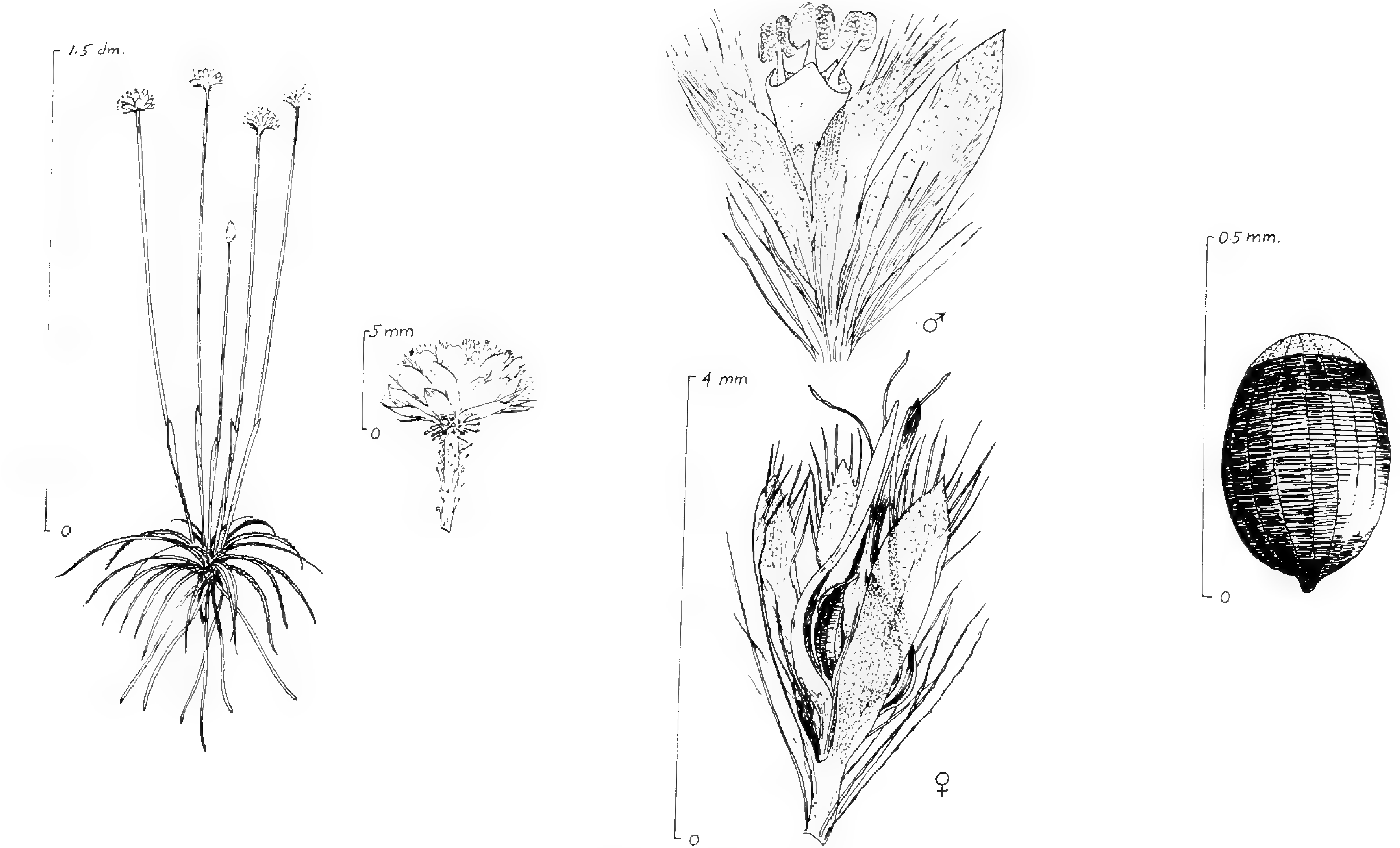
SYNGONANTHUS Ruhl. in Urb., Symb. Ant. 1: 487. 1900

1. SYNGONANTHUS FLAVIDULUS (Michx.) Ruhl., in Engler, Pflanzenreich IV. 30: 256. 1903.

Eriocaulon flavidulum Michx., Fl. Bor. Am. 2: 166. 1803.

Paepalanthus flavidulus Kunth, Enum. Pl. 3:532. 1841.

A clump former or solitary, the dense, recurved-leaved, rosettes of



Syngonanthus flavidulus

crowded leaves on short stems which develop from lateral buds, the roots pale and spongy-thickened, but lacking septae. Leaf bluish-green, narrowly linear, 2.0-6.0 cm. long, attenuate, broadening gradually toward, then flaring abruptly at the clasping base, almost smooth to densely pubescent with long, pustular-based, multicellular trichomes. Sheath of the scape exceeding the leaf (actually very slightly but seemingly considerably, for the leaves are usually recurved and flattened against the substratum while the scapes are erect), acute or bifid, ascending-pilose, many of the hairs gland-tipped or clavate. Scape 5.0-30.0 cm. long, slightly twisted, 5-ridged, with ascending, slight to copious pubescence of long, multicellular, translucent trichomes, many of which have glandular tips. Young flowering heads hemisphaerical, mostly obscured by the straw-coloured outer bracts, later becoming globose, gray, chaffy, 5.0-10.0 mm. broad. Receptacle densely pilose with long, filiform-acute, translucent trichomes. Longer receptacular bracts oblanceolate, about 2.5-3.5 mm. long, straw-coloured, acute, sparingly ciliate with filiform, multicellular, acute trichomes. Male flower: sepals 3, spatulate or oblanceolate, ca. 2.0-3.0 mm. long, pale, acute, equipped on the backs distally with slender, acute, multicellular, translucent trichomes; receptacle slightly hairy; petals 3, fused into a narrowly funnelform tube ca. 2.5 mm. long, pale yellow, the short lobes alternating with the filaments of the stamens; stamens 3, the filaments originating at a disc midway the length of the corolla tube and slightly extending past the corolla rim, the anthers short-oblong, yellowish, seemingly bilocular but actually with 4 locules; staminodia 3, obovoid, yellowish. Female flower: sepals 3, linear, acuminate, ca. 3 mm. long, pale, translucent, accrescent, smooth or the backs glabrescent; petals 3, narrowly linear, acute, about the length of the sepals, the tips connivent above the gynoecium, smooth; receptacle and gynophore smooth or hairy, the gynoecium 3-carpellate, 3-locular, 3-ovulate (1 often aborting), the ovules pendulous, the styles 3, unbranched; seeds ellipsoidal, evidently longitudinally and vertically striate, ca. 0.5 mm. long, the connecting vertical striae faint but forming evident ladders of alveolae, lustrous.

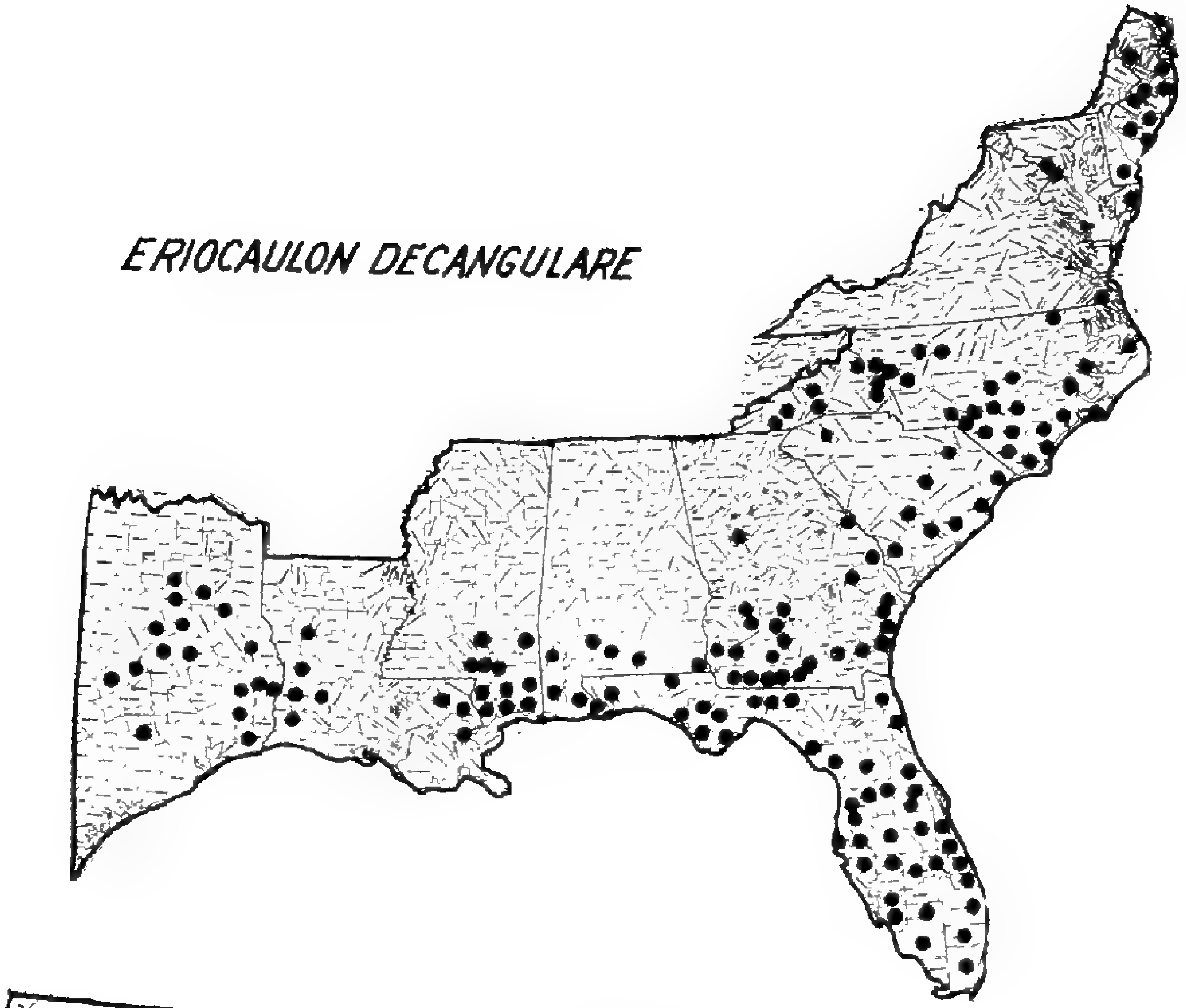
Moist to rather dry sands, sandy peats or peats of pine flatwoods, lake or pond margins, seepage bogs, ditches, ditchbanks and savannas, coastal plain, particularly the lower terraces, Florida north to southeastern Virginia (?), west to southern Alabama.

Characteristics which distinguish this species from other Eriocaulaceous plants of the United States and Canada are as follows:

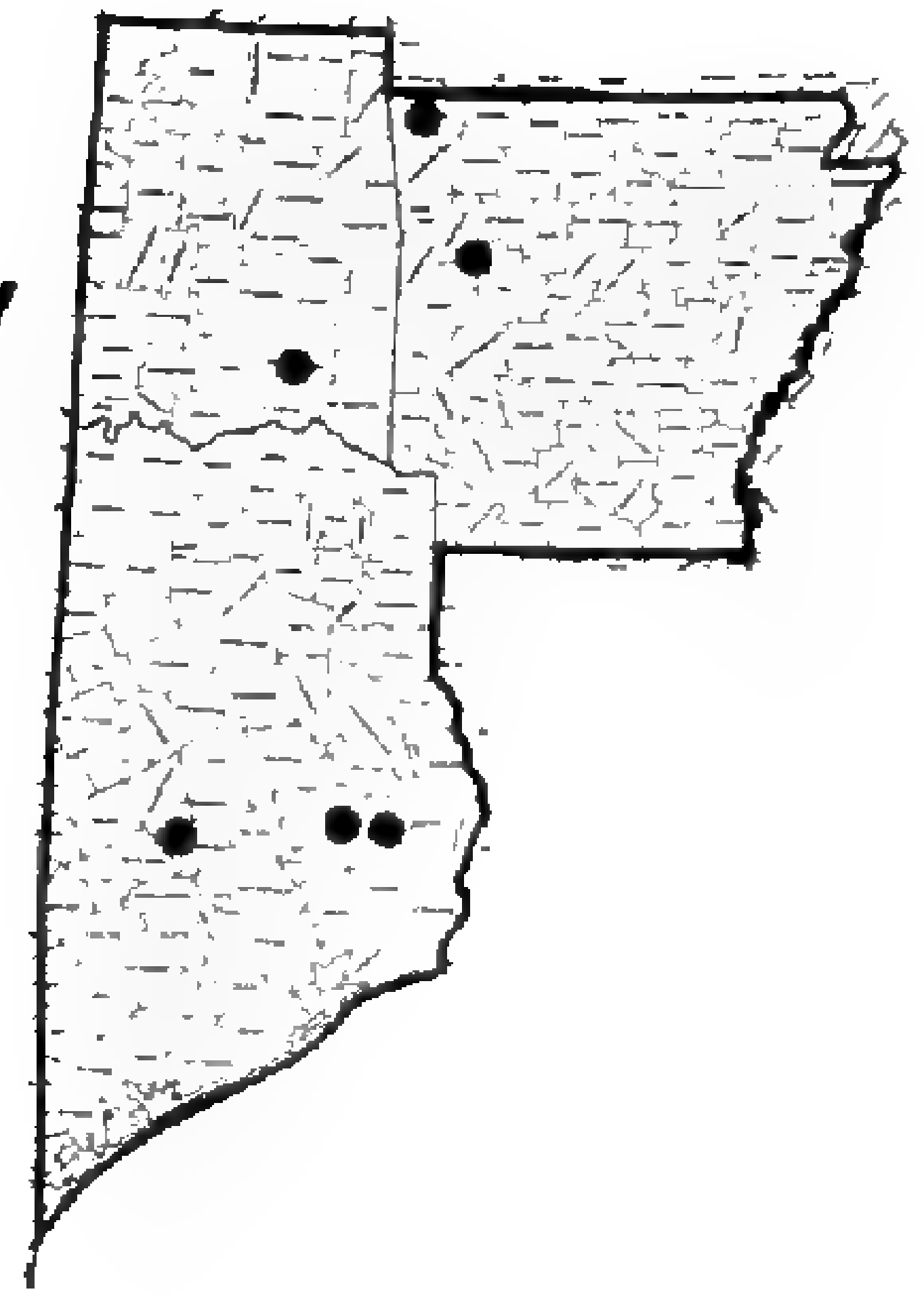
1. Roots unbranched, spongy-thickened, non-septate . . . this in contrast to roots branched and slender-fibrous in *Lachnocaulon* and roots thickened-septate in *Eriocaulon*.

2. Leaves of the rosette very copious, very narrowly linear, and def-

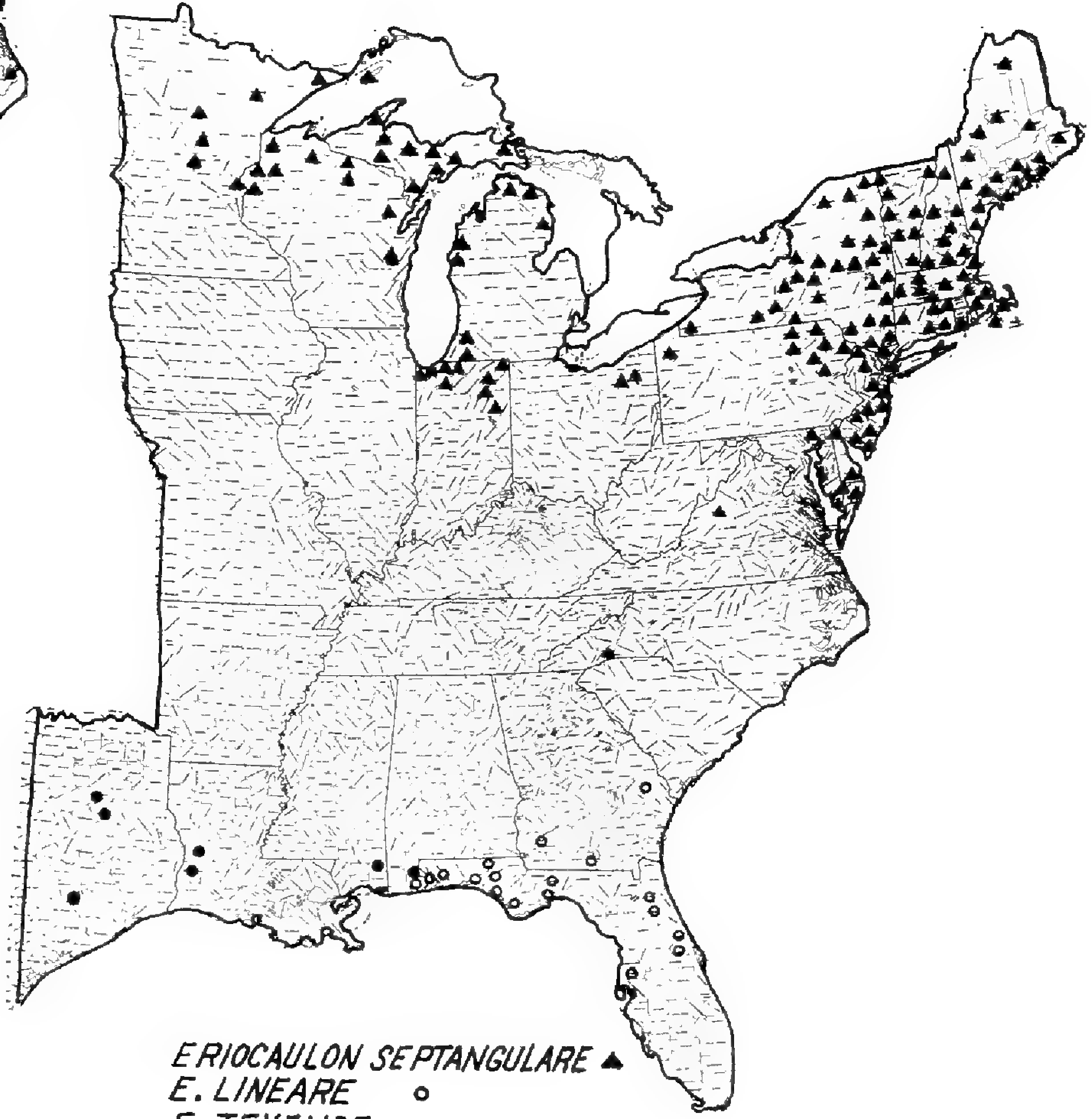
ERIOCAULON DECANGULARE



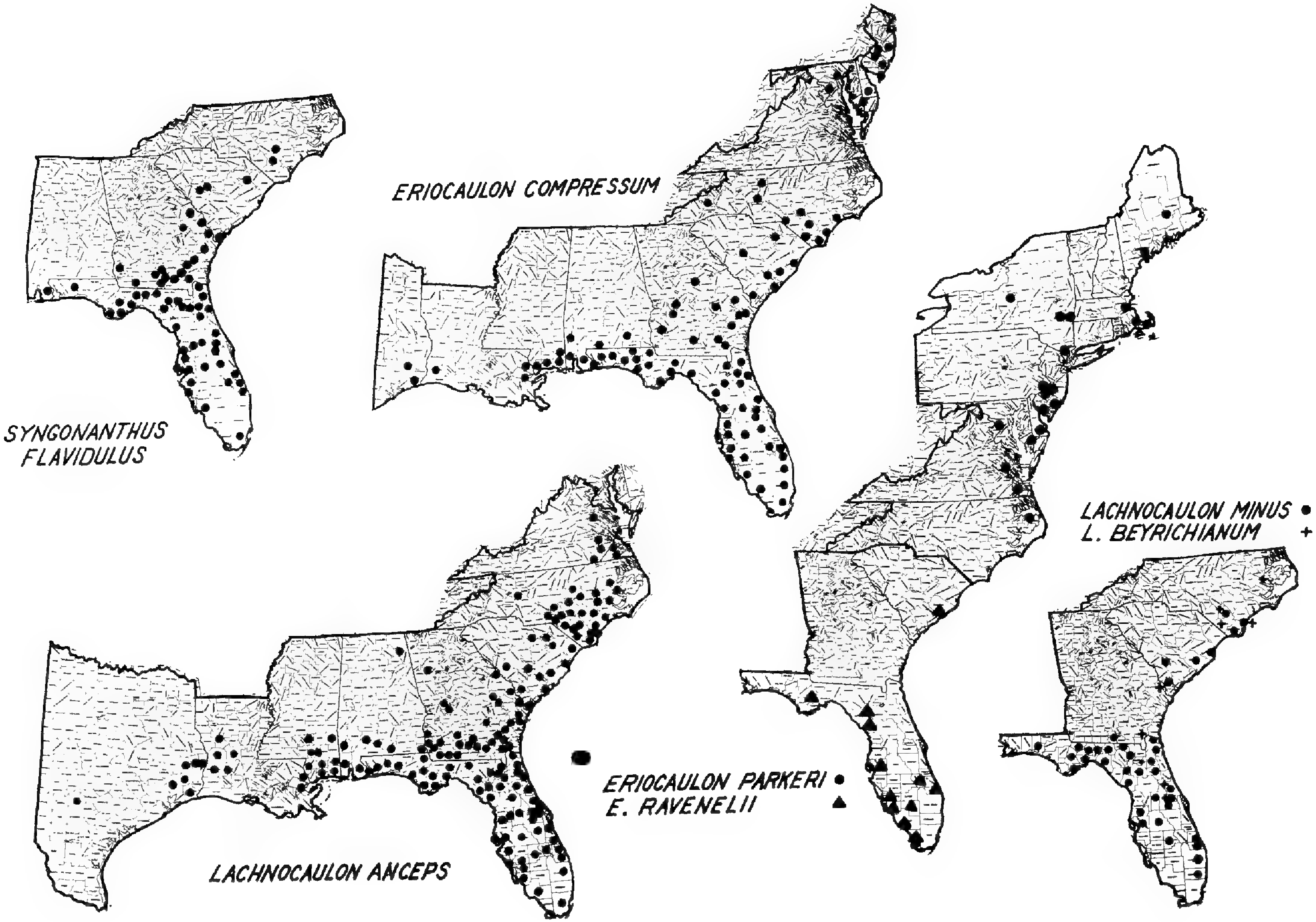
ERIOCAULON KORNICKIANUM



ERIOCAULON CINEREUM ○
E. MICROCEPHALUM ●



ERIOCAULON SEPTANGULARE ▲
E. LINEARE ○
E. TEXENSE ●


ERIOCAULON COMPRESSUM
SYNGONANTHUS FLAVIDULUS
LACHNOCAULON MINUS ●
L. BEYRICHIANUM +
ERIOCAULON PARKERI ●
E. RAVENELII ▲
LACHNOCAULON ANCEPS

initely recurved to flatten against the substratum . . . this in contrast to the ascending-spreading leaf habit of sympatric Eriocaulaceae.

3. Trichomes of the leaves tending to be pustular based, a characteristic not found on sympatric Eriocaulaceae; at least some of the trichomes of the upper scape clavate or glandular-tipped.

4. Both sets of perianth parts present, the flowers seemingly actinomorphic . . . this in contrast to *Lachnocaulon*, in which only one set of parts is present or *Eriocaulon*, in which zygomorphy is apparent.

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TEXAS POLIANTHES, INCLUDING MANFREDA (AGAVE SUBGENUS MANFREDA) AND RUNYONIA (AGAVACEAE)

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Recognition of the family Agavaceae by Hutchinson (1944, 1959) was one of many admirable features in his handling of the monocotyledons, but his treatment of the genera leaves much to be desired. Though largely following Rose for *Polianthes* and its allies, he does not accept *Manfreda* as distinct from *Agave*, which he places in a separate tribe from *Polianthes*. Yet Rose was surely correct in associating *Manfreda* with *Polianthes* in a group characterized by herbaceous, spineless leaves and simple inflorescences, in contrast with the persistent, spine-tipped and commonly spiny-margined leaves and simple or more commonly paniculate inflorescences of true *Agave*. Like Pax and Hoffman (1935), Hutchinson puts great reliance on the difference between regular flowers in *Agave* and irregular ones in *Polianthes*. But the flowers of the garden tuberose, *Polianthes tuberosa*, are quite symmetrical except for a slight curving of the perianth tube, while some species of *Manfreda* (which these authors treat as a subgenus of *Agave)* also have a slightly curved perianth tube. In fact this was the key feature of Rose's subgenus *Pseudomanfreda* (1899). Neither perianth shape nor inflorescence provides as sharp a distinction as the vegetative ones of leaves and duration.

If floral features are not suitable for tribal separation, the question remains whether they are suitable for delimiting genera. I find them no better for that purpose. Rose's primary feature, paired flowers versus solitary, is scarcely workable. Plants of tuberose in my garden regularly have the lower flowers solitary while the rest are paired, and herbarium specimens of Mexican species show like variation. Engelmann describes a plant of the normally solitary-flowered *Agave (Manfreda) virginica* with two or three flowers per node (though he stresses that these are not truly paired as in *Agave* proper). Differences in perianth form are really ones of degree rather than basic kind, ranging even within *Manfreda* from perfectly straight to strongly curved, while *Prochnyanthes*, with both curved and abruptly enlarged perianth, represents an extreme in the series. Sessile anthers, which set off *Runyonia*, likewise represent one extreme in a series that ranges from the conspicuously elongate filaments of such species as *Agave (Manfreda) variegata* through relatively short ones in *A. (M.) virginica* and very short ones in *Polianthes tuberosa*. I have had insufficient material for checking the peculiarity of straight versus folded stamens in bud. This is the one

SIDA 2 (4): 333-338. 1966.

floral feature which might permit the genera recognized by Rose to be divided sharply into two groups. It would place *Pseudobravoa* and *Manfreda* with *Agave* proper, leaving *Polianthes* and *Prochnyanthes* in a second group; *Runyonia,* with sessile anthers, could not be placed on this basis. I suspect that non-folding of stamens simply results when filaments are very short, and has no real significance. In view of the great variation in floral features among the herbaceous species, it seems to me best to place chief emphasis on vegetative characters and put them all together in a single genus. The oldest name for the group is *Polianthes,* and to this the accepted species described under *Bravoa, Pseudobravoa, Manfreda, Prochnyanthes,* and *Agave* (herbaceous) are to be transferred. Those not found in Texas (except in local cultivation) are listed in an appendix.

POLIANTHES L., Sp. Pl. 1: 316. 1753. (Also Genera Pl. ed. 5 p. 148. 1754.) Only species: *P. tuberosa* L.

Manfreda Salisbury, Gen. Pl. Fragm. p. 78. 1866. (Not seen). Only species: *M. virginica* (L.) Salisbury. (See note at end of article.)

Bravoa Lexarza in La Llave & Lexarza, Nov. Veg. Descr. 1: 6. 1824. Only species: *B. geminiflora* Lexarza.

Agave sect. *Singuliflorae* Engelmann, Trans. Acad. St. Louis 3: 296, 300. 1875.

Agave subg. *Manfreda* (Salisbury) J. G. Baker, Gard. Chron. 1877, II. p. 807. (Not seen.)

Prochnyanthes S. Watson, Proc. Amer. Acad. 22: 457. 1887. Only species: *P. viridescens* S. Watson.

Manfreda subg. *Eumanfreda* Rose, Contrib. U.S. Nat. Herb. 5: 153. 1899. Automatic type species: *M. virginica* (L.) Salisbury.

Manfreda subg. *Pseudomanfreda* Rose, ibid. Type species not indicated, but in his later revision (l.c. 8: 16, 1903), only *M. singuliflora* (S. Watson) Rose has "perianth tube strongly curved," the distinguishing feature of subg. *Pseudomanfreda.*

Pseudobravoa Rose, Contrib. U.S. Nat. Herb. 5: 155. 1899. Only species: *P. densiflora* (Robinson & Fernald) Rose.

Runyonia Rose, Addisonia 7: 39. 1922. Only species: *R. longiflora* Rose.

KEY TO TEXAS POLIANTHES

1a. Filaments very short or absent, the anthers slightly or not exserted
  2a. Leaf margins smooth and entire; perianth white . . . . . 1. *P. tuberosa*
  2b. Leaf margins finely serrulate; perianth red . . . . . 2. *P. Runyonii*
1b. Filaments moderately to very long, the anthers well exserted
  3a. Perianth lobes 3-8 mm. long; north central and eastern Texas
    4a. Perianth (including ovary) 20-23 mm. long; anthers 8-10 mm. long . . . . 3. *P. virginica*

4b. Perianth (including ovary) 26-35 mm. long; anthers 13-15 mm. long . . . . 4. *P. lata*
3b. Perianth lobes 10-15 mm. long; south central and far south Texas
5a. Filaments exserted to less than twice the length of the perianth lobes . . . . 5. *P. maculosa*
5b. Filaments exserted to 3-6 times the length of the perianth lobes . . . . 6. *P. variegata*

1. P. TUBEROSA L., Sp. Pl. 1: 316. 1753. "*Habitat in* India." Not known as wild plant; believed to have originated in Mexico (where all its close relatives are found), and to have been widely spread around the world soon after Columbus. Often cultivated in Texas. The fragrance is most evident at night. The double-flowered form is *P. tuberosa* f. *plena* Moldenke, Phytologia 3: 41, 1948.

2. P. **Runyonii** Shinners, nom. nov. *Runyonia longiflora* Rose, Addisonia 7: 39-40, pl. 244. 1922. Type cultivated at New York; plants sent from Brownsville, Cameron Co., Texas. (Not *Polianthes longiflora* Rose, 1903.) Known to me only from the original description and plate.

3. P. **virginica** *(L.)* Shinners, comb. nov. *Agave virginica* L., Sp. Pl. 1: 323. 1753. "*Habitat in* Virginia." *Manfreda virginica* (L.) Salisbury, Gen. Pl. Fragm. p. 78. 1866. (Not seen.) The form with mottled or spotted leaves occurs with the plain green one; it certainly does not deserve to rank as a species or variety. Because of its minor horticultural interest, it may be designated *P. virginica* f. **tigrina** (Engelmann) Shinners, comb. nov. *Agave virginica* var. *tigrina* Engelmann, Trans. Acad. St. Louis 3: 302. 1875. *A. virginica* f. *tigrina* (Engelmann) Palmer & Steyermark, Ann. Mo. Bot. Gard. 22: 507. 1935. *A. tigrina* (Engelmann) Cory, Rhodora 38: 405. 1936. *Manfreda tigrina* (Engelmann) Small ex Rose in Small, Fl. S.E. U.S. 287, 1329. 1903.

Frequent in open woods and roadsides, sandy or sandy clay soil, eastern Texas, west to Wood, Smith, Brazos, and Harris counties. Flowering from late June to late August.

4. P. **lata** (Shinners) Shinners, comb. nov. *Agave lata* Shinners, Field & Lab. 19: 171-172. 1951. Still known in Texas only from the type collection, 4.7 miles south of Sherman, Grayson Co., in blackland prairie clay. Flowering from about mid June to mid July. More frequent in eastern Oklahoma (specimens seen from Muskogee, Pontotoc, and Sequoyah counties), where it grows in open oak woods.

5. P. **maculosa** (Hooker) Shinners, comb. nov. *Agave maculosa* Hooker, Bot. Mag. 85: t. 5122. 1859. Described from plants cultivated in England, received from Texas. *A. maculata* Engelmann ex Torrey in Emory, Rept. U.S. & Mex. Boundary Survey 2: 214-215. 1859. (Not *A. maculata* Regel, 1856, nor *Polianthes maculata* Martius, 1831.) Presumably *A. maculosa* var. *brevituba* Engelmann, Trans. Acad. St. Louis 3: 301, 1875, also belongs here, as Mulford (1896) says. The type locality, "below El Paso,"

is far outside the known range of this species. Whether there was confusion as to locality, or a cultivated plant was involved, I do not know. *Manfreda maculosa* (Hooker) Rose, Contrib. U.S. Nat. Herb. 8: 17. 1903.

Frequent on sandy clay or clayey soils, south central Texas (specimens seen from Bee, Duval, Jim Wells, Karnes, San Patricio, and Wilson counties; also planted on roadside in Brooks County). Flowering mid April to mid July. Named for the mottled leaves, which are also found in *P. virginica* and *P. variegata*, with the result that plants of all three species may be mistaken for one of the others.

6. P. **variegata** (Jacobi) Shinners, comb. nov. *Agave variegata* Jacobi, Hamburger Garten- und Blumenzeitung 21: 459-462. 1865. "We found this plant in the summer of 1856 in the Botanical Garden at Copenhagen, as *A. polyanthoides*." *Manfreda variegata* (Jacobi) Rose, Contrib. U.S. Nat. Herb. 8: 20. 1903. I have followed Rose and Berger in applying the name to our plant. The description fits very well. I have seen only one flowering specimen, from Cameron Co.: 3½ miles southeast of Russelltown, frequent on roadside, *V. L. Cory 54616*, July 6, 1948. A fruiting specimen with a few shrivelled flowers, from "Russelltown; a colony on roadside," *H. R. Reed 1213*, July 25, 1951, is apparently the same and may have come from the same place.

ADDITIONAL TRANSFERS

The most recent and comprehensive account of the species to be referred to *Polianthes* is that of Conzatti (1947). This is in large part a compilation from Rose's publications, but Conzatti restores *Bravoa*, transferring to it two of Rose's new species of *Polianthes (P. platyphylla, P. graminifolia)*. The third, the type of the genus, had been referred by Rose to *Polianthes*, as *P. geminiflora* (Lexarza) Rose. The fourth is treated twice by Conzatti, with identical descriptions, under both *Bravoa* and *Pseudobravoa*. He accepts eight species of *Polianthes*, as in Rose's revision, but omitting the doubtful *P. gracilis* Link & Otto, suspected of being a form of *P. tuberosa*. Two species of *Prochnyanthes* are given instead of the three listed by Rose. Rose expressed doubt as to whether more than one variable species was involved. I can add nothing to his comments (1903, pp. 13-14), and for the present leave *Prochnyanthes viridescens* S. Watson and *P. Bulliana* J. G. Baker as probable synonyms of *Polianthes mexicana* Zuccarini *(Prochnyanthes mexicana* (Zuccarini) Rose). The single species of *Pseudobravoa* requires a new name under *Polianthes*, becoming P. **densiflora** (Robinson & Fernald) Shinners, comb. nov., based on *Bravoa densiflora* Robinson & Fernald, Proc. Amer. Acad. 30 (Contrib. Gray Herb. n.s. 8): 122, 1894 *(Pseudobravoa densiflora* (Robinson & Fernald) Rose, Contrib. U.S. Nat. Herb. 8: 14, 1903). Most of the 14 species of *Manfreda* require new names under *Polianthes*. Species 6 was based on *Polianthes maculata* Martius, hence no transfer is required. (Berger calls this *Agave pubescens* Regel &

Ortgies, the name *Agave maculata* having been used twice previously, by Regel and by Engelmann, for other species.) The transfer for species 9, *M. variegata,* has been made above; the remaining ones appear below.

P. **singuliflora** (S. Watson) Shinners, comb. nov. *Bravoa singuliflora* S. Watson, Proc. Amer. Acad. 22: 479. 1887. *Manfreda singuliflora* (S. Watson) Rose, Contrib. U.S. Nat. Herb. 8: 16. 1903.

P. **revoluta** (Klotzsch) Shinners, comb. nov. *Agave revoluta* Klotzsch in Otto & Deitrich, Allgem. Gartenzeitung 8: 274. 1840. (Not seen.) *Manfreda revoluta* Klotzsch) Rose, l.c. 21.

P. **potosina** (Robinson & Greenman) Shinners, comb. nov. *Agave potosina* Robinson & Greenman, Proc. Amer. Acad. 29 (Contrib. Gray Herb. n.s. 7): 393-394. 1894. *Manfreda potosina* (Robinson & Greenman) Rose, l.c. 18. Berger does not mention this species.

P. **brunnea** (S. Watson) Shinners, comb. nov. *Agave brunnea* S. Watson, Proc. Amer. Acad. 26: 156. 1891. *Manfreda brunnea* (S. Watson) Rose, l.c. 19.

P. **debilis** (Berger) Shinners, comb. nov. *Agave debilis* Berger, Die Agaven p. 33. 1915. (New name for the following.) *Manfreda Pringlei* Rose, l.c. 19. (Not *Polianthes Pringlei* Rose, 1903; not *Agave Pringlei* Engelmann ex Orcutt, 1883.)

P. **brachystachys** (Cavanilles) Shinners, comb. nov. *Agave brachystachys* Cavanilles, Descripcion de las Plantas que Demostró en las Lecciones Publicos p. 453. 1802. (Not seen.) *Manfreda brachystachys* (Cavanilles) Rose, l.c. 20.

P. **planifolia** (S. Watson) Shinners, comb. nov. *Agave planifolia* S. Watson, Proc. Amer. Acad. 22: 479. 1887. *Manfreda planifolia* (S. Watson) Rose, l.c. 22.

P. **guttata** (Jacobi & Bouché) Shinners, comb. nov. *Agave guttata* Jacobi & Bouché, Hamburger Garten- und Blumenzeitung 21: 190. 1865. *Manfreda guttata* (Jacobi & Bouché) Rose, l.c. 21.

P. **elongata** (Rose) Shinners, comb. nov. *Manfreda elongata* Rose, l.c. 21. *Agave gracilis* Berger, Die Agaven p. 33. 1915. (New name for this species, not *Agave elongata* Jacobi, 1865.)

P. **Oliverana** (Rose) Shinners, comb. nov. *Manfreda Oliverana* Rose, l.c. 21. *Agave Oliverana* (Rose) Berger, l.c. 33.

P. **rubescens** (Rose) Shinners, comb. nov. *Manfreda rubescens* Rose, l.c. 22. *Agave pratensis* Berger, l.c. 37. (New name for this species, not *Agave rubescens* Salm-Dyck, 1834.)

P. **jaliscana** (Rose) Shinners, comb. nov. *Manfreda jaliscana* Rose, l.c. 22. *Agave jaliscana* (Rose) Berger, l.c. 38.

There are three additional names which Rose lists at the end of his account of *Manfreda* as having been introduced into cultivation as *Agave* species. He does not include them in his treatment of the species, and does not formally transfer the names to *Manfreda.* Two are recognized by Berger, while the third (*A. conduplicata* Jacobi & Bouché) he says "remains insufficiently known" (p. 38). Since the two he accepts and describes are apparently known only from material cultivated in Europe (believed to be of Mexican origin, but the possibility of hybrid derivation exists), no transfers are proposed for them. The name used by Berger for the first of these, *Agave Alibertii* J. G. Baker, is illegitimate, there being an earlier name in the same rank, *Alibertia intermedia* Marion. The other, *Agave undulata* Klotzsch in Otto & Dietrich, is available for transfer to *Polianthes* if recognized as a valid species.

One further species was recently transferred to *Manfreda* as *M. sessiliflora* (Hemsley) Matuda, An. Inst. Biol. 31: 66, 1961 (based on *Agave sessiliflora* Hemsley, Diagn. 3: 55, 1880). This is recognized by Berger (p. 33), but Rose merely mentions it incidentally as "very close" to *Manfreda brachystachys* (Cavanilles) Rose. It is not the same as *Polianthes sessiliflora* (Hemsley) Rose, which was based on *Bravoa sessiliflora* Hemsley. A new name will be required for it if accepted as a distinct species under *Polianthes.*

Finally there are two species of *Polianthes* described by Sessé and Mocino which are unknown to me: *P. americana* (La Naturaleza ser. 2, 1, app. 54, 1888) and *P. tubulata* (Fl. Mex. ed. 2 p. 88, 1894). The latter may be only a misspelling of *P. tuberosa,* and it is possible that both names are synonyms of the Linnaean species.

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NOTE: While this article was in galley proofs a copy of Salisbury's *Genera* was acquired for the S.M.U. Science Library. The one species of *Manfreda* is listed simply as *Agave virginica* L. Apparently the first valid publication of the combination *Manfreda virginica* was by Rose (1899, p. 155).

REVISION OF PENSTEMON SECTION CHAMAELEON (SCROPHULARIACEAE)

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The herbarium discovery of an apparently new species of *Penstemon* from southern Arizona led to an investigation of the species related to it. It soon became apparent that this species and its relatives comprise an entirely new section of *Penstemon,* sharply separated from other sections by the peculiarly flattened and twisted anther sacs which are usually sharply toothed or stoutly hispid at the suture. The name chosen for the new section is derived from the name of a lizard genus which is notorious for color-changes. This alludes to the fact that both red-flowered and blue-purple-flowered species are accommodated in the section and that in any one species the opposite pigment apparently underlies the primary one. In poorly pressed or old material, the true color may be difficult of determination, and indeed, Asa Gray named one species twice, first as a blue-purple species, and second as a red species!

Although flower color may occasionally be confused, it is still the most useful character taxonomically, and species divided on that basis do not actually intergrade. Indeed, had Asa Gray more critically examined the specimen he thought to be red-flowered, his mistake could have been avoided. Instead, I believe, he relied on the collectors field notes which I believe referred not to the plant before him, but rather to *P. ramosus* below.

The "new species" has already been adequately described by E. L. Greene in 1888, but the name applied by him is a later homonym of one applied to another species. The name *Penstemon ramosus* below is therefore an avowed substitute for Greene's name, and the species strictly speaking is not new. Stillborn herbarium names have been applied to species of the section by Standley, Greene, and Pennell. An anonymous *nomen nudum* has been applied to the section in various publications of the American Penstemon Society, while at least the herbarium name coined by Standley has appeared in horticultural literature as an anonymous *nomen nudum,* also. Only valid published names, or at least effectively published names are listed below, except where a herbarium name coined by Greene enters intimately into the problem of typifying *P. ramosus.*

PENSTEMON sect. **Chamaeleon** Crosswhite, sect. nov. Caudex suffrutescens. Folia lanceolata integra pubescentia. Corollae rubrae vel purpureae, ventricosae vel tubulosae. Antherarum loculi contortissimi suturis dentato-hispidis. Typus: *Penstemon lanceolatus* Bentham.

SIDA 2 (4): 339-346. 1966.

KEY TO SPECIES OF SECTION CHAMAELEON

A. Corollas red, tubular.

B. Stems unbranched below the inflorescence; leaves mostly 4-8 mm. wide, not revolute . . . . 1. *P. lanceolatus*

BB. Stems branched below the inflorescence; leaves revolute, those of the branches 1 mm. wide, those of the stem 3-6 mm. wide. . . . . 2. *P. ramosus*

AA. Corollas blue-purple, ventricose (tubular in *P. dasyphyllus* when young).

C. Inflorescence densely glandular . . . . 4. *P. dasyphyllus*

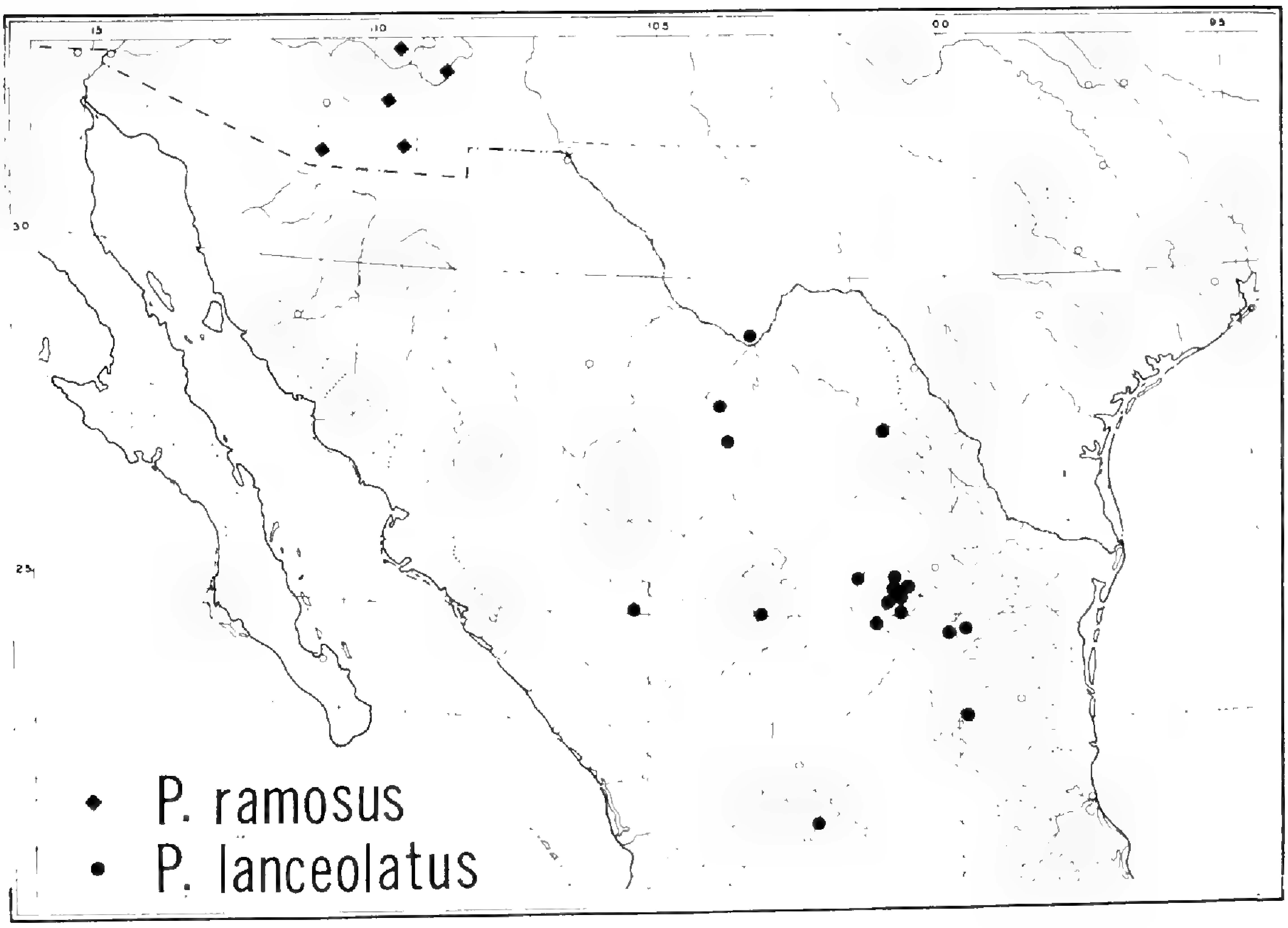
CC. Inflorescence eglandular . . . . 3. *P. stenophyllus*

1. PENSTEMON LANCEOLATUS Bentham, Plantae Hartwegianae 22, 1839. Type: "in petrosis Mexicanis prope Aguas Calientes", Hartweg 184 (Herb. Benth., not seen; photo, GH.; isotype, GH!). The photograph of the holotype in the Gray Herbarium is accompanied by H. M. Hall's (1928) observations: "Herbage densely puberulent, the hairs on the lower stem stiff and short, those of the inflorescence gland-tipped, as also some of those below." The Gray Herbarium isotype very closely matches the holotype and also bears capsules which the holotype lacks.

Stems 1-5 from a thick, coarse, woody caudex, not normally branched below the inflorescence, 2-5.5 dm. high, lightly to densely puberulent or pubescent, glandular pubescent above; basal leaves usually absent at anthesis, light green or bluish-green, lanceolate, 5-8 mm. wide, 25-40 mm. long, lightly puberulent to glabrescent below, moderately puberulent on the upper surfaces; cauline leaves darkening in drying, narrowly lanceolate, mostly 4-8 mm. wide and 25-85 mm. long, (or occasionally broadly lanceolate, about the same length but to 22 mm. wide), lightly puberulent above to moderately pubescent both on the upper and lower leaf-surfaces; inflorescence moderately to densely glandular-pubescent, cymose, usually with only one branch per node growing, this of 1 or 2 flowers; corollas straight, red, 25-32 mm. long, often white-pubescent externally; sepals 5-7 mm. long, opaque, glandular, red-margined in flower, brown in fruit; capsules 14-15 mm. long, 4-valved, the lobes spreading with dehiscence; seeds ca. 2.5 mm. long.

Specimens examined:

MEXICO: AGUASCALIENTES: Aguascalientes, *Hartweg 184* (GH), *Rose & Hay 6219* (GH), *Rose & Painter 7728* (GH). COAHUILA: Battlefield near Buena Vista, *Gregg 57* (GH). Canon del Indio Felipe, in Sierra Hechiceros, *Stewart 151* (GH). Carneros Pass, *Johnston 7286* (GH). 2-16 mi. e. of Carneros Pass, *Correll & Johnston 21324* (LL). Above Chorro de Agua, *Correll & Johnston 21367* (LL). 15 km. w. of Concepcion del Oro, *Stanford et al. 538* (GH). 11 km. n.e. of Jimulco, *Radford et al. 28* (GH). West base of Picacho del Fuste, n.e. of Tanque Vaionetta, *Johnston 8446* (GH). Muzquiz, *Marsh 173* (TEX). Palomas Negras, 8 km.



w. of Sierra Mojada, *Stewart 2192* (GH). Saltillo, *Palmer 19* (GH). N. of Saltillo, *Gregg 441* (GH). 6 mi. e. of Saltillo, *Palmer* 974. San Lorenzo Canyon, 6 mi. s.e. of Saltillo, Palmer 550 (GH). Sierra Almagre, above Rancho El Almagre, *Johnston & Muller 1168* (GH). Sierra Paila, G. Cepeda, *Hinton et al. 16548* (GH). DURANGO: Papasquiaro, *Nelson 4665 (GH). Santiago Papasquiaro, Palmer 403* (GH). NUEVO LEON: 3 mi. s. of Galeana, *Correll & Johnston 19858* (LL). Vic. Rancho Pablillo, 15 mi. s.w. of Pueblo Galeana, *Mueller & Mueller 500, 531, 600* (GH). TAMAULIPAS: 4 km. w. of Miquihuana, *Stanford et al. 612.* (GH).

UNITED STATES: TEXAS: BREWSTER CO.: Head of Heath Canyon, Dead Horse Mts., Big Bend Nat. Park, *Warnock 10725* (LL, SMU).

Richard Straw (1959) has pointed out the confusion that has existed between this species and the other red-flowered species of Mexico. His treatment is composite, of *P. lanceolatus* and *P. ramosus*, but those specimens cited from Mexico and Texas probably refer to *P. lanceolatus*.

2. PENSTEMON **ramosus,** Crosswhite, nom. nov.

Penstemon pauciflorus Greene, in Bot. Gaz. 6:218. 1888. Type: "Bluffs of the Rio Gila", August 30, 1880, E. L. Greene. By the time Greene finally named the species, he had probably already distributed the specimens under another manuscript name which proved to be a later homonym, necessitating the change. If so, his description might have been drawn from memory and fragmentary notes. If this is the case, the specimen labelled "Penstemon angustifolius, n. sp., Bluffs of the Rio Gila, Aug. 29, 1880" by Greene in the Gray Herbarium may be part of the type material. Not *P. pauciflorus* Buckley, 1862.

Robust heterophyllous perennials from a woody caudex; stems 3-7.5 dm. tall, puberulent, often branching midway up the stem; leaves of the branches linear, ca. 1 mm. wide and 25 mm. long; leaves of the main stem 3-6 mm. wide, 6-11 cm. long, isophyllous among themselves, narrowly linear-lanceolate, moderately puberulent, involute; inflorescence moderately to densely glandular-pubescent, a modified cyme with only one branch at a node, this bearing one or two flowers; corollas straight, red, 28-40 mm. long; sepals 5-10 mm. long; anther sacs opening almost throughout, twisted, not at all explanate, the sutures not toothed; capsules 9-15 mm. long, 4-valved, the lobes widely divaricate with dehiscence; seeds ca. 3 mm. long.

Specimens examined:

ARIZONA: COCHISE CO.: Paradise, *Blumer 1604* (GH), *Peebles 5847* (US, not seen; photo PH!). GRAHAM CO.: Frye Mesa, Pinaleno Mts., *Maguire et al. 11723* (PH). GREENLEE CO.: ½ mi. n. of Metcalfe, *Maguire et al. 11811* (PH). PIMA or SANTA CRUZ CO.: Santa Rita Mts., *Pringle s.n.* (GH).

NEW MEXICO: Bluffs of the Rio Gila, *Greene 281* (GH).

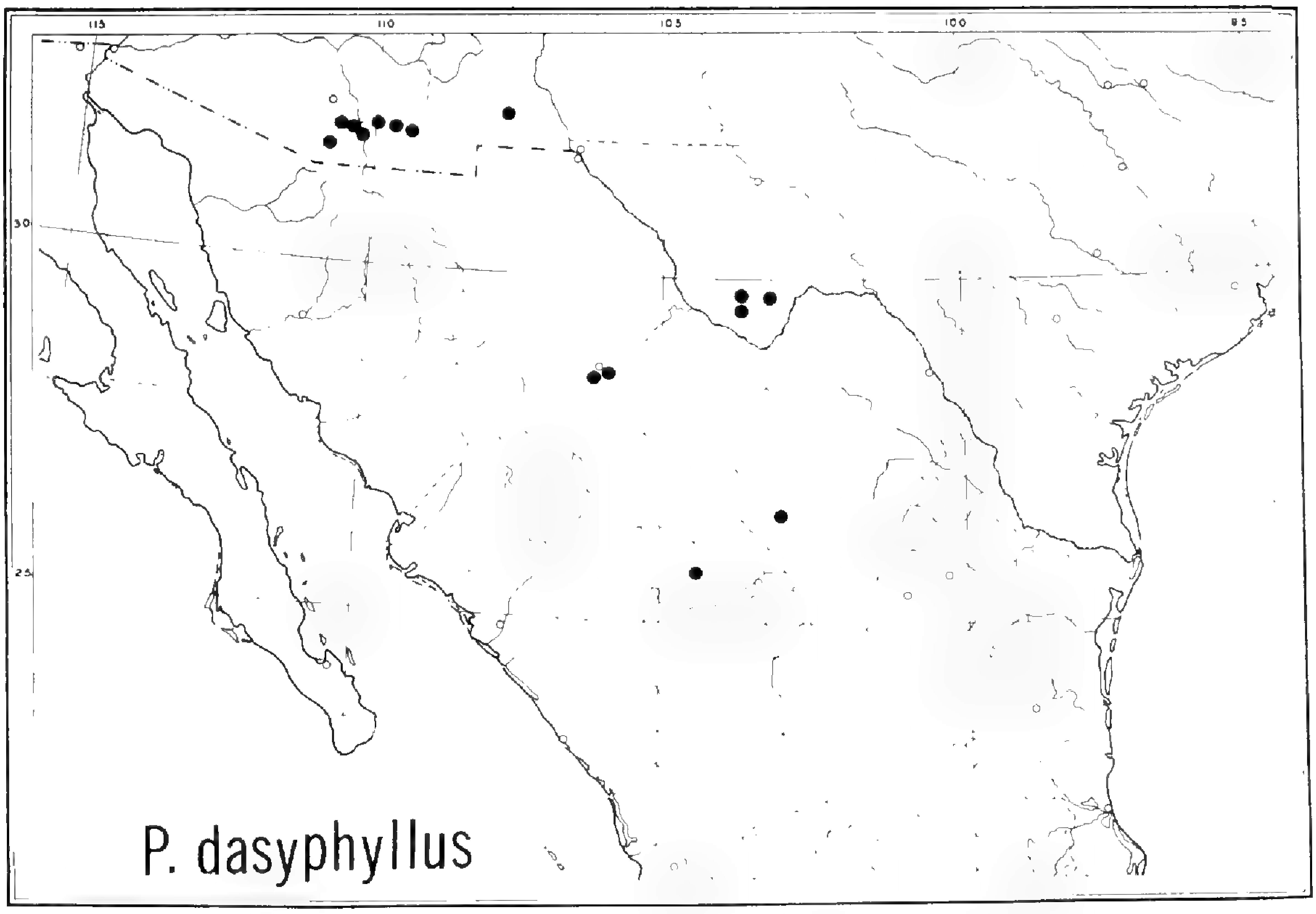
This is the species referred to as "*P. lanceolatus*" in *Arizona Flora* by Keck (Kearney & Peebles, 1959); the specimens cited by Nisbet & Jackson (1960) from New Mexico in "The genus *Penstemon* in New Mexico" are probably also referrable here.

3. PENSTEMON STENOPHYLLUS A. Gray, Bot. U.S. & Mex. Bound. Surv. 112. 1859. Type: "Hills from Babocomori towards Santa Cruz." C. *Wright 1477* (GH!, labelled in Gray's hand "*Pentstemon stenophyllus* n. sp.").

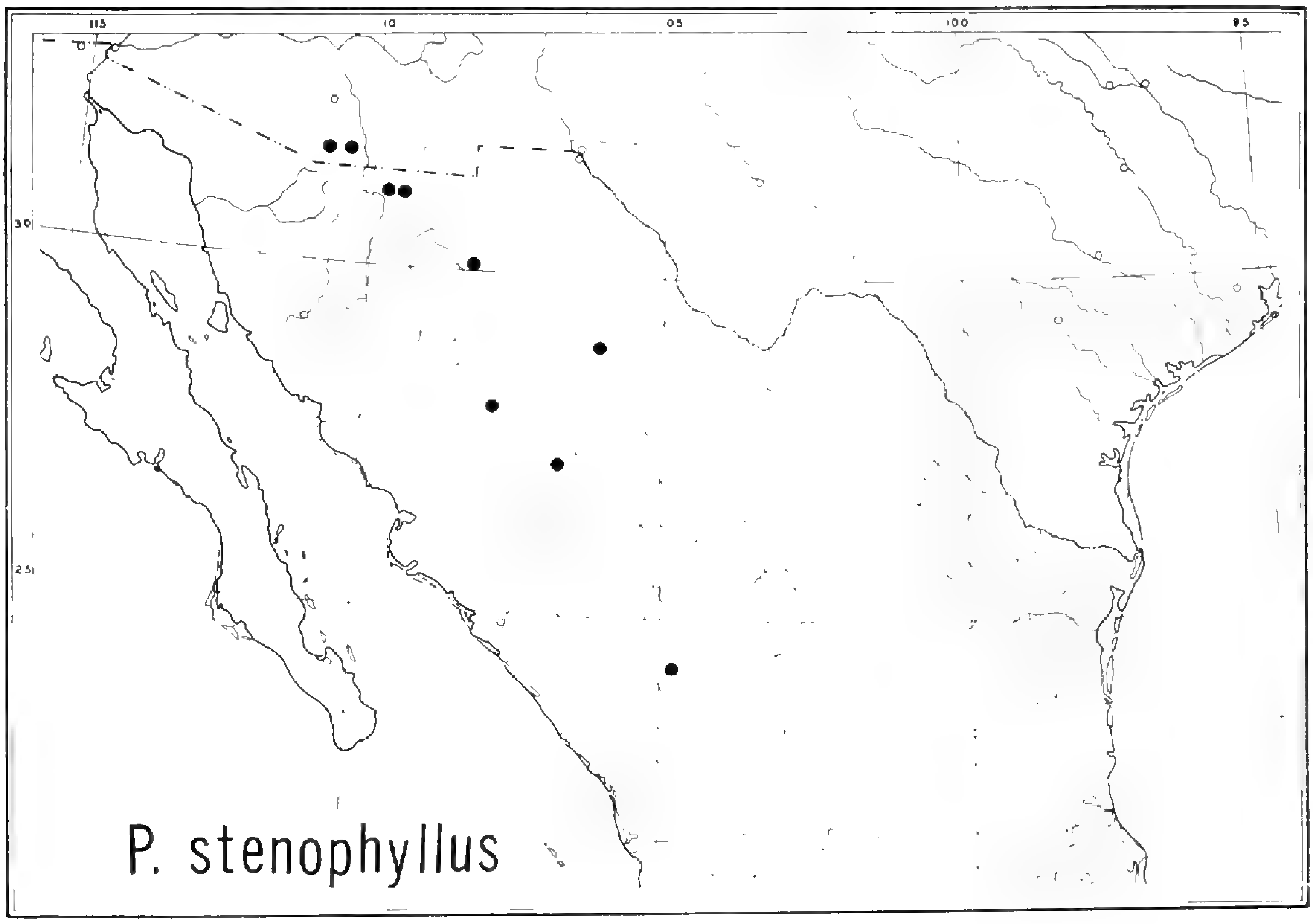
Penstemon rubescens A. Gray, Proc. Amer. Acad. 19: 92. 1883.

Type. Jarvis Canyon?, near Fort Huachuca, *Lemmon 2852* (GH!).

Tall willowy perennials from a suffrutescent caudex, erect with narrow spreading parts, therefore airy; stems 2-9 dm. tall, puberulent to apparently glabrous, simple (i.e. branched only in the inflorescence); leaves all cauline in anthesis, linear, 6-13 cm. long, 1-3 (-5) mm. wide, lightly to moderately puberulent or apparently glabrous, occasionally folded or revolute; inflorescence glabrous or nearly so, usually spreading and much-branched, the cymes regular or nearly so (i.e. both lateral branches growing at a cymose branch); corollas well-inflated, blue-purple or apparently occasionally reddish (Gentry 1897 "lutescent lavender, petals deepening to purple, throat very pale with deep red lines; Gentry 2583 "red-purple; throat whitish, streaked with purple"), 23-37



P. dasyphyllus



P. stenophyllus

mm. long; sepals wide (to 4-5 mm.), erosulate, caudate, hyaline-margined, glabrous; anther sacs twisted or occasionally almost straight, opening almost throughout, but not at all explanate, the sutures with abundant white teeth; capsules ca. 15 mm. long, 4-valved, the lobes spreading widely with dehiscence; seeds 2-3 mm. long.

Specimens examined:

UNITED STATES: ARIZONA: Hills from Babocomori toward Santa Cruz, *Wright 1477* (GH). Near Fort Huachuca, *Lemmon 2851, 2852, 3046* (GH).

MEXICO: CHIHUAHUA: 20 mi. n. of Chihuahua *Stewart & Johnston 2126* (GH). Near Colonia Garcia, *Townsend & Barber 313* (GH). Loreto, Rio Mayo, *Gentry 2583* (GH). 63 mi. w. of Parral on rd. to El Vergel, *Correll & Gentry 22873* (LL). 8 mi. n. of Santo Tomas, *Muller 3387* (GH). Sierra Madre, *Nelson 6312* (GH). Sierra Canelas, Rio Mayo, *Gentry 1897* (GH). DURANGO: Otinapa, *Palmer 430* (GH). Sandia Station, *Pringle 13663* (GH). SONORA: Between San Pedro and Fronteras, *Hartman 890* (GH). Cosiquiriachi, *Wislizenus 186* (GH).

4. PENSTEMON DASYPHYLLUS A. Gray, Bot. U.S. & Mex. Bound. Surv. 112. 1859. The type sheet contains five plants apparently representing three separate collections. Luckily, all are referrable to *P. dasyphyllus* and were probably meant by Gray to together represent his new species, as he wrote in the lower right hand corner of the whole sheet, "P. dasyphyllus n. sp.". This was inadvertently covered up by the Synoptic Flora annotation label and can scarcely be seen without candling. The three collections above "P. dasyphyllus n. sp." have three separate labels, and with some difficulty it is possible to associate the proper plants with the proper labels. Francis W. Pennell (1941) without mentioning that all three of the collections were mounted on the same sheet, designated one, C. Wright 1478, as the type. The label for this collection (on the usual blue-colored printed paper) also bears Asa Gray's "P. dasyphyllus n. sp.", but Pennell chose it for the type because it "is accompanied by an open flower showing special study by Gray". The packet containing this flower is above the stems that I believe should go with the Wright label, but the same packet contains a flower which seems, from the stain marks on the paper, to have come from another collection. I do not find a place on the Wright collection stems where the other (opened and critically studied) flower could have been attached. I believe that since the packet was probably placed over the Wright collection in Asa Gray's time to accommodate the opened flower (the paper being cut from manuscript notes of about that date), that the critically studied flower probably did indeed come from Wright 1478, perhaps from material (now isotypical) transmitted later to the Boston Society of Natural History or elsewhere. The other material in the packet may have been added later by someone unfamiliar with

Gray's methods of mounting specimens. In the absence of exacting criteria in the International Rules of Botanical Nomenclature, I here designate the three stems on the left of the sheet and the open flower dried onto manuscript notes in the packet as the type. The second collection on the sheet is co-typical and is now a paratype, labelled (by Gray) "San Pedro. E. K. Smith." In the type description it is cited "Valley of the San Pedro, Sonora, Capt. E. K. Smith . . .". The third collection, the last on the right of the sheet, is from the Mexican Boundary Survey, but does not have the characteristic blue ticket of Wright, having rather a general printed label bearing the names of Parry, Bigelow, Wright, and Schott. It is best considered a paratype and is a wide-leaved form rather different from the other material on the sheet. As Pennell has pointed out, Wright's field notes indicate number 1478 (through his field number 267 written under the label by Gray) to have come from "Stony hills of the Pecos." The simplest explanation is that the third specimen, therefore, is from the other locality cited by Gray, "Cook's Spring, New Mexico." A fourth location, however, "Valley of the Santa Cruz River" mentioned in the type description is yet unaccounted for in the Gray Herbarium specimens, but would appear from the sentence structure to have been found by E. K. Smith's group, and hence not eligible to receive the printed label of Parry, Bigelow, Wright & Schott.

P. *stenophyllus* var. *dasyphyllus* (A. Gray) A. Gray, Syn. Fl. (reissue) vol. 2 pt. p. 441. 1886.

Perennial from a suffrutescent caudex; stems 2 to many, 2-4.5 dm. high, close-pubescent below, pronouncedly glandular above; leaves usually all cauline in anthesis, or if basal, not strictly different from the cauline (the true basal rosettes apparently appearing before anthesis and therefore never collected); cauline leaves typically densely pubescent with short stiff hairs, often not at all heavily so, especially on the lower surfaces, narrowly lanceolate to linear-lanceolate, 4 mm. wide and 65 mm. long or very rarely more widely lanceolate to 12 mm. wide and 65 mm. long, usually folded at the midrib to totally conceal the upper leaf-surface, occasionally revolute; secondary fascicles occasionally present in the leaf axils, these expanding to form sterile or fertile branches or remaining contracted as the fascicles of section *Fasciculus* Keck ex Straw; inflorescence densely glandular-pubescent, anomalous in being a polychasial cyme which at each branching usually forms only one lateral branch, this usually reduced to a single flower and the entire inflorescence appearing simply racemose, but determinate; corollas inflated, blue-purple to pink-lavender (Hewitt 326 "reddish blue"; Lemon 419 with "red fl."), 27-35 mm. long; sepals densely pubescent entire, 5-8 mm. long; anther sacs opening almost throughout but not at all explanate, twisted, the sutures long-dentate; staminode glabrous;

capsules 11-15 mm. long when mature, 4-valved, the lobes spreading widely with dehiscence; the persistent calyx about 2/3 the length of the capsule; seeds ca. 2 mm. long.

Specimens examined:

UNITED STATES: ARIZONA: COCHISE CO.: 6 mi. w. of Benson, *Maguire & Maguire 11704* (GH). 4 mi. n.e. of Dragoon, *Maguire & Maguire 11181* (GH). Lewis Spring, Chiricahua Mts., *Lemmon 253* (GH). Rucker Valley, *Lemmon 397, 419* (GH). Speiden Ranch, 10 mi. w. of Benson, *Glendening s.n.* (WIS). PIMA CO.; Between Sonoita and Vail, *McKelvey 2106* (GH). SANTA CRUZ CO.: Patagonia to Sonoita, *Peebles & Fulton 11464* (GH). 2 mi. n. of Vaughn, *Arnold s.n.* (GH). COUNTY UNCERTAIN: Valley of San Pedro, *Smith et el. s.n.* (GH). NEW MEXICO: Niggerhead Mts., near Monument No. 82, *Mearns 1922* (GH). Cook's Spring?, *Mexican Boundary Survey* s.n. (GH).

MEXICO: COAHUILA: Canon del Cuervo Chico, ca. 16 km. n. of Cuesta Zozaya, *Johnston 8532* (GH). West base of Sierra de los Guajes, 7 km. e. of Rancho Buena Vista, *Stewart 1475*. Sierra del Pino, vic. La Noria, *Johnston & Muller 429* (GH). CHIHUAHUA: 2 mi. s.w. of Chihuahua, *Correll & oJhnston 21583* (LL). Santa Eulalia, *Hewitt 289, 317, 326* (GH), *Palmer 134* (GH). DURANGO: 11 mi. e. of La Zarca, *Correll & Johnston 20266* (LL). 3-6 mi. w. of La Zarca Jct., *Straw & Forman 1715* (WIS).

TEXAS: BREWSTER CO.: Bear Creek, ca. 30 mi. s.e. of Marathon, *Correll & Rollins 23745* (LUN, type). 47 mi. s. of Alpine, *Rose-Innes & Moon 1161* (WIS). Oak Canyon, *Moore & Steyermark 3360* (GH). Terlingua to Alpine, *Tharp s.n.* (GH). COUNTY UNCERTAIN: Stony hills of the Pecos, *Wright 1478* (GH).

ACKNOWLEDGEMENTS

This study was supported by a grant from the Research Committee of the University of Wisconsin on funds from the Wisconsin Alumni Research Foundation. Some of the herbarium specimens were studied or borrowed while on a trip financed by the J. J. Davis Memorial Fund administered by the Faculty of the Department of Botany of the University of Wisconsin. I wish to thank Dr. Hugh H. Iltis for his help and interest in the study.

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NOTES

SCIRPUS AMERICANUS PERSOON (CYPERACEAE) IN COSTA RICA.—According to Standley, Flora of Costa Rica, Field Mus. Bot. Ser. 16: 104-105, 1937, the genus *Scirpus* is not at all well represented in Costa Rica, having only one species, *S. inundatus* (R. Br.) Poir., a small plant of high meadows and bogs on the volcanoes.

Hence I was surprised to see what appeared to be *S. americanus* on a kodachrome slide shown me by Stephen J. Gawarecki, of the U. S. Geological Survey. The plant formed a dense belt of bright green around a hot spring. He furnished exact directions as to the locality, so I wrote to Dr. William H. Hatheway, of the Tropical Science Center, San Jose, Costa Rica, and asked him to try to locate the stand and collect specimens for me. He had no difficulty in finding it and sent an excellent series of specimens, though the heads are a bit young and bear few full-sized achenes. The plant forms dense stands around iron-rich hot springs in a pasture near Bermejo, about 4 km. south of Cartago, elevation about 1400 m., April 11, 1965, *Hatheway 1314* (US, NY, SMU, F). The culms are said to be used to stuff mattresses.

The plant resembles in habit *Scirpus olneyi* Gray more than it does most material of *S. americanus* Persoon, especially in the very short stiffly erect bract subtending the capitate inflorescence. Moreover, the size and dimensions of the achene, 2 mm. x 1.5 mm., ar those of *S. olneyi*. They seemed completely filled out, though immature; possibly they would have enlarged some. However, these specimens have reduced second and third involucral bracts, a character never found in *S. olneyi* according to Koyama in the most recent treatment of *Scirpus* sect. *Pterolepis,* to which these plants belong (Canad. Jour. Bot. 41: 1107-1131, 1963). They also have the scales of the spikelet bifid, with mucro equalling or shorter than the lobes of the scales, a character of *S. americanus*. The heads are dark purplish brown. In Koyama's key (op. cit. p. 1111), once it is admitted that the specimens belong to *S. americanus,* they run readily to *S. americanus* var. *monophyllus* (Presl) Koyama, which ranges from British Columbia southward along the Pacific Coast to Chile, thence eastward to Uruguay and westward to New Zealand and Australia. Though Central America is within the range of this variety, Koyama cities no specimens from between Baja California and Lima, Peru. Dr. Tetsuo Koyama, on a recent visit to Washington, kindly examined this material and confirmed that they are, indeed, *S. americanus* var. *monophyllus.*

The ambiguity of the characters of these specimens, as well as of several others determined by Koyama as *S. americanus,* leads one to wonder if *S. olneyi* is really a good species, after all. The possession of

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the second and third bracts is a positive character, and constant, more tangible than habit, but the fact that *S. olneyi* is cited by Koyama from Honduras and Guatemala may also be significant. This is no place to make a formal reduction, but I do not hesitate to recommend that collectors in Central America search for plants of this relationship and accumulate enough material to demonstrate whether one or two populations are represented, and whether the Hatheway specimens may not represent an intermediate population, effectively breaking down the distinction between *S. americanus* and *S. olneyi*.—*F. R. Fosberg, Pacific Vegetation Project, National Research Council, Washington, D. C.*

ASTRANTHIUM INTEGRIFOLIUM VAR. TRIFLORUM (RAFINESQUE) SHINNERS, COMB. NOV. (COMPOSITAE).—Based on *Bellis ciliata* var. *triflora* Rafinesque, New Fl. N.A. 2: 25. 1837 ("1836"). This is the oldest name in the rank of variety for the common Texas race. *A. integrifolium* var. *ciliatum* (Rafinesque) Larsen, Ann. Mo. Bot. Garden 20: 35, 1933, and *A. integrifolium* var. *rosulatum* Larsen, ibid. 36, are the same. In the excellent new monograph of the genus by D. C. D. DeJong ("A Systematic Study of the Genus Astranthium (Compositae, Astereae)," Publ. Museum Michigan State Univ. Biol Ser. vol. 2 no. 9: 429-528, 1965) it appears as *A. integrifolium* subsp. *ciliatum* (Rafinesque) DeJong (p. 504).—*Lloyd H. Shinners.*

THELESPERMA FILIFOLIUM VAR. INTERMEDIUM (RYDBERG) SHINNERS, COMB. NOV. (COMPOSITAE).—Based on *T. intermedium* Rydberg, Bull. Torr. Bot. Club 27: 631-632. 1900. This is a well-defined western and more inland race of the species. As Dr. B. L. Turner has already pointed out (Rhodora 61: 243-246, 1959), the name *T. filifolium* (Hooker) Gray was mistakenly applied in my account of the Texas species (Field. & Lab. 18: 17-24, 1950) to the coastal endemic later described as *T. nuecense* Turner. The plant I called *T. intermedium* has remained without a name in varietal rank.—*Lloyd H. Shinners.*

SIDA CONTRIBUTIONS TO BOTANY

VOLUME 2 NUMBER 5 SEPTEMBER 1966

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SIDA is privately published by Lloyd H. Shinners, SMU Box 473, Dallas, Texas 75222, U.S.A. Subscription price $6 (U.S.) per volume of about 360—400 pages, parts issued at irregular intervals.

AMMOPHILA CHAMPLAINENSIS (GRAMINEAE), A NEW SPECIES IN NEW YORK AND VERMONT

FRANK C. SEYMOUR

Pringle Herbarium, University of Vermont, Burlington, Vermont 05401

In the course of compiling data at the Pringle Herbarium for my forthcoming book on the Flora of New England, my attention was drawn to some specimens of *Ammophila* from Lake Champlain. To find any species of *Ammophila* so far inland as this seems surprising, as this genus of grasses is found with us particularly on saline sand dunes along sea coasts. Curiosity over this occurrence being piqued, an examination of the specimens and comparison of them with some from the seacoast brought further surprise in finding that they showed some very clear differences, such as shorter and acute rather than acuminate glumes and shorter less tapering inflorescences. This new species appears to be a relict of the age when the area now covered by the fresh waters of Lake Champlain was an ancient inland arm of the Atlantic Ocean.

Therefore I designate it as:

AMMOPHILA **champlainensis**, species nova. *A. breviligulatam* Fern. simulans; ligulis rotundatis vel truncatis, 1-3 mm longis; panicula linearicylindrica, abrupte terminata, non attenuata, 13-16 cm longa; glumis scabrellis, acutis, non attenuatis; gluma inferiore 9-10.5 mm longa; gluma superiore 10-11.5 mm longa; lemmate acuto, 9-10.5 mm longo; palea acuta 9-10 mm longa. Ammophila champlainensis, new species. Similar to *Ammophila breviligulata* Fern.; ligules rounded or truncate, 1-3 mm long; panicle linear-cylindric, abruptly ended, not attenuate, 13-16 cm long; glumes finely scabrous, acute, not attenuate; lower glume 9-10.5 mm long; upper glume 10-11.5 mm long; lemma acute 9-10.5 mm long; palea acute, 9-10 mm long.

Type: New York, on Lake Champlain, Au Sable Point, in sand, 3 July 1902, Nellie F. Flynn (VT). Other representative specimens are: New York, mouth of Au Sable River, 3 July 1902, L. R. Jones (VT); Vermont, sandy shore, Lake Champlain, Alburg, 19 July 1878, C. G. Pringle (VT).

In New England, three species are now known to occur, namely, (1) the familiar common species of the Atlantic Coast, *A. breviligulata* Fern.; (2) *A. arenaria* (L.) Link, the European Beachgrass, planted in some places such as Provincetown, Mass.; (3) *A. champlainensis* sp. nov., of Lake Champlain. To present the distinguishing characters of these three species in the most contrasting form, the following key is presented. Attention is called to the accompanying photographic illustrations of the two indigenous species.

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KEY TO THE NEW ENGLAND SPECIES OF AMMOPHILA

A. Ligule 1-3 cm long; blades puberulent above; panicle 1-2 dm long; lemma 2-toothed at tip; lemma and palea mucronate; glumes usually glabrous; axis of panicle glabrous or nearly so . . . *A. arenaria*

A. Ligule 1-3 mm long; blades scabrous on nerves above but not puberulent; panicle 13-30 cm long, rarely longer; lemma not 2-toothed; glumes puberulent or minutely scabrous; axis of panicle puberulent B.

B. Panicle (19-) 21-30 cm long, rarely longer, gradually tapering at both ends; lower glume attenuate, 11-13 mm long; upper glume 12-14 mm long, attenuate; keel of glumes almost straight; lemma 10-12 mm long; palea 10-11.5 mm long . . . . *A. breviligulata*

B. Panicle 13-16 cm long, abrupt at both ends; lower glume merely acute, 9-10.5 mm long; upper glume 10-11.5 mm long, merely acute; keel of glumes decidedly curved especially at tip; lemma 9-10.5 mm long; palea 9-10 mm long . . . . *A. champlainensis*

(Opposite)

Ammophila breviligulata
    N. J., sea coast
    Dr. J. B. Brinton
    1882 (VT)
    1. Spikelet × 6
Ammophila breviligulata
    Mass., Nantucket
    sea beaches, 12 Aug. 1897
    Mrs. Nellie F. Flynn (VT)
    2. Inflorescence × ½
Ammophila champlainensis
    N. Y., on Lake Champlain
    Au Sable Point, in sand
    3 July 1902,
    Mrs. Nellie F. Flynn (VT)
    TYPE
    3. Spikelet × 6
    4. Inflorescence × ½
    1 division of scales represents 1 mm.


1


2

SEEDS OF SOME UNITED STATES PHYTOLACCACEAE AND AIZOACEAE

JOHN W. THIERET

University of Southwestern Louisiana, Lafayette

Some years ago I embarked on a project that, hopefully, was to result in the production of a seed atlas of the genera of the United States flora. The plan was to characterize the seeds of each genus by describing and illustrating the seeds of one or more species chosen as typical. The Centrospermae were chosen as the starting place for the project—which soon came to an abrupt end as promised financial aid for the illustrations was not forthcoming. The project's main distinction, then, is that it was the shortest long-range endeavor in New World botanical history. The superb illustrations included in the present paper are the major results of the project; they are the work of Samuel H. Grove, Jr., who currently is drawing ticks in Egypt.

Realistic illustrations and accurate detailed descriptions of the gross external morphology of seeds are all too uncommon. Illustrations and descriptions of seeds of weedy plants are much more frequently encountered than are those of seeds of other plants. In only one publication known to me—the *Zadenatlas der Nederlandsche Flora,* which appeared in 1947—are *all* the seeds of a political area illustrated. Certain floras contain brief descriptions and occasional illustrations of seeds, but by far most of them present no more than descriptions. The descriptions range from quite inadequate—even ridiculous—to excellent, the latter case being singularly uncommon. In monographic treatments of various taxa, seeds may be treated in some detail or, more likely, essentially neglected.

Illustrations and descriptions of seeds have, of course, a practical value as an aid in seed identification. Of more fundamental significance, however, is the possible systematic application of data derived from studies of gross external morphology of seeds. Of seeds and systematics Buxbaum (1951) had this to say.

"Es ist eigentlich unglaublich, wie wenig in der Systematik auf den äusseren Bau der Samen geachtet wurde. Bearbeitet wurde meist nur Vorhandsein oder Fehlen, sowie die Beschaffenheit des Endospermes und die Gestalt und Lage des Embryo. Die äussere Gestalt und Textur der Testa wird fast immer arg vernachlässigt. Und doch können von ihr wichtige Aufschlüsse sowohl in Bezug auf die innere Gliederung einer Familie, als auch in Fragen der hoheren Kategorien der Klärung nähergebracht werden."

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This neglect of seeds is most incongruous, especially, perhaps, because seeds are the characteristic structure of the taxon called the "seed plants." The characters of vegetative and floral structure have always occupied a position of prominence with the systematic botanist, but those of seeds have been little used. The seed, like any other plant part, may have potential value. The systematist can discover, only through detailed study, those taxa in which seeds might be useful in the solution of problems of classification. Few such studies have been made.

The present paper is intended as a contribution to descriptive literature on seeds. Presented here are illustrations and descriptions of seeds chosen to typify seven genera of Centrospermae as represented in the United States: *Rivina* and *Phytolacca* of the Phytolaccaceae; and *Mollugo, Glinus, Cypselea, Trianthema,* and *Sesuvium* of the Aizoaceae. Seeds for study were obtained from herbarium specimens (from three herbaria: LAF, SMU, and F) and from collections made by me. Each pair of illustrations is a portrait of *one* seed chosen as representative; they are *not* composite drawings. The descriptions were composed after study of seeds from at least ten different collections, of the widest possible geographic distribution within the United States. When compared with the illustrations, they serve well to emphasize that existing terminology for seed description is rather inadequate. Terminology followed in this paper is, at least largely, that of Murley (1951). The figures given for length and width are of these dimensions as seen in lateral view of the seed. In the illustrations, the left drawing is of a lateral view, and the right drawing is of a ventral view. Order of presentation of taxa is that of Wilson (1932).

PHYTOLACCACEAE

RIVINA

1. *Rivina humilis* L. Fig. 1 (top)

Fruit 1-seeded. Seed length 2.2-2.4 mm., width 2.2-2.4 mm.; shape orbicular to orbicular-oval in lateral view, oval to ellipsoid in ventral view; testa black but densely covered with short (0.17-0.20 mm.), septate, occasionally branched, nearly colorless to pale brown hairs; testa minutely rugulose to almost smooth; hilum prominent.

PHYTOLACCA

1. *Phytolacca americana* L. Fig. 1 (bottom)

Fruit 7-11 seeded, usually 10. Seed length 2.6-3.1 mm., width 2.2-2.8 mm.; shape hemioval to oval or even orbicular in lateral view, narrowly oval to ellipsoid in ventral view; color black, highly glossy, hilar peg yellowish white; testa smooth; hilar depression prominent.

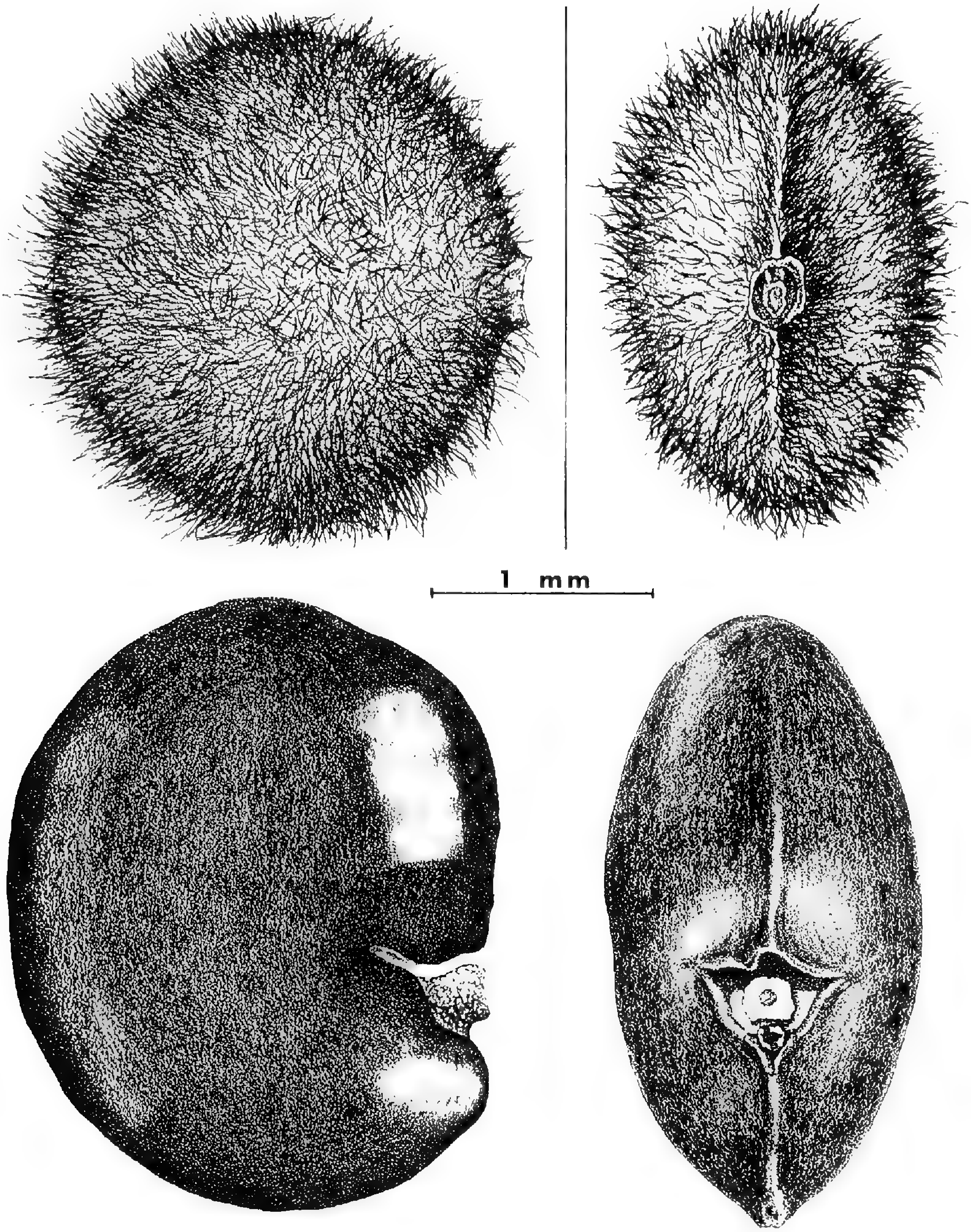

Fig. 1. *Rivina humilis* (top), *Phytolacca americana* (bottom).

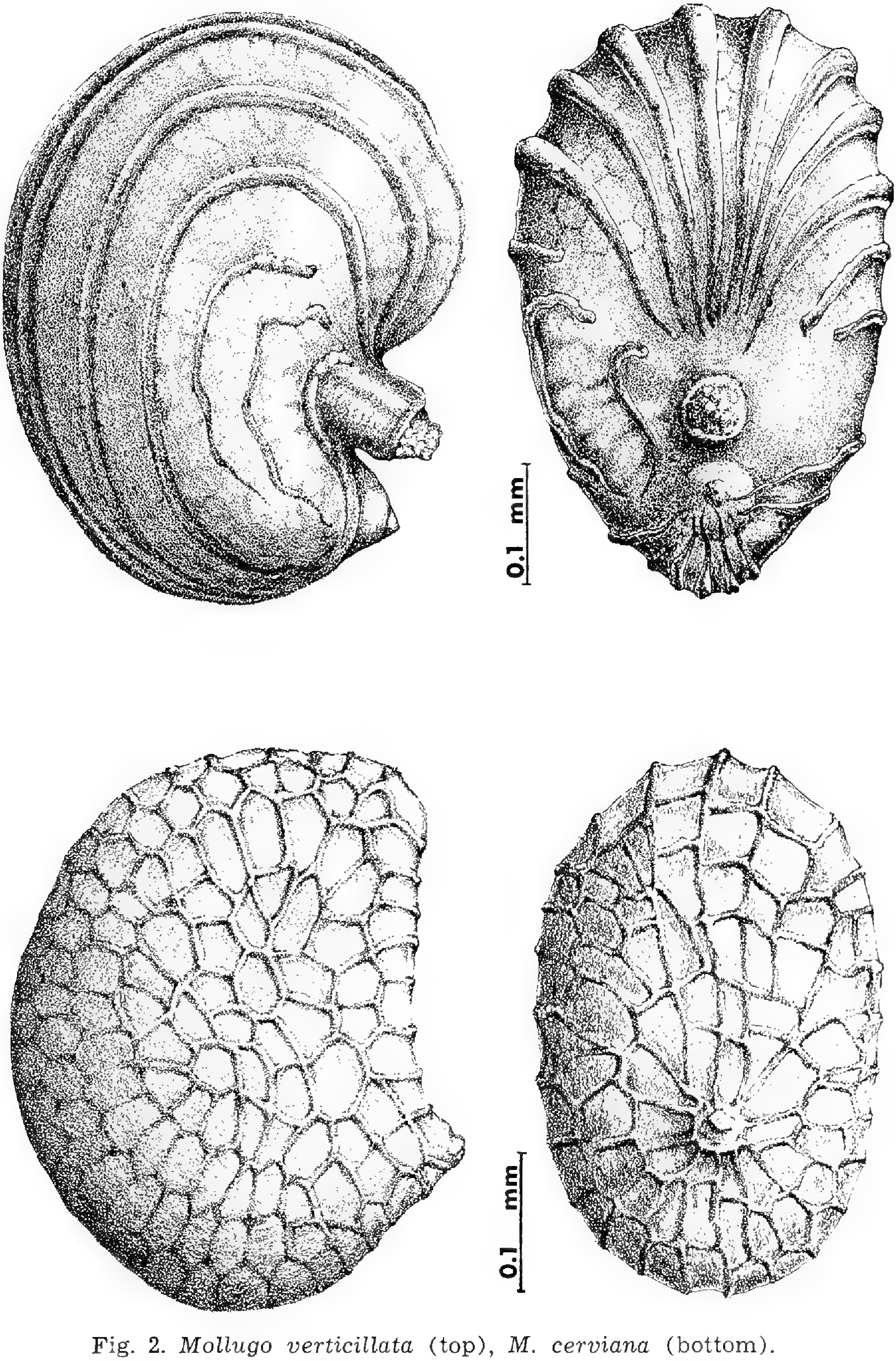

Fig. 2. *Mollugo verticillata* (top), *M. cerviana* (bottom).

AIZOACEAE

MOLLUGO

1. *Mollugo verticillata* L. Fig. 2 (top)

Fruit many seeded. Seed length 0.5-0.6 mm., width 0.4-0.5 mm.; shape asymmetrically reniform in lateral view, oval to somewhat ovoid in ventral view; color orange brown, highly glossy; testa smooth to strongly ribbed (see text below); hilar peg and hilar depression prominent; micropyle prominent.

The seeds of *Mollugo verticillata* are more variable than any others examined during the preparation of this paper. It is true, of course, that all the seeds studied showed a certain amount of variation in shape and size that appears to depend not so much on genetics (i.e., variation from individual to individual) as on the physical factors of position within the fruit and number of seeds maturing within the fruit. *Mollugo verticillata* seeds show such variation in shape and size, but they also show remarkable variation in sculpturing of the testa. Figure 2 (top) shows a *M. verticillata* seed with the maximum amount of ribbing that I have seen in this species. At the other extreme are those seeds without any ribbing at all but with entirely smooth testae. Between these extremes can be found every intermediate. Thus, seeds may have only one rib—this centrally on the dorsal surface. Increase in number of ribs takes place through development of a more or less equal number of additional ribs on either side of the central dorsal one, i.e., a three-ribbed seed has one rib on each side of the dorsal one, a five-ribbed seed has two ribs on each side of the dorsal one, etc.

I carried out mass collection studies of *M. verticillata* seeds to investigate possible causes of variation in sculpturing of the testa. From these studies I have concluded that position of seed within the fruit, position of fruit on the plant, number of seeds maturing within the fruit, and time of ripening of fruit (all of which *can* affect testa characteristics in some species) have little to do with these characteristics in *M. verticillata*. For the most part, the testae of all seeds borne by a single plant, and by all plants in a local population, are more often less similar in sculpturing. Thus of ten populations (separated from each other by at least ½ mile) studied by me in Lake, Porter, and La Porte counties, Indiana, six had smooth seeds, three had moderately ribbed seeds, and one had seeds with the maximum amount of ribbing (and was the source of the seed illustrated in Fig. 2 [top]). It can probably be safely concluded, therefore, that testa variation in *M. verticillata* is largely genetically controlled.

2. *Mollugo cerviana* (L.) Ser. in DC. Fig. 2 (bottom)

Fruit many seeded. Seed length 0.3-0.4 mm., width 0.3-0.4 mm.; shape asymmetrically hemioval in lateral view, oval to ellipsoid in ventral view; color orange brown; testa finely reticulate, the reticulations irregular in the central area of the lateral surfaces of the seed, becoming more or less scalariform on the dorsal surface and around the periphery of the lateral surfaces; hilum prominent.

GLINUS

1. *Glinus lotoides* L. Fig. 3 (top)

Fruit many seeded. Seeds strophiolate and with a persistent, long slender funiculus. Seed length 0.4-0.6 mm., width 0.3-0.4 mm; shape reniform (often asymmetrically so) in a lateral view, oblong to ovoid in ventral view; color of testa light to dark orange brown, highly glossy, of strophiole and funiculus white to yellow white; testa minutely tuberculate, strophiole obscurely reticulate; hilar depression shallow.

Seeds of the other species of *Glinus* in the United States, *G. radiatus* (Ruiz et Pavon) Rohrb., are similar in aspect to those of *G. lotoides*. They differ, however, in being somewhat smaller (length 0.4-0.5 mm., width 0.25-0.30 mm.) and in having a *smooth* testa. The seeds provide an easy means to distinguish these two species.

CYPSELEA

1. *Cypselea humifusa* Turp. Fig. 3 (bottom)

Fruit many seeded. Seed length 0.30-0.35 mm., width 0.20-0.25 mm.; shape reniform (often asymmetrically so) in lateral view, oval-ellipsoid in ventral view; color of testa brown to yellow brown, somewhat glossy; hilar area prominent, spongy, dull white, or not at all differentiated; testa very finely and obscurely reticulate; hilar depression shallow; hilar peg present or absent.

TRIANTHEMA Fig. 4 (top)

1. *Trianthema portulacastrum* L.

Fruit 3-10 seeded, with 1 or 2 of these seeds contained in the indehiscent apical portion. Seed length 1.5-2.0 mm., width 1.4-1.6 mm.; shape orbicular to reniform in lateral view, ellipsoid to oblong in ventral view; color brown black to black, slightly glossy; testa strongly rugose, the wrinkles low and rounded to steep-sided and angular at the summit; hilar depression prominent to almost lacking; hilar peg usually present, whitish.

The one or two seeds contained in the indehiscent apical "cap" of the fruit are usually slightly larger than those contained in the lower portion; they are also more nearly orbicular. Here, then, is a good example of the effect, on seed size and shape, of position in the fruit.

SESUVIUM

1. *Sesuvium portulacastrum* (L.) L. Fig. 4 (bottom)

Fruit many seeded. Seed length 1.0-1.5 mm., width 0.9-1.3 mm.; shape reniform (often asymmetrically so) to obtusely triangular in lateral view, oval-ellipsoid in ventral view; outermost layer of testa 1 cell thick, persistent or, at least in part, sloughing off, this layer nearly colorless, the testa below this layer brown black or black, glossy; testa nearly

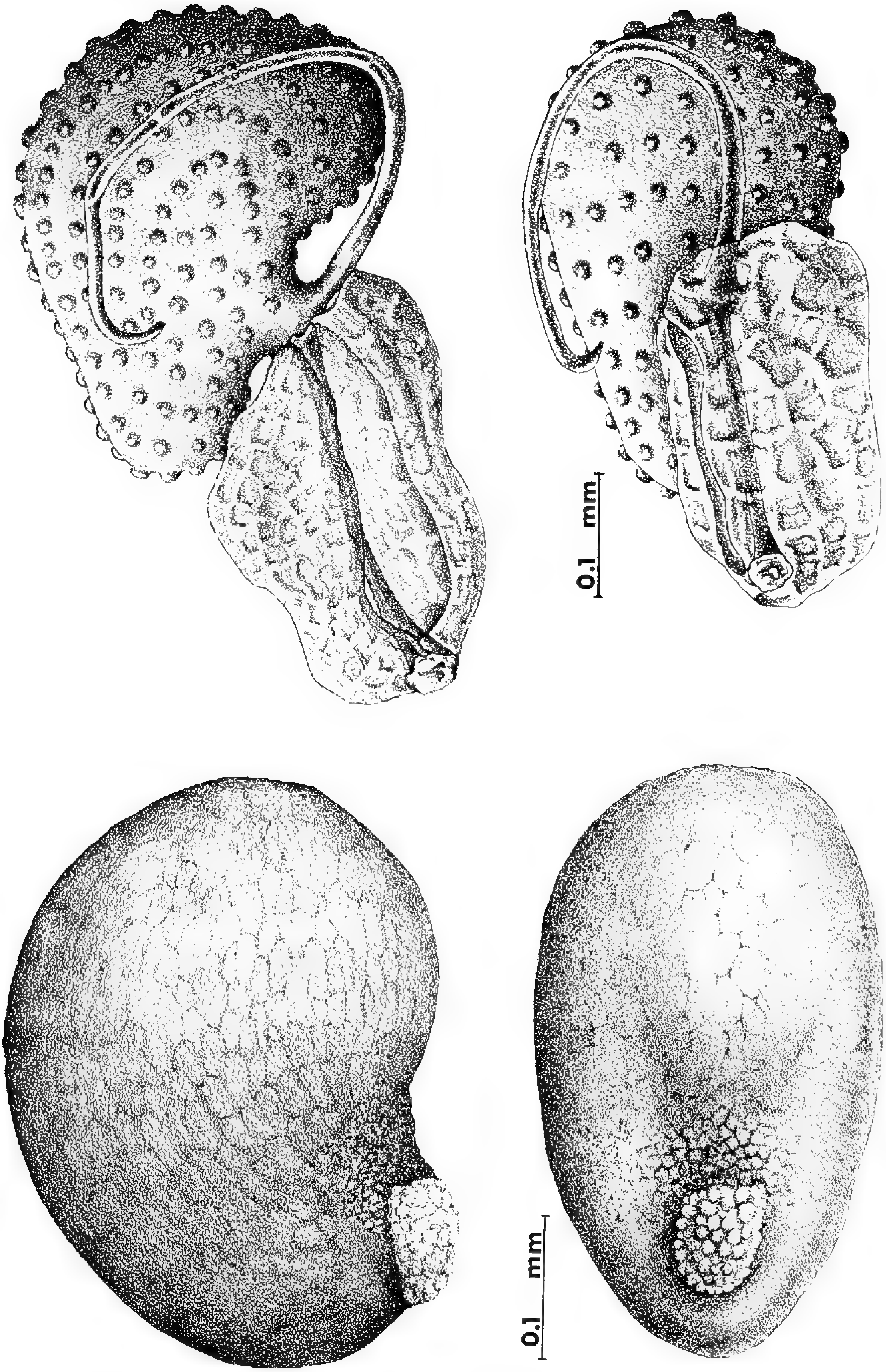

Fig. 3. *Glinus lotoides* (top), *Cypselea humifusa* (bottom).

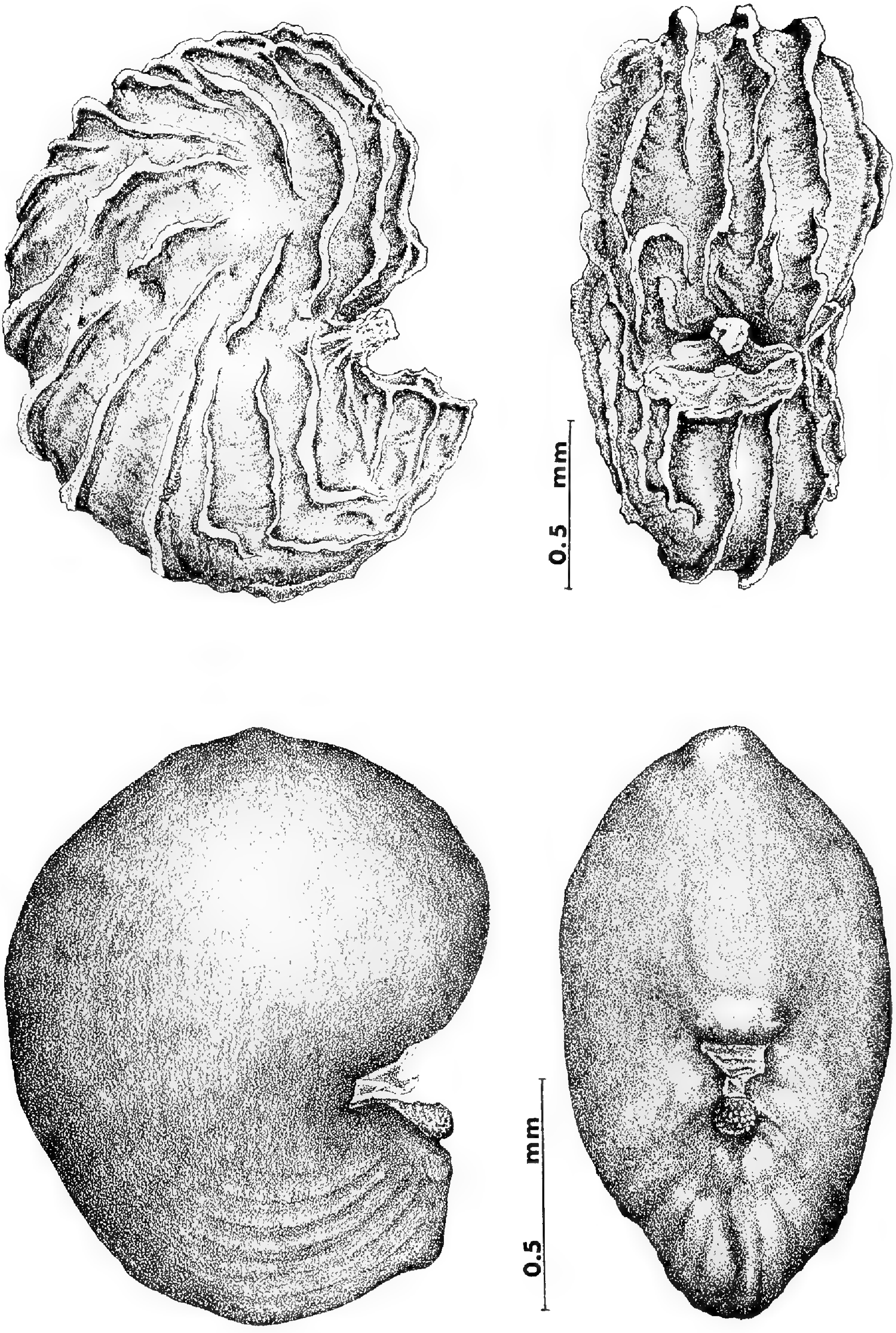

Fig. 4. *Trianthema portulacastrum* (top), *Sesuvium portulacastrum* (bottom).

smooth to irregularly puncticulate, sometimes with very faint, low, rounded ridges in the hilar quarter of the seed; hilar depression prominent; hilar peg usually present, whitish to brownish.

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THE DISTRIBUTION OF *RORIPPA SYLVESTRIS* (CRUCIFERAE) IN NORTH AMERICA[1, 2]

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Rorippa sylvestris (Linnaeus) Besser, creeping yellow cress, has been introduced into North America from Europe, and today it is quite common east of the Mississippi River in northeastern United States and southern Canada, where it grows along streams, rivers, and ditches, about ponds and dumps, and in gardens.

Data from the Literature

E. J. Hill (1909) reviewed the early history of the introduction and apparent spread of this species in eastern United States. According to Hill, *R. sylvestris* first received notice in American botany by Thomas Nuttall in his *Genera* (2: 68) and by William P. C. Barton in his *Compendium Florae Philadelphicae* (2: 55), both published in 1818. It was not mentioned by Barton in his earlier work, *Prodromus of the Flora of Philadelphia* (1815), nor in Henry Muhlenberg's *Catalogue* (1813), nor in Frederick Pursh's *Flora* (1814). Taking these dates as a starting point, Hill concluded that creeping yellow cress was introduced into the United States not far from that time, "since otherwise it could hardly have escaped the eyes of those who then represented the most active botanical center in the land."

Hill further wrote that the Philadelphia station was the only one in Torrey and Gray's *Flora of North America* (1838), Eaton and Wright's *Botany* (1840), and Wood's *Class Book* (1854), a reprint of the 1847 edition (*see* Merrill, Rhodora 50: 105. 1948). In Gray's *Manual* (1856) the entry was "wet meadows near Philadelphia; and Newton, Mass. *C. J. Sprague.*" In the fifth edition (1868) and the sixth edition (1889) of Gray's *Manual,* the range had been extended and was recorded as "Massachusetts to Virginia, rare." The range was further extended to "occasional from Massachusetts and Virginia to Ohio," in the Britton and Brown *Illustrated Flora* (1897). In Britton's *Manual* (1901) the range was "Newf. to Mass., Va. and Mich." By 1904 it had found a place in Beal's *Michigan Flora,* the single station being Detroit, but was not in the preceding catalogue of Beal and Wheeler (1892). A single station, Painesville (near Lake Erie), was mentioned in Kellerman and Wer-

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[1] Extracted from a portion of "Appendix II. Species Introduced into North America," of the author's doctoral dissertation, "The Taxonomy and Distribution of the Genus *Rorippa* (Cruciferae) in North America." The University of Michigan, Ann Arbor, msc. xiv + 482 p. 1965.

[2] Paper No. 715 from the Department of Bontany and Plant Pathology, The Ohio State University, Columbus 43210.

SIDA 2 (5): 361—376. 1966.

ner's *Catalogue of Ohio Plants* (1893). At length, Hill discussed the occurrence and spread of *R. sylvestris* in New York and added his own field observations made in western New York during the summers of 1882 and 1884.

Several other references are noteworthy. Hill (1892) reported it "quite abundant near Western Springs" and "at Salt Creek," both locaities being near Chicago. Mohr's *Plant Life of Alabama* (1901) recorded it from Mobile, Alabama, as "fully established in shallow marshes and muddy ditches . . . observed for the past fifteen years, constantly spreading." Fassett (1927) noted it "apparently a newcomer in Wisconsin," and he cited several collections, the earliest made in 1912. West of the Mississippi River, *R. sylvestris* was not recorded until 1941 by Peck who listed it from the Willamette Valley in his *Manual of Higher Plants of Oregon*. Howell (1946) regarded a collection "made at Mud Bay, Thurston County, by M. J. Forsell on Sept. 1, 1945," as probably the first collection from the state of Washington. However, I have seen an earlier collection from Washington made at Lake Crescent by G. N. Jones *(3493 PH)* in July 1931. In a *Handbook of North Dakota Plants*, Stevens (1950) gave its occurrence in that state as ". . . Fargo, apparently well established in 1922 but has not been seen since. The location was probably destroyed by building operations." Apparently the first report for Iowa was given by Thorne (1954) based on collections made in 1951 and 1952, but earlier collections from that state are known (see specimen citations). Several localities are given in the *Arizona Flora* by Kearney and Peebles (1951), in the *Flora of Missouri* by Steyermark (1963), and in the *Vascular Plants of the Pacific Northwest* by Hitchcock and Cronquist (1964). I have not seen specimens from Arizona. The report of *Radicula sylvestris* from the Mogollon Mountains in the *Flora of New Mexico* by Wooton and Standley (1915) was based on a specimen of *Rorippa microtitis*, a species native to the highlands of western New Mexico, central Arizona, and northern Chihuahua. In *A Flora of Northeastern Minnesota*, Lakela (1965) gives one locality for St. Louis County. In southeastern United States, Radford, Ahles, and Bell include *R. sylvestris* from Orange County, North Carolina, in their *Atlas of the Vascular Flora of the Carolinas* (1965). I have not seen the specimens supporting these two recent reports.

Data from the Specimens

These statements from the literature suggested that it would be worthwhile to map *R. sylvestris* in such a manner so as to show the apparent spread of this species in the United States from its several points of introduction or presumed introduction based on the time when collections were made. I divided the collecting periods into 20-year intervals, and assigned the earliest period, those collections made before 1839, the number 1. Plants collected between 1840 and 1859 are mapped as number 2.

Table 1 presents a complete list of the numbers used and their meaning. The resulting map is figure 1. Having had access to the specimens on which most of the literature records given above were based, I have been able to verify these early reports. These authors, except where noted, have correctly reported *R. sylvestris*, and my map therefore is in agreement with the data from the literature. A study of this map shows that symbol 1, or collections made before 1839, occurs in two locations—Philadelphia, where Nuttall collected and reported it as early as 1818 (specimen at PH), and at St. Louis where Thomas Basil collected it June 1837, (NY). Symbol 2, or collections taken between 1840-1859, occurs only once. This is the collection made at Newton, Massachusetts, by C. J. Sprague, (specimen at GH) which was cited in Gray's *Manual* of 1856. Collections made between 1860-1879, symbol 3, come from several localities on the east coast. Between 1880-1889, several inland stations are noted, especially at Clevland, Sandusky, Detroit, and Chicago on the Great Lakes, and at the southern seaport cities of Mobile and New Orleans. *R. sylvestris* was not obtained until after 1900 (1916) in Wisconsin, until after 1920 (1927) in Iowa, and until after 1900 (1919) in the west coast states. It was not known from Colorado, Montana, or Idaho until I found it on my western plant collecting trip in 1963. The exact dates of collections and localities are given in the list of specimens cited.

Distribution in Canada

My map does not show the distribution of *R. sylvestris* in certain parts of Canada. According to Groh (1936), creeping yellow cress was found in eastern Canada as early as June 10, 1897, from Ontario where most of the collections have been made in that country. It has also gained a foothold in western Canada, especially in the upper Columbia River valley and sparingly in the extensive drier territory of the plains. The following records, which supplement the list of Canadian specimens cited, have been taken from the available Canadian literature. These records will give some idea of its occurrence in the region north of my map.

ALBERTA: "Reported" (E. H. Moss. 1959. Flora of Alberta, Toronto p. 267).

BRITISH COLUMBIA: "Vancouver; Windermere in the Columbia valley" (H. Groh. 1936. Sci. Agr. 16: 331); "Prince Rupert and Smithers, 1939; Revelstock and lower Fraser Valley" (H. Groh. 1941. Canad. Field-Nat. 55: 55).

MANITOBA: "Known in the province only from Morden, where it was collected by H. Marshall in 1941. First report" (H. J. Scoggan. 1957. Natl. Mus. Canada. Bull. No. 140. p. 321).

ONTARIO: "W. C. McCalla, from a roadside near Ball's Mills, Lincoln Co. . . ., June 10, 1897" (H. Groh. 1936. *op. cit.)*; "Amos, around farm

buildings . . . August 16, 1953. No. 5502. Found only once and apparently a rare weed in the Clay Belt. Not reported northward" (W. K. W. Baldwin. 1958. Natl. Mus. Canada Bull. 156. p. 166).

SASKATCHEWAN: ". . . In cultivated fields and gardens. Regina, Leader (DAO)" (A. J. Breitung. 1957. Am. Midl. Nat. 58: 36).

Evidence for an Introduced Status

In the absence of a statement that a plant has actually been introduced from one part of the world to another part of the world, one must evaluate evidence from various sources. The contention that *R. sylvestris* grew in North America before the spread of European man on this continent has no validity. If *R. sylvestris* had been growing in central and western United States as a native species, it would by now have been collected many times. Such native *Rorippa* species as *R. sessiliflora, R. curvipes, R. curvisiliqua, R. sinuata,* and *R. islandica* are all represented by many collections from parts of the United States west of the Mississippi River (*see* Stuckey, 1965, for specimen citations and maps). If *R. sylvestris,* which grows in the same kinds of habitats, was also there, it would have been collected. The botanists of the early exploring expeditions, who often traveled the rivers where *Rorippa* commonly grows, found and collected the native species of *Rorippa,* but they did not find *R. sylvestris* (*see* Stuckey, 1965, especially p. 49).

Recently, I have been engaged in studying plant collections of the pioneer Ohio—and some of the other midwestern—naturalists of the period 1800-1840 (Stuckey, 1964; Stuckey, 1966). *R. sylvestris* was not found in the collections of John Samples (MICH), W. S. Sullivant (OS), or M. G. Williams (Urbana Junior College, Urbana, Ohio); nor was it found in the herbaria where a major portion of the collections of

Table 1. Significant collections of *Rorippa sylvestris* during each twenty-year period and definition of symbols used in map opposite.

Symbol	*Date*	*Significant collections*
1	before 1839	at Philadelphia and St. Louis only
2	from 1840 through 1859	near Boston only
3	from 1860 through 1879	several eastern seaport cities
4	from 1880 through 1899	southern seaport cities and along the Great Lakes
5	from 1900 through 1919	first collections from Wisconsin, Minnesota, and North Dakota; introduced on the west coast
6	from 1920 through 1939	first collection from Iowa
7	from 1940 through 1959	spreading in the east and midwest
8	since 1960	first reports for Colorado, Montana, and Idaho

J. W. VanCleve (PH), T. G. Lea (PH), C. S. Rafinesque (PH), and C. W. Short (PH) are deposited. Others could be listed. Each one of these naturalists, except Samples, did collect a specimen of the native *R. islandica*. These negative data further support the fact that *R. sylvestris* apparently did not reach midwestern United States until after the time of these naturalists. As a further example, in a well-collected area such as the Douglas Lake region of Michigan, *R. sylvestris* was not found until 1954 *(Voss 2380, UMBS)*.

Factors Favoring the Spread of Creeping Yellow Cress

R. sylvestris spreads profusely by creeping roots[3] which bud many times and send up new plants. Each offspring further spreads by forming new buds and new plants from its roots. Soon a massive colony is formed. This phenomenon was repeatedly observed in plants growing in the greenhouse. As soon as a young plant becomes pot-bound, usually after about two weeks' growth, young rosettes begin to appear in the medium in which the pots were placed. These rosettes grow from the roots of the parent plant and soon many plants are formed. After several of these rosettes were planted along the edge of a pond at the University of Michigan Botanical Gardens, they quickly grew into a large clone. The plants may often spread into much drier soils such as on the bank of a river or pond after having become established in the more moist areas adjacent to the water. Even if the roots become broken up or are subjected to dry conditions for some time, they remain viable and are capable of budding when favorable conditions return. A small fragment of a root or stem may be carried in a stream or river, on logs or other debris, or on the feet, feathers, or beaks of birds, and then deposited in another favorable moist habitat. Here the plant can resume growth, become established, and produce another colony. The avenues of streams, rivers, ditches, railroads, highways, and the transport of garden and nursery stock have all undoubtedly aided in spreading *R. sylvestris* throughout eastern United States. Groh (1936) believed that the movement of nursery stock has played a prominent part in establishing new colonies of creeping yellow cress, both from within the Canadian border, and from abroad. In fact the spread of *R. sylvestris* has probably been almost totally limited to vegetative reproduction. Seldom do the plants produce seeds. Almost all of the herbarium specimens examined that had mature siliques were void of seed. None of my plants in the greenhouse produced seeds. Jonsell (1964) has reported that seed-setting in *R. sylvestris* is rare in Scandinavia where the species is also introduced. Allard (1959) put on record the observance of a completely sterile plant

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[3] The tissue in the center of these underground parts in xylem. I am indebted to Dr. David H. Benzing, now of the Department of Biology, Oberlin College, Oberlin, Ohio, for preparing stained cross-sections of these roots.

in which the flowers remained closed, the petals scarcely equaled the sepals, the anther sacs failed to develop, and no viable pollen was produced. I have seen his specimen (US), and this plant does have the unopened flowers. Here is a species in which sexual reproduction may be entirely suppressed. It is therefore evident that the production and dispersal of seeds has played at most only a minor role in the spread of *R. sylvestris* in North America.

Summary

Although these data may have certain limitations in interpreting the apparent spread of *R. sylvestris* in North America, nevertheless they are the only ones available. Some plants may have been in an area long before they were collected, and *R. sylvestris* is undoubtedly growing in places in North America where it has not yet been collected or reported. However, several generalizations can be made about the spread of *R. sylvestris* in the United States. We do not know how many times *R. sylvestris* was separately introduced from Europe. It seems to me that the areas around Philadelphia, St. Louis, Boston, Washington, D. C., New York City, Mobile, New Orleans, the Great Lake ports listed above, and the stations in west coast states probably all represent collections from colonies that were established by separate introductions either from Europe or from an already existing colony in North America. From these places, as well as other less obvious or unrecorded localities in North America, *R. sylvestris* has spread. Very early (before 1900) it became established in the North Atlantic coast states as indicated by the abundance of symbols 3, 4, and 5, but it did not spread and become established until after 1900 in the midwestern states. At the present time it appears to be established in certain western states, such as Colorado, Idaho, Montana, Oregon, and Washington. The rapidity with which the plants reproduce by vegetative propagation has undoubtedly aided in its spread on the continent. Dispersal by seed has played little or no role in bringing about the present distribution in North America.

Acknowledgments

I am indebted to many people who have aided me in my study of the genus *Rorippa*. A detailed list is included in my doctoral dissertation (Stuckey, 1965). To Dr. Edward G. Voss I am particularly grateful for his services as adviser, teacher, editor, and consultant. To the Herbarium and Botanical Gardens of the University of Michigan I am indebted for use of their facilities, where this investigation was carried out, and to the Horace H. Rackham School of Graduate Studies (the University of Michigan) and the National Science Foundation for financial support. My thanks are also extended to the curators of the various herbaria whose specimens were studied.

SPECIMENS EXAMINED[4]

CANADA: BRITISH COLUMBIA: Occasional at edge of marsh, s end of Mara Lake, s of Sicamous, 20 Jul 1953, *J. A. Calder, D. B. O. Saville 10773* (US); a number of patches extending for 50 ft, not seen elsewhere, 3 mi n U. S. A. border on Halls Prairie, road s of Cloverdale, 27 Jun 1955, *D. Lindsay, W. Woodbury 1188* (US).

ONTARIO: HALDIMAND CO.: Shallow water, Grand River, Oneida Twp., 1 mi n of York, *B. Miller 344* (HAM); Caledonia, 28 Jun 1939, *J. J. Stroud 446* (NY). HURON CO.: Platiers calcaires de la riviere, Goderich, 7 Jul 1936, *M.-Victorin, R.-Germain, F. Dominique 45986* (GH). WATERLOO CO.: Grand River bank, Doon, 2 Jul 1939, *E. L. James 190* (HAM); Galt, 28 Jun 1901, *J. Macoun 33850* (GH, NY, US); on limestone rock, river bank ½ mi below Galt, 26 Aug 1939, *F. H. Montgomery 188* (HAM). WELLINGTON CO.: Fields, etc., Guelph, 29 Jun 1923, *J. H. Soper s.n.* (GH). [WENTWORTH CO.]: Banks of canals, S, Area 20, banks of old creek at canal crossing (21) [near Hamilton], 10 Jul 1957, *A. Tamsalu 2999* (HAM).

NEW BRUNSWICK: Railroad track to salt marsh near St. Andrews & surrounding woods, 16 Jul 1929, *M. O. Malte 29829* (GH); roadside, New Castle, 30 Jul 1922, *M. L. Fernald, A. S. Pease 25105* (GH).

NEWFOUNDLAND: Weed in a garden, pools in the marsh near the mouth of Spruce Brook, St. George's Pond, Silurian Region between Bay St. George and Bay of Islands, 19 Aug. 1910, *3482* (GH, NY, US), ledges and gravel along Waterford River between Waterford Bridge and St. John's Eastern Avalon Peninsula, 1 Aug 1911, *5483* (GH, NY, PH), both *M. L. Fernald, K. M. Wiegand;* banks of Rennie's River, St. John's, 4 Aug 1894, *B. L. Robinson, H. Schrenk s.n.* (GH); Humber District, open places near the city dump, Corner Brook, Dormston Farm, 7 Aug 1943, *3825* (NY, US), St. Johns East District, waste places near roadside, ca. 0.7 mi n of St. John's near Russell Place, 8 Aug 1960, *6062* (FSU, NY, US), both *E. Rouleau.*

QUEBEC: ARGENTEUIL CO.: rives rocheuses du lac St.-Adolphe, 24 Jul 1955, *R.-Germain 6263* (FSU, US); le long du vieux canal, sur les talus herbeux, Carillon, 8 Jul 1933, *M-Victorin, R.-Germain, J. Brunes 45298* (GH); sur les bords du canal, Carillon 28 Jun 1931, *M.-Victorin, R.-Germain 43780* (GH). BERTHIER CO.: rivages humides du St.-Laurent, Lanoraie, 6 Jul 1932, *M.-Victorin, R-Germain 49209* (GH, ND). [CHAMBY CO.]: Ile de Boucherville, pres de Boucherville, au bord d'un étang

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[4] The following list of cited specimens is selected and represents mostly those to which the symbols on the map refer. Nearly all of those specimens seen from Canada and those seen from west of the Allegheny Mountains in the United States are cited. Collections from the east coast states are more plentiful, and the intent has been to cite and map the oldest collections for any locality. For a complete list of all specimens seen and cited in this study, consult Stuckey (1965).

á l'interieur de l'ile, 28 Jun 1934, *R.-Germain 43390* (GH). HOCHELAGE CO.: Sur une ile, Riviere-des-Prairies, 6 Jun 1931, *M.-Victorin, R.-Germain* 46752 (PH). NICOLET CO.: Sur les greves du fleuve en dehors de l'influence de la marée, Saint-Pierre-les Becquets, 28 July 1933, *M.-Victorin, R.-Germain, R.-Meilleur 44431* (GH, ND). [RICHELIEU-VERCHERES CO.]: Saint-Aime, 13 Jul 1926, *F. Adrien 1194* (GH). [SHEFFORD CO.]: Autour des habitations, Granby, 5 Jul 1947, *F. Allyre 1975* (GH). STANSTEAD CO.: Sur les sables au bord du lac, Magog, 1 Jul 1943, *M.-Victorin, R.-Germain, E. Rouleau, M. Raymond 2006* (NY). [TERREBONNE CO.]: Ste. Agathe des Monts, 30 Jul 1938, *H. Groh s.n.* (WIS). VAUDREUIL CO.: Rigaud, 9 Jul 1934, *E. Roy 3218* (WIS). YAMASKA CO.: Prairie labourée par les glaces du printemps, Yamaska, 22 Aug 1943, *M.-Victorin, R.-Germain, E. Rouleau 2213* (WIS); Yamaska, 17 Jul 1926, *F. Adrien 1220* (GH). YAMASKA EST CO.: Embouchure de la riviere, 13 Jul 1927, *F. Adrien 1752* (GH).

UNITED STATES: ALABAMA: [MOBILE CO.]: Naturalized, introduced with ballast, ditches near the river, Mobile, 5 Oct 1883 (US), borders of ditches, plentiful near the S. & H. R. A. shops, introduced with ballast fr[om] Europe, near the w[h]arves, Mobile, 22 May 1884 (US), naturalized, ditches, Mobile, 26 Apr 1896 (NY), all *C. Mohr s.n.*

COLORADO: BOULDER CO.: Local along w side of muddy bank of Boulder and White Rock Ditch near Hayden Lake, NW ¼ Sec. 21, T1N, R70W, near Boulder Airport, ca. 2 mi e of Boulder, 7 Jul 1963, *R. L. Stuckey 1737* (MICH).

CONNECTICUT: [FAIRFIELD CO.]: At water edge of Housatonic River, Sandy Hook, 15 Jul 1896, *J. K. Goodrich s.n.* (NY); along the Housatonic, Stratford, 9 Jun 1901, *E. F. Williams s.n.* (GH). HARTFORD CO.: Abundant, banks of the Conn[ecticut] River, East Windsor, 21 Jul 1895, *C. H. Bissell* (GH); introduced with grass seed, Granby, 3 Jul 1929, *I. Holcomb s.n.* (GH). LITCHFIELD CO.: Moist field, Winstead, 22 Jun 1913, *A. E. Blewitt s.n.* (NEBC). [MIDDLESEX CO.]: Ditch, Cromwell, 23 Jun 1889, *J. H. Barnhart 313* (NY); meadows along Connecticut River, East Haddam, 18 Jun 1918, *C. A. Weatherby 4299* (NEBC). [NEW HAVEN CO.]: By roadside, Waterbury, 20 Jun 1915, *A. E. Blewitt 3475* (NEBC, PH). NEW LONDON CO.: Greenville, 10 Jul 1884, *G. R. Lumsdem s.n.* (OC).

DELAWARE: [NEW CASTLE CO.]: Wilmington, Apr 1865, *E. Tatnall s.n.* (NY); river shore, above New Castle, 30 Jun 1896, *A. Commons s.n.* (GH, NY, PH).

DISTRICT OF COLUMBIA: In vicinis Washington, D. C., 27 May 1873, *J. W. Chickering, Jr. s.n.* (NY).

IDAHO: BONNER CO.: Local in wet depression in sandy rocky soil on beach at Lake Pend Oreille, Samowen Campground, ca. 18 mi e Sand

Point, 16 Jul 1963, *1898*, local along sandy-muddy shore of Lake Pend Oreille, Public Beach at Sand Point, 17 Jul 1963, *1901*, both *R. L. Stuckey* (MICH).

ILLINOIS: [BROWN CO.]: Low prairie, LaGrange, Jul 1901, *L. M. Umbach s.n.* (WIS 12986). [COOK CO.]: By salt creek and adjacent roadsides, Western Springs, 30 May 1890, *E. J. Hill 83* (ILL); Chicago, 27 Aug 1893, *C. D. Lippincott s.n.* (PH). [DUPAGE CO.]: Borders of pools, Lemont, 29 Jun 1898, *E. J. Hill 89* (ILL). FULTON CO.: Local, one colony of about 8 plants growing beside garbage barrel in camp ground on shore of Anderson Lake, ca. 4 mi n of Bluff City, 20 Jun 1963, *R. L. Stuckey 1599* (MICH). HANCOCK CO.: Underground parts interconnected, two colonies growing on the high dry floodplain bank of the Mississippi River, ca. 4 mi s of Warsaw, 21 Jun 1963, *R. L. Stuckey 1614, 1615* (MICH). HENDERSON CO.: Underground parts interconnected, locally abundant in colonies in sandy loamy soil on drying floodplain bank of slough of the Mississippi River, at Shokaquon, ca. 5.5 mi s of Gulfport, 22 Jun 1963, *R. L. Stuckey 1617* (MICH). JACKSON CO.: Grand Tower, May 1902, *H. A. Gleason s.n.* (GH). MASON CO.: Along river, Havana, 1894, *G. P. Clinton 2378* (GH). [PEORIA CO.]: Low pasture along Illinois River, s of Chillicothe, 18 Jun 1922, *V. H. Chase 3947* (NY); alluvial bottom lands of Illinois River, Peoria, Jun 1903, *F. E. McDonald s.n.* (GH). TAZWELL CO.: Low ground, along Illinois River, near East Peoria, 11 Jul 1919, *V. H. Chase 3175* (NY). [WILL CO.]: Lockport, 29 Jun 1905, *H. C. Skeels 620* (GH, NY); low woods, Romeo, 18 Jul 1898, *L. M. Umbach s.n.* (WIS 8686).

INDIANA: CARROLL CO.: Low field along Wildcat Creek and Rd. 22, 0.2 mi w of Howard-Carroll County line, 19 Jun 1943, *R. C. Friesner 17712* (GH, MICH, MO, OC, WIS.) FULTON CO.: In mud of the e bank of the Tippecanoe River, ca. 2 mi s of Talma, 27 Jun 1961, *N. C. Henderson 61-469* (FSU). HOWARD CO.: Low place, Melfalfa Park, 8 Jun 1938, *E. M. Ek 160* (US). HUNTINGTON CO.: In low field along the Wabash River, 2 mi s of Huntington, 5 Jun 1959, *N. C. Henderson s.n.* (FSU). LAWRENCE CO.: Moist bank of slough ½ mi e of Williams, 5 Jun 1934, *R. M. Kriebel 1946* (GH). [MARION CO.]: Indianapolis, 13 Jun 1919, *G. L. Fisher 21* (US). MARSHALL CO.: Roadside along Ind. No. 10, ca. 1 mi e of Argos, 15 Jul 1961, *N. C. Henderson 61-608* (FSU). [ST. JOSEPH CO.]: On lawn, Notre Dame, 1816, *J. A. Nieuwland s.n.* (ND). VERMILLION CO.: In shaded border of gravelly lane on s side of gravel pit, on road 63, 2 mi n of Clinton, 23 Jun 1945, *R. C. Friesner 19166* (GH, NY). [WELLS CO.]: On banks of the Wabash River at Bluffton, 7 Sep 1939, *F. T. McFarland, H. T. Shacklette, J. Lyle 3663* (MICH).

IOWA: [BLACK HAWK CO.]: Cedar Falls, 18 Jul 1927, *L. H. Pammel s.n.* (PH). CASS CO.: Marsh 1 mi n of Griswold, 8 Jul 1952, *M. J. Fay*

3464 (WIS). CLAY CO.: On moist soil, bank of the Little Sioux River at Gillett Grove, 16 Jul 1936, *5004* (GH, NY, PH, US), along the bank of the Little Sioux River with other weeds, 2 mi e of Spencer, 3 Jul 1940, *7421* (PH, WIS), both *A. Hayden.* JOHNSON CO.: Iowa River bank near the S U I Memorial Union, Iowa City, 2 Jul 1951, *M. J. Fay s.n.* (US). MUSCATINE CO.: Few plants in sandy-muddy soil along Mississippi River, Shady Creek Public Area, 10 mi e of Muscatine, 23 June 1963, *1626,* one colony growing on bank of the Mississippi River, ca. 4 mi e of Muscatine, 23 Jun 1963, *1628,* both *R. L. Stuckey* (MICH). PLYMOUTH CO.: Wet roadside w of Brunsville, 26 Jul 1938, *A. Hayden 11257* (NY, US).

KENTUCKY: CARROLL CO.: Pond margins, Butler State Park, 17 Jul 1940, *E. L. Braun 3173* (GH). FULTON CO.: Swampy meadow, s w of Hickman, 21 Jul 1937, *L. B. Smith, A. R. Hodgdon 4124* (GH, US). HICKMAN CO.: Bottom-land of the Mississippi River, Columbus, 28 Jun 1940, *H. A. Gleason 8974* (NY, WIS). JEFFERSON CO.: Swamps, Indian Hills swamp, 500 ft, 11 Jul 1939, *M. Seargent 59* (GH). JESSAMINE CO.: Sandy banks of Kentucky River, 14 May 1939, *F. T. McFarland 3238* (MICH).

LOUISIANA: [ORLEANS]: Near New Orleans, 3 Jun 1885, *W. B. Waite s.n.* (US). PLAQUEMINES: Roadsides, Pointe a la Hache, Jun 1885, *A. B. Langlois 4* (MICH).

MAINE: CUMBERLAND CO.: Roadside, Deering Junction, 11 Jul 1907, *E. B. Chamberlain 955* (NEBC). FRANKLIN CO.: Roadside, introduced in nurseryman's packing, Farmington, 10 Aug 1912, *C. H. Knowlton s.n.* (NEBC). HANCOCK CO.: Waste place, county road, Seal Harbor, Mount Desert Island, 4 Aug 1931, *G. L. Stebbins s.n.* (NEBC). KNOX CO.: Gravel beach, Rockport, 13 Aug 1913, *M. L. Fernald 9554* (NEBC). SAGADOHOC CO.: Bath, 12 Jul 1913, *K. Furbish s.n.* (NEBC). WASHINGTON CO.: Garden weed, Marshfield, 16 Aug 1936, *C. H. Knowlton s.n.* (NEBC). YORK CO.: Green Island, Cape Porpoise, 27 Jul 1894, *F. H. Manningly s.n.* (NEBC); common weed in yards, Kennebunkport, 17 Jul 1902, *A. S. Pease 1506* (NEBC).

MARYLAND [BALTIMORE CO.]: Baltimore, 18 May 1889, *W. Whitney s.n.* (OC). MONTGOMERY CO.: Cabin John, 26 May 1896, *E. S. Steele s.n.* (US). [PRINCE GEORGES CO.]: Open field near mouth of the Sligo, 27 May 1915, *P. C. Standley 11586* (US).

MASSACHUSETTS: [BARNSTABLE CO.]: Dry, gravelly soil, edge of Wood Pond, w of Gardina Rd., Woods Hole, 15 Jul 1923, *J. M. Fogg, Jr. s.n.* (PH). BERKSHIRE CO.: River meadow, Sheffield, 12 Jun 1919, *J. R. Churchill s.n.* (GH, NEBC); border of brook, Adams, 12 Aug 1901, *M. A. Day 104* (GH). ESSEX CO.: In grass, Coolidge Pt., Magnolia, 20 Sep 1911, *C. H. Clarke s.n.* (GH); beds of Corliss Bros. Nurseries, Ipswich, 21 Jun 1955, *10231,* Town dump, Clark Street, North Andover, 7 Jul 1958, *18024,* both *S. K. Harris* (NEBC). FRANKLIN CO.: Shelburne, Jul 1876, *Miss S. E. Anderson s.n.* (MICH); banks of the Conn[ecticut] River, Montaque, 27 Jul 1887, *W. Deane s.n.* (GH, NEBC, NY). HAMPSHIRE CO.: Northampton, 18 Jun 1890, *G. G. Kennedy 2* (GH). MIDDLESEX CO.: In a meadow on the banks of Charles River, [after 1838, but before 1856], *C. J. Sprague s.n.* (GH). NORFOLK CO.: Near 1st, R. R. Bridge, Newton Lower Falls, in the vicinity of Wellesley College Campus, 27 Jul 1908, *M. Heatley, K. M. Wiegand s.n.* (WIS). NANTUCKET CO.: Dump, Milk St., Nantucket, 23 Aug 1913, *C. Schweinfurth s.n.* (NEBC). [PLYMOUTH CO.]: Hingham, 5 Oct 1887, *J. R. Churchill s.n.* (NY). WORCESTER CO.: Ponds, W. Brookfield, 12 Jul 1881, *B. P. Clark s.n.* (NEBC); a considerable colony in cinders, entrance to paper salvage mill, on n side of the building, Brookfield, 24 Jul 1948, *B. N. Gates 23203* (NEBC, WIS).

MICHIGAN: ALLEGAN CO.: Green Lake, 27 Jun 1941, *C. W. Bazuin 3079* (MSC). CLINTON CO.: Uncommon, silver maple swamp forest, s side of Maple River, Sec. 15, Lebanon Twp., ca. 4 mi s w of Maple Rapids, 23 Jul 1960, *E. G. Voss 9655* (MICH). EMMET CO.: Scarce, in moist rocky ground along shore of Crooked Lake, Sec. 15, Littlefield Twp., 6 Aug 1954, *E. G. Voss 2380* (UMBS). INGHAM CO.: Campus of Michigan State College, East Lansing, 9 Jun 1923, *C. Billington s.n.* (MICH). KENT CO.: Wet, sandy, Plymouth Road near Leonard St., Grand Rapids, 12 Jul 1943, *C. W. Bazuin 5516* (MSC). MACOMB CO.: Damp soil along Red Run River, near 14 mile road, 14 Jul 1951, *C. M. Rogers 7894* (WUD). MARQUETTE CO.: Turin, 8 Jul 1901, *B. Barlow s.n.* (MSC). ST. CLAIR CO.: Damp ground, near Smith Creek, 12 Jul 1911, *C. K. Dodge 155* (MSC). SHIAWASSEE CO.: Depression in cultivated field, Hazelton Twp., 15 Jul 1947, *G. W. Parmelee 223* (MSC). WAYNE CO.: Flat Rock, 1 Jul 1925, *7453* (BLH, MICH), banks of Rouge River, Livonia, 2 Sep 1930, *8749* (BLH, MICH), all *O. A. Farwell;* Detroit, 17 Jul 1891, *G. Suttie 620* (MICH). WASHTENAW CO.: South Huron St., Ypsilanti, 18 Jul 1918, *B. A. Walpole 40* (BLH); weed, U. of M. Botanical Gardens, 2 Aug 1946, *C. M. Rogers 3870* (WUD).

MINNESOTA: WABASKA CO.: Damp ground, Mississippi R[iver] bottoms, Wabasha, 9 Aug 1926, *N. C. Fassett, N .Hotchkiss 2900* (GH).

MISSISSIPPI: JEFFERSON CO.: Roadside, Natchez Trace Parkway, 23 Apr 1948, *W. B. McDougall 1605* (US).

MISSOURI: MISSISSIPPI CO.: Wet ditches around Wolf Island, 2 May 1936, *J. A. Steyermark 10280* (MO). NEW MADRID CO.: Swampy woods near East Bayou, Sec. 11, T23N, R15E, 2 mi w of Bayouville, 18 May 1950, *J. A. Steyermark 69690* (MO). NEWTON CO.: Moist rocky ground, along banks of Hickory Creek, Neosho, 29 June 1954, *E. J. Palmer 58083* (WIS). [ST. LOUIS CO.]: Ad riam pr. St. Louis, Jun 1837, *T. Basil s.n.* (NY).

MONTANA: SANDERS CO.: Locally abundant in waste areas where water flowed earlier in the year, along back water ditch of the Clark Fork River, ca. 2 mi w of Plains, 15 Jul 1963, *1889*, locally abundant along bank of Clark Fork River, at Paradise, 15 Jul 1963, *1893*, both *R. L. Stuckey* (MICH).

NEW HAMPSHIRE: [CARROLL CO.]: Kearsarge, Jul 1924, *R. S. Barlow s.n.* (NY). CHESHIRE CO.: Abundant, swale on bank of Conn[ecticut] R[iver], Walpole, 19 Jun 1932, *R. J. Eaton, L. Griscom s.n.* (NEBC): alluvial ground, Westmoreland, 5 Aug 1899, *H. W. Webster, M. L. Fernald 76* (GH, NEBC). COOS CO.: Weed in vegetable garden, Philbrook Farm, Shelburne, 15 Aug 1917, *W. Deane s.n.*; dump 2 mi n of town, Berlin, 3 Aug 1915, *16502* (NEBC), spreading around a camp, Martin Meadow Pond, Lancaster, 22 Jul 1927, *20079* (NEBC), weed in P. W. Bridgman's garden, Randolph, 8 Aug 1936, *25626* (GH, NEBC), garden weed, Colebrook, 28 Jul 1937, *25980* (NEBC), gravelly bank of John's R[iver], Dalton, 27 Aug 1942, *29781 (NEBC), all A. S. Pease.* [GRAFTON CO.]: Minkbrook bog, Hanover, 7 Jul 1910, *E. F. Williams s.n.* (GH, NY, US). [HILLSBORO CO.]: Weed in garden, Peterborough, 30 Jun 1919, *C. F. Batchelder s.n.* (NEBC, PH). STAFFORD CO.: Roadside by reservoir, near Horticultural Farm, Durham, 31 Jul 1945, *A. R. Hodgdon, H. Gidding, Jr. 5160* (NEBC). SULLIVAN CO.: Low bank of Connecticut River, Plainfield 28 Jul 1962, *C. L. Wilson s.n.* (NEBC).

NEW JERSEY: CAPE MAY CO.: Made-land adjoining the city, Cape May City, 3 Jun 1916, *B. Long 14818* (GH, PH). [ESSEX CO.]: Orange, 26 May 1891, *J. R. Churchill s.n.* (GH): Bloomfield, Jul 1879, *H. H. Rusby s.n.* (MICH). MERCER CO.: Moist sandy alluvial shore, along Delaware River, n w of Trenton, 7 Nov 1936, *B. Long 49326* (PH). SOMERSET CO.: In wet ditch, Watchung, 9 Jul 1927, *H. N. Moldenke 3237* (NY). WARREN CO.: Alluvium, ¼ mi n w of Columbia, 25 Jun 1948, *R. L. Schaeffer, Jr.* (PH).

NEW YORK: ALBANY CO.: Roadsides near Loudonville, 26 Jun 1939, *H. D. House 26557* (US). CAYUGA CO.: Damp railroad bank s of Union Springs, Springport Twp., 19 Jun 1919, *A. J. Eames, K. M. Wiegand 12098* (GH). CHAUTAUQUA CO.: Beach, Bemus Point, Lake Chautauqua, 3 Aug 1896, *J. R. Churchill s.n.* (GH). LIVINGSTON CO.: Wet shore of Conesus Lake, 28 Jun 1925, *W. A. Matthews 2382* (WIS). MONROE CO.: Rochester, Aug 1884, *Miss N. Lellinger s.n.* (GH). NASSAU CO.: Woodmere, 19 Jul 1903, *E. P. Bicknell s.n.* (NY). [NEW YORK CO.]: Carmansville, [New York City], 27 Jun 1869, *W. H. Leggett s.n.* (NY). ONEIDA CO.: Sandy thickets, Verona Beach, 11 Jun 1925, *H. D. House 10874* (GH). [ONONDAGA CO.]: Shore of Onondaga Lake, Syracuse, 5 Jul 1902, *N. L. Britton s.n.* (NY). [QUEENS CO.]: Scarce, Flushing, Long Island, Jul 1864, *W. H. Leggett s.n.* (NY). RENSSELAER CO.: Along

Kinderhrook Creek at East Nassau, 11 Aug 1934, *H. D. House 21943* (GH). RICHMOND CO.: Foot of Bard Ave., Staten Island, 1 Jun 1904, *P. Dowell 2873* (GH). [SUFFOLK CO.]: Edge of lane near old nursery, Brookhaven, Long Island, 12 Jun 1960, *L. M. Andrews s.n.* (HAM). TOMPKINS CO.: Along R. R., Ithaca, 26 Jun 1903, *C. H. Kauffman 932* (MICH). [WESTCHESTER CO.]: Ditch, Sunnyside Lane, Tarrytown, 23 Jul 1896, *J. H. Barnhart 1536* (NY).

NORTH DAKOTA: [CASS CO.]: Street, Fargo, 9 Jul 1922, *O. A. Stevens s.n.* (MO, NY, OC, PH).

OHIO: ATHENS CO.: [Without locality], summer 1929, *L. Stephenson s.n.* (OS). BELMONT CO.: "Green Mount," Barnesville, 17 Jun 1918, *E. E. Laughlin s.n.* (OS). CHAMPAIGN CO.: Cedar Swamp, 28 Aug 1917, *E. C. Leonard, W. J. Rogers 696* (US). CLARK CO.: North Rubber plant, Madriver, 5 Jul 1914, *E. C. Leonard 696* (US). CLINTON CO.: Moist soil along Anderson's Fork, 1½ mi s w of Bloomington, 24 Jun 1941, *E. E. Terrell, Jr. s.n.* (OS). CUYAHOGA CO.: Gordon Park, Cleveland, 189-, *E. Claassen s.n.* (OS). ERIE CO.: Perkins, 13 Jun 1897, (GH, US), common along valley of Pipe Creek, Sandusky, 25 Jun 1927, (GH, MICH), both *E. L. Moseley s.n.* FRANKLIN CO.: Near Cyclotron Laboratory, Ohio State University Campus, 6 Jun 1960, *A. W. Cusick s.n.* (OS). GREEN CO.: Gravelly river bank, Xenia, 15 Jun 1933, *C. McCalmont s.n.* (OC). HAMILTON CO.: Ditches & wet places, flood plains, Anderson's Ferry, Cincinnati, 15 Jun 1917, *E. L. Braun s.n.* (OS). HIGHLAND CO.: Bank of a small stream near Hillsboro, 25 Jun 1923, *K. M. Roads s.n.* (OS). JEFFERSON CO.: Ditch along dirt road, valley of Lea Branch of Salem Creek, Salem Twp., 1½ mi e of Annapolis, 10 Jul 1961, *A. W. Cusick s.n.* (OS). [LAKE CO.]: Near Painesville, Jul 1890, *W. C. Werner s.n.* (OS). LUCAS CO.: Ottawa Park, Toledo, Jun 1900, *E. H. Burclehaus s.n.* (OS); along Maumee River n of town, Waterville, 18 Jun 1958, *N. W. Easterly 662* (OS). MAHONING CO.: Calla, 1 Oct 1895, *H. G. Wolfgang s.n.* (GH). PICKAWAY CO.: Lowland along Scioto River, Pickaway Twp., 10 Jun 1936, *Bartley & Pontius 203* (NY). PIKE CO.: Old canal bed at Jasper, 20 May 1945, *L. L. Pontius, F Bartley 945* (US). PORTAGE CO.: Near armory on Freedom St., Ravenna, 4 Jul 1958, *E. M. Herrick s.n.* (OS); along Erie R. R., Garrettsville, 23 Jun 1913, *R. J. Webb s.n.* (OS). ROSS CO.: In roadside ditch, Liberty Twp., 2 mi n of Richmondale, 3 Jul 1950, *F. Bartley 1318* (US). SANDUSKY CO.: Bank of Sandusky River near bridge of route 148, 0.2 mi w of route 173, Ballville Twp., 21 Aug 1961, *D. J. Pinkava 6180* (OS). SENECA CO.: Local, rosettes in drying bottom of Sandusky River, ca. 1.5 mi n of Tiffin, 14 Sep 1963, *R. L. Stuckey 2172* (MICH). STARK CO.: Lawrence Twp., Canal Fulton, 6 Aug 1941, *D. M. Brown s.n.* (OS). SUMMIT CO.: Roadside ditch (usually dry), route 14, 1¼ mi s e of Twinsburg, 11 Jun 1959, *E. M. Herrick s.n.* (OS). WOOD CO.: Sec. 34, Grand Rapids Twp., 24 Jul 1937, *R. E. Shanks 777* (NY, OS). VAN WERT CO.: Low ground by pond, Woodland Cemetery, Van Wert Twp., 23 Jul 1963, *A. S. Brooks 3647* (OS).

OREGON: [MARION CO.]: Dry soil in street-parking, Salem, 18 Jul 1919, *2743* (GH), dry parking on N. Summer St., Salem, 10 Jul 1920, *3190* (PH), in flower-bed on Market St., Salem, 14 Jul 1922, *4426* (PH), all *J. C. Nelson.*

PENNSYLVANIA: BERKS CO.: Moist soil on a culm flat, at the mouth of Allegheny Creek, 0.4 mi n n w of Gibraltar, 13 Jun 1954, *W. C. Brumbach 4621* (PH). BRADFORD CO.: Rocky shore, foot of cliffs, along Susquehanna River, 1.5 mi n n w of Wylusing, 8 Jun 1938, *J. M. Fogg, Jr. 14487* (GH). BUCKS CO.: Delaware River bank, Washington's Crossing, 27 Jul 1924, *R. R. Dreisbach 3039* (PH), Wyker's Island, 11 Jul 1898, *C. D. Fretz, s.n.* (PH). CHESTER CO.: Moist soil, along White Clay Creek, London Grove Twp., Avondale, 12 Jun 1913, *F. W. Pennell 5016* (PH). COLUMBIA CO.: Vacant lot along ditch, Bloomsburg, 20 Aug 1920, *H. B. Meredith s.n.* (PH). DELAWARE CO.: Valley near Merion Golf Course, 2 mi s of Haverford, 15 Jun 1924, *H. E. Stone s.n.* (PH). LANCASTER CO.: Beech Dale along creek, Meadow Mill Creek, ½ mi n w Bird in Hand, 3 Jun 1934, *E. Brubaker 390* (PH). LAWRENCE CO.: Quakertown, 17 Jun 1902, *F. Ball s.n.* (PH). LEHIGH CO.: Oats field 25th and Chew Sts., Allentown, 21 Jun 1923, *W. M. Benner 2210* (PH). MONTGOMERY CO.: Open alluvial shore of Schuylkill River, within 0.75 mi s e of Linfield, 17 Jul 1943, *B. Long 59306* (PH). NORTHAMPTON CO.: Island Park, above Easton, 31 Jul 1899, *T. C. Porter, s.n.* (PH). [PHILADELPHIA CO.]: Ballast, Philadelphia, Aug 1876, *I. C. Martindale s.n.* (GH); ad ripa Delaware, Phil[adelphia], [before 1818], *T. Nuttall s.n.* (PH). PIKE CO.: Bushkill, 24 Jun 1914, *E. B. Bartram 3596* (PH). SULLIVAN CO.: Roadside near Eaglesmere, 6 Jul 1948, *T. S. Githens s.n.* (PH). WARREN CO.: Along Allegheny River near S-Bridge, Irvine Demon Forest Exp. Stat., 1200 ft, 18 Jul 1960, *F. C. Olday 67* (USFS).

RHODE ISLAND: NEWPORT CO.: Easton's Pond, Newport, 19 Jun 1903, *B. L. Robinson s.n.* (GH, NEBC).

TENNESSEE: DYER CO.: In pasture at edge of Miston, 29 Apr 1949, *A. J. Sharp, C. J. Felix, Bill Adams 12191* (GH).

VERMONT: CHITTENDEN CO.: Wet soil by Lake Champlain, Colchester, 13 Jul 1932, *C. H. Knowlton s.n.* (NEBC). WINDHAM CO.: Brattleboro, 1895, *J .A. Bates s.n.* (GH). [WINDSOR CO.] Wet meadows, Norwich, 29 Sep 1893, *W. W. Eggleston s.n.* (MICH, NEBC, US); river banks, Windsor, 8 Jun 1880, *G. H. Leland s.n.* (NEBC, NY).

VIRGINIA: BATH CO.: Roadside, Virginia Hot Springs, 1 Jul 1917, *F. W. Hunnewell, 2nd. 4819* (GH). FAIRFAX CO.: A strictly sterile form with closed flowers, no pollen, no seed, the siliques never grow to normal size, an extremely bad weed spreading by underground stems, appeared in my garden in 1957, and spreads rapidly, 3000 7th North Arlington, 23 Jun 1959, *H. A. Allard 22040* (US). PRINCE WILLIAM CO.: Abundant, island in Bull Run Creek, 1½ mi below bridge on Rt. 211, eastern slope of Bull Run Mountains, 5 Jun 1949, *H. A. Allard 19468* (US). ROCKINGHAM CO.: Moist places, field along left bank of South River near Grottoes, 8 Jun 1949, *L. Artz 875* (GH).

WASHINGTON: [CLALLAM CO.]: Lake Crescent, Jul 1931, *G. N. Jones 3493* (PH). KING CO.: South Seattle, 25 Jul 1934, *W. J. Eyerdam s.n.* (MO, ND).

WEST VIRGINIA: JEFFERSON CO.: Among rocks in the river, Island Park, Harpers Ferry, 17 Jul 1910, *P. C. Standley 5356* (US). RALEIGH CO.: Sandy bottoms along New River at Hinton Bridge, Hinton, 16 Jun 1941, *J. P. Tosh 816* (US).

WISCONSIN: DANE CO.: Black Earth, 17 Jun 1921, *Davis & McFarland s.n.* (WIS); Madison, 11 Jul 1916, *R. H. Denniston s.n.* (WIS). GRANT CO.: Blue River, 19 Jun 1926, *J. J. Davis s.n.* (WIS). GREEN CO.: On Marion Lewis farm, Jordan, T2N, R6E, Sec. 7, 16 Jun 1958, *H. Richards s.n.* (WIS). GREEN LAKE CO.: Sandy shore of L. Pickaway, Marquette, T15N, R11E, Sec. 33, 20 Sep 1936, *N. C. Fassett, T. M. Sperry 18388* (WIS). [IOWA CO.]: Arena, 20 Jul 1922, *J. J. Davis s.n.* (WIS). LINCOLN CO.: At water's edge along Wisconsin River, T31N, R7E, Sec. 32, Scott, 22 Jul 1954, *F. C. Seymour, R. Schlising 15981* (WIS). PIERCE CO.: Swale, along slough, T25N, R17W, Sec. 8, Bay City, 29 Aug 1927, *N. C. Fassett, L. R. Wilson 4252* (GH, MICH, MO, WIS). ROCK CO.: Edgerton, 17 Aug 1922, *J. J. Davis s.n.* (WIS). [SHEBOYGAN CO.]: Sheboygan, 28 Jun 1918, *G. Goessl s.n.* (WIS). WAUKESHA CO.: Cultivated field, Oconomowoc, 26 Jul 1938, *W. W. Oppel C4* (GH).

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THE SPECIES OF PHYLLANTHUS (EUPHORBIACEAE) COLLECTED BY SESSÉ AND MOCIÑO

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The lugubrious fate of Sessé and Mociño's botanical writings, which were not published until nearly a century after their completion, has been described by a number of authors, notably Sprague (Kew Bull. 1926: 417-425). Most of the names published so belatedly in the "Plantae Novae Hispaniae" (ed. 1, 1887-1891; ed. 2, 1893) and the "Flora Mexicana" (ed. 1, 1891-1897; ed. 2, 1894) have been relegated to synonymy, but in the interest of nomenclatural stability it would be desirable if all of the names could be properly typified and taxonomically evaluated. By no means all of the specimens in the Plantae Novae Hispaniae collection in the Madrid Herbarium were listed in the two published books, and not all of the Sessé and Mociño collections are preserved at Madrid (some, for example, are only at Geneva). Furthermore, as pointed out by McVaugh (ined.), a number of different writers have published on the Sessé and Mociño collections. Consequently, a considerable amount of labor is involved in accounting for all aspects of Sessé and Mociño's botanical work.

In the course of revisionary studies on the Mexican and Central American species of *Phyllanthus*, it has been found necessary to interpret various names proposed for the Sessé and Mociño collections. Fortunately, I was able to examine a set of their specimens from the Instituto Cavanilles at Madrid through the courtesy of the Chicago Natural History Museum and Dr. Rogers McVaugh (who is preparing an account of the contributions to botany made by Sessé and Mociño). In the following review, therefore, both the names published by Sessé and Mociño and their specimens are disposed of according to present concepts of the neotropical species of *Phyllanthus*.[1]

SPECIES OF PHYLLANTHUS DESCRIBED BY SESSE AND MOCINO[2]

1. PHYLLANTHUS AMERICANUS Sessé & Moc., Pl. Nov. Hisp. ed. 1, 159. 1890; Fl. Mex. ed. 2, 212. 1894.

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[1] I wish to acknowledge the generous assistance of Dr. Rogers McVaugh, who reviewed the manuscript, made some helpful suggestions, and provided a copy of the treatment of *Phyllanthus* in his forthcoming book on Sessé and Moçiño.

[2] The localities quoted in this section are mostly taken from the discussions in the 'Plantae Novae Hispaniae' and 'Flora Mexicana,' as the specimens examined by me are nearly devoid of locality data. The serial numbers cited are those of the Sessé and Moçiño specimens at the Instituto Antonio Jose Cavanilles, Madrid (MA), some duplicates of which are in the herbarium of the Chicago Natural History Museum (F); these numbers were arbitrarily assigned in Madrid about 1935, and bear no relation to the original numbers of the collectors.

SIDA 2 (5): 377—380. 1966.

No. 4561; said to have been collected "in temperatis agris" near Mazatlán, a small village in Guerrero. The collection represents *Phyllanthus galeottianus* Baill. (Adansonia 1: 32. (1860); Baillon cited a duplicate sheet of the collectors in the Delessert Herbarium, but implicitly typified his specific concept by a Galeotti collection.

2. PHYLLANTHUS DECANDER Sessé & Moc. Fl. Mex. ed. 2, 212. 1894. Nos. 4565 (ex p.), 4566; collected near Guanabacoa, a suburb of Havana.

Both the description and the specimens clearly refer to *Phyllanthus discolor* Poepp. ex Spr., an endemic Cuban species.

3. PHYLLANTHUS NIRURI sensu Sessé & Moc., Pl. Nov. Hisp. ed. 1, 159. 1890 (non L. 1753 nec Fl. Mex. 1894).

No. 4556; cited as from Acahuizotla, Gro., and Apatzingan, Michoacán. Baillon (Adansonia 1: 35. 1860) based his *Phyllanthus mocinianus* on a Sessé and Mociño collection in the Delessert Herbarium; this has been annotated by McVaugh as a holotype, so that No. 4556 presumably represents an isotype of the species.

4. PHYLLANTHUS NIRURI sensu Sessé & Moc. Fl. Mex. ed. 2, 212. 1894 (non L. 1753).

Two species described under this name are both represented in the collections at Chicago, and neither of them is the same as the plant described as "P. niruri" in the 'Plantae Novae Hispaniae'; true *P. niruri* is not represented among the Sessé and Mociño collections seen by me.

The first "Phyllanthus niruri" on p. 212, said to be from "rupes cavernae" at Tagarnana, near Havana, Cuba, appears to be represented by specimen No. 4453; this is *Phyllanthus pentaphyllus* Wright. The description of the second "Phyllanthus niruri" on p. 212, also from Tagarnana, suggests *P. caroliniensis* ssp. *saxicola* (Small) Webster. However, the only other herbaceous plants in the Sessé and Mociño collection labelled as *P. niruri* are Nos. 4554 and 4555, which represent *P. compressus*, a Mexican species not known in Cuba. Evidently Sessé and Mociño's concept of *P. niruri* was badly confused.

Baillon (Adansonia 1: 31. 1860) described *Phyllanthus cyclanthera* Baill. on the basis of a Sessé and Mociño specimen in the Delessert Herbarium, a fragment of which is preserved at the Laboratoire de Phanérogamie, Paris (P). The sheet bears in Baillon's handwriting a label reading, in part: ["Phyllanthus] niruri, Moc. ms. Mexico, Sessé et Mocinno. (ex herb. Lessertiano)". Mueller (DC. Prodr. 15 [2]: 408. 1866) apparently saw the main sheet of this in the Delessert Herbarium, as he noted that it was labelled by Pavon "N.E." [Nova España], which misled Baillon into thinking that the plant was from Mexico instead of from Cuba. Neither McVaugh nor I were able to relocate this Pavon sheet, which should be deposited at the Conservatoire Botanique in Geneva

(G); evidently it has been lost. Since, as pointed out earlier (Webster, Contr. Gray Herb. 176: 48-50. 1955), the specimen preserved by Baillon is a portion of a plant of *Phyllanthus pentaphyllus*, it cannot serve as the typical element for a species characterized by Baillon as having a highly specialized androecium (synandrium). As Baillon described the Cuban synandrium-bearing species a year later (Adansonia 2:13. 1861) as *P. lindenianus*, it has seemed best to reject the name *P. cyclanthera* Baill. as a nomen confusum. It should be pointed out that there are no specimens of *P. lindendianus*, or any other member of sect. *Cyclanthera*, among the collections at Madrid, while on the other hand Sessé and Mociño did collect *P. pentaphyllus* in Cuba. Consequently, unless the Pavon sheet noted by Mueller is rediscovered, there is no need to modify the nomenclatural decision arrived at a decade ago, and there remains no evidence that Sessé and Mociño ever collected *P. lindenianus*.

5. PHYLLANTHUS QUINQUEFIDUS Sessé and Moc. Fl. Mex. ed. 2, 212. 1894.

No. 4567; plant said to come from Toa Alta, a locality in Oriente Province, Cuba. Baillon (Adansonia 1:39-40. 1860) correctly referred a Sessé and Mociño specimen with this name to the synonymy of *P. juglandifolius* Willd., but mistakenly judged the locality to be in Mexico.

6. PHYLLANTHUS ROTUNDIFOLIUS Sessé & Moc. Fl. Mex. ed. 2, 212. 1894.

No. 4565 (ex p.) (mixed with *P. discolor*). The label on sheet 4565 reads *P. decander;* evidently two collections were confounded when mounted. The description and associated specimen clearly represent *P. orbicularis* Kunth, a species endemic to Cuba.

ENUMERATION OF SPECIES REPRESENTED IN THE SESSE AND MOCINO HERBARIUM COLLECTIONS

P. acuminatus Vahl: 4563, 4564 ex p.
P. compressus Kunth: 4554
P. discolor Poepp. ex Spr.: 4565 ex p., 4566
P. galeottianus Baill.: 4561
P. grandifolius L.: 410 bis, 691, 692, 4683
P. juglandifolius Willd.: 4567
P. mocinianus Baill.: 4556, 4557, 4558, 4559
P. orbicularis Kunth: 4565 ex p.
P. pentaphyllus Wright: 4453 bis
P. polygonoides Nutt. ex. Spr.: 4560
P. sessei Briq.: 4562, 4564 ex p.

Of the species enumerated in this index to specimens, some of the ones published on by authors other than Sessé and Mociño require additional comment, as detailed below. Furthermore, some species proposed by other botanists are not represented in the main Sessé and Mociño collection at Madrid. Additional details on these taxa, including references to illustrations made by Sessé and Mociño's botanical party, are given in the work by McVaugh (ined.).

PHYLLANTHUS FILIFORMIS Pavon ex Baill. Adansonia 1: 29. 1860.

The type specimen, cited by Baillon as '*Pavon,* Mexico, n. 315 (h. Less.)', was referred to *P. lathyroides B genuinus* by Mueller (DC. Prodr. 15 [2]: 404. 1866). According to McVaugh (ined.), this specimen is now at Geneva. The plant, which is not represented at Madrid, seems best classified as *P. niruri* L. ssp. *lathyroides* (Kunth) Webster, Contr. Gray Herb. 176: 52. 1955.

PHYLLANTHUS GRANDIFOLIUS L. Sp. Pl. 981. 1753.

The specimens of this plant were not well understood by Sessé and Mociño, as most sheets were unlabelled, and No. 691 was ticketed as *Genipa!* These specimens have been determined as *P. laxiflorus* Benth.; however, that, as well as several other proposed Mexican and Central American species of subg. *Botryanthus,* appears to be a synonym of *P. grandifolius.*

PHYLLANTHUS MOCINIANUS Baill. Adansonia 1:35. 1860.

As noted above (under species described by Sessé and Mociño), this species was based on a Sessé and Mociño collection which is now preserved at Geneva. Judging from specimen labels and the annotations by McVaugh (ined.), Sessé and Mociño apparently equated this plant with either *P. niruri* or *P. emblica,* while Pavon recognized it as a new species 'Phyllanthus arboreus' which, however, was published only in synonymy by Baillon.

PHYLLANTHUS SESSEI Briq. Ann. Cons. Jard. Bot. Geneva 4:224. 1900.

According to McVaugh (ined.), the type of this species is at Geneva (G-Del), and bears a Pavon label 'Phyllanthus acuminatus N E, as well as the number '34'. The specimens at Madrid, 4562 and 4564, seem to represent the same gathering but may be a different collection from the type, since they have the number '21-3'. It is not surprising that the Spanish botanists confused this plant with *P. acuminatus,* since as Briquet acknowledged it is quite similar in many respects. However, it differs from *P. acuminatus* in its blunter leaves, different inflorescence (female flowers often 2 or 3 and males several per node, vs. female flowers solitary and males many per node in *P. acuminatus),* and larger male flowers (calyx c. 1.5 mm long) with blunter anthers. Unfortunately, no specific locality was preserved on the specimen labels, which merely say 'Nova Hispania', and the species does not seem to have been recollected. It is to be hoped that it will be rediscovered during further botanical collecting in the tropical parts of Mexico.

JUVENILE FORMS IN SOLANUM MITLENSE AND S. BLODGETTII (SOLANACEAE) AND THEIR IMPORTANCE IN TAXONOMY

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Plasticity of the phenotype is common in many plant genera. Familiar examples are the submerged and floating leaves of *Potamogeton,* the sun and shade leaves of deciduous forest trees such as *Quercus,* and the vernal and autumnal forms in *Panicum* (cf. Geobel, 1900; Van Steenis, 1954). Van Steenis (l.c.) has classified such phenotypic modifications under 4 general headings in which he recognizes 24 kinds of variation induced by the environment. One of these is juvenile forms, the condition in which young plants of a species are conspicuously different from mature ones in some character(s). The dimorphic effect of juvenile forms has contributed to the taxonomic difficulties in certain notoriously perplexing genera such as *Solanum.* In many woody tropical species of this genus, leaf shape and size and spinescence are especially variable, young plants often bearing no resemblance to mature ones. The juvenile forms of *Solanum mitlense* Dunal and *S. blodgettii* Chapman serve to illustrate the effect of this source of variation on taxonomic interpretation.

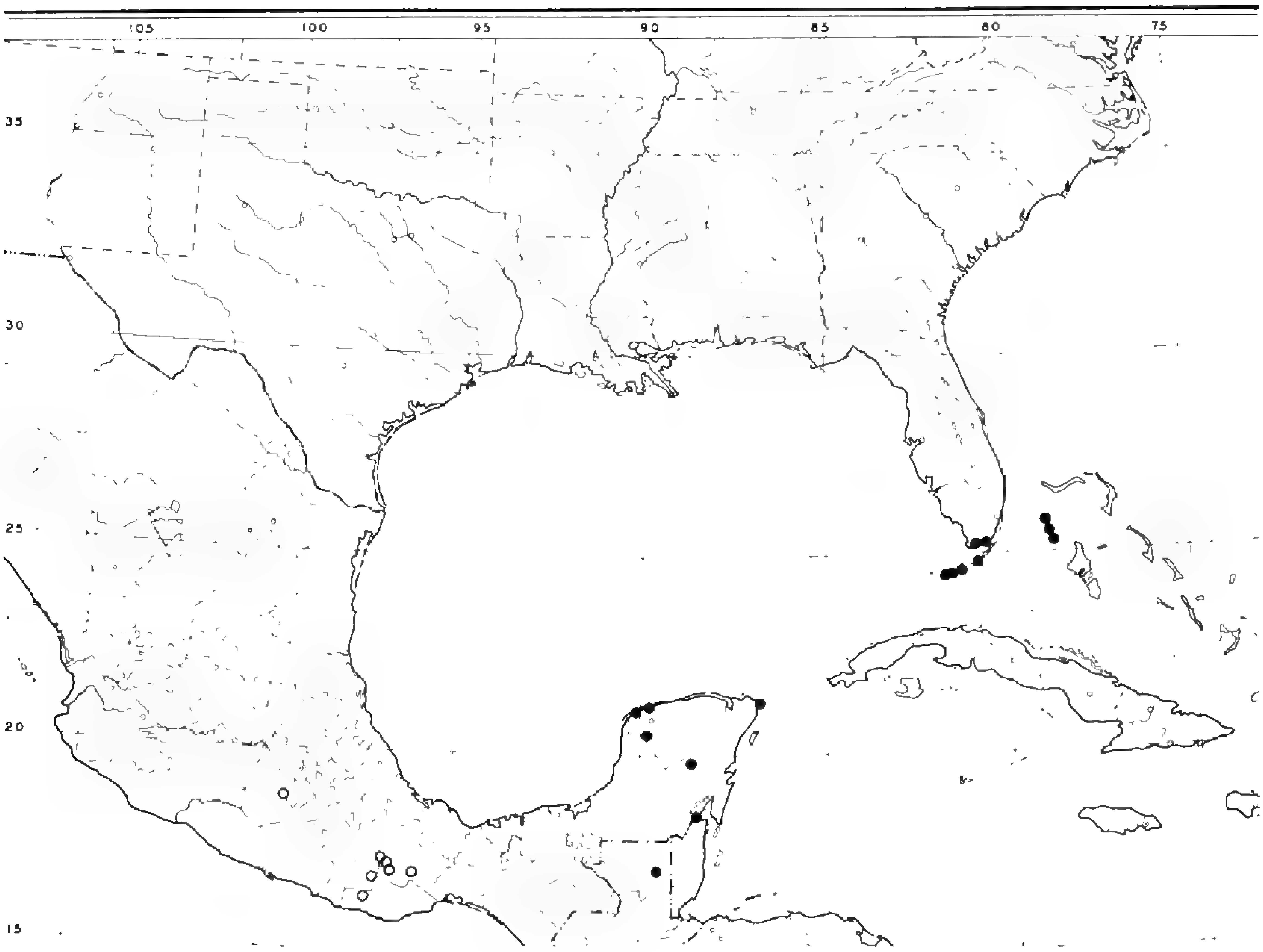
While collecting botanical specimens in Mexico during the summers of 1964 and 1965, I encountered *Solanum mitlense* on several occasions. At first I was inclined to believe that two species were involved, i.e., a large-leaved, prickly shrub type and a small-leaved, nearly unarmed tree type (Fig. 1). Further examination of inflorescences, flowers, stems and significant characters of other parts suggested that the shrub was only a juvenile form of the tree. This was substantiated later near Sola de Vega, Oaxaca when plants intermediate in age exhibited a complete transition from shrub to tree. At the site near Ixtapan de la Sal, Mexico, which was collected both years, the individuals that were robust shrubs in 1964 were medium-sized trees by 1965, had leaves intermediate in size and lacked prickles on their leaves and young branches.

This example of an extreme dimorphic habit reflects the importance of adequate collections of specimens and accurate descriptions on labels to facilitate taxonomic understanding in *Solanum.* Because of the great intrinsic variation in many *Solanum* species and simply because of their large size it is usually impossible to show more than a small fraction of the entire phenotype on a single herbarium sheet. Furthermore, juvenile forms and stump sprouts are often non-blooming and thus neglected by collectors.

SIDA 2 (5): 381—385. 1966.

Fig. 1: Photograph taken near Ixtapan de la Sal, Edo. de México, Mexico of shrub and tree forms of *Solanum mitlense*. Several specimens of the shrub form (Mick & Roe 265), about 2 m high, are in the immediate foreground. A single tree (Mick & Roe 264), about 4 m high, is in the immediate background behind an unidentified small shrub.

To be useful, future *Solanum* collections should include all the obvious variation shown by single plants and as much as possible of that shown by the population, especially the extreme forms such as those in *S.*



Map: Closed circles represent *Solanum blodgettii*, open ones *S. mitlense*.

mitlense. Several sheets may be necessary to contain the variety of shapes, sizes and colors of leaves, stump sprouts, wood samples, fruits, etc. The "Inclusive Herbarium" technique of Anderson (1951) might well be employed. In a genus whose species are regarded as being highly variable, it is often crucial to be familiar with the ontogeny of the species in order to avoid misidentification.

The juvenile form of *Solanum blodgettii* is not so striking as that of *S. mitlense* but is significant in classification studies. This tropical and subtropical species is restricted in its range to the limestone islands and shores of Florida and the Bahamas while also reaching inland on the great limestone Yucatan Peninsula.[1]

From the time of its original description, most authors (cf. Chapman, 1860; Britton & Millspaugh, 1920; Small, 1913) have regarded *Solanum blodgettii* as an unarmed species, probably due to its general resemblance to *S. erianthum* D. Don[2] (Britton, 1912). Gray (1886), who seems to have suspected its true relationship, says ". . . Perhaps merely an un-

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[1] *Solanum blodgettii* apparently has not previously been reported from Mexico. Its specimens are often misidentified as *Solanum bicolor* Willd.

[2] *Solanum verbascifolium* of authors, not L.

armed form of some normally prickly species . . .". That this latter interpretation is more nearly the correct one could be suspected from its long attenuate anthers characteristic of prickly species. This was confirmed when seed from Big Pine Key, Florida *(Roe 119)* and near Progreso, Yucatan *(Roe, Roe & Mori 1308)* produced 24 seedlings, all bearing small but numerous prickles. One young, non-flowering plant and 2 root-shoots from it collected in Florida *(Roe 104)* also were prickly but 13 young sprouts from mature plants were not (Roe 119, 120). As the greenhouse plants matured they no longer produced prickles so that, above 20 cm, their stems were unarmed just as in mature plants and their sprouts from the field. This evidence is scanty but may suggest that the production of prickles in this species is under hormonal control, the expression of prickles having evolved in response to environmental conditions at some time in the plant's history and now remains as only a vestigial character.

For purposes of identification only, of course, the prickly condition of the juvenile form in this case may be of little concern since, at least in the herbarium, we are usually dealing with mature plants and not with non-flowering seedlings or sprouts. However, if our interest is in species relationships, this prickly condition in young plants is of considerable importance since the character is used as a major taxonomic criterion in *Solanum* classification.

Dunal (1852), in the only world-wide monograph of *Solanum*, divides the genus into two major divisions, these based, in part, on the presence or absence of prickles. His Sectio *Pachystemonum* includes the unarmed species, while those normally armed are placed in Sectio *Leptostemonum*. Bitter (1919, 1922) describes Subgenus *Eusolanum* and Subgenus *Leptostemonum*, again using prickles as delimiting character. Morton (1944) supports division of the genus by pointing to the correlation of spinescence with a characteristic anther shape and mode of dehiscence as good evidence for two distinct natural groups within *Solanum*.

If we classify species on the basis of overall similarity (i.e., greatest correlation of characters), all stages of a plant's life cycle are important including those atavistic characters disappearing with maturation (Davis & Heywood, 1963). It appears that the prickly juvenile form of *Solanum blodgettii* has generally been unknown or disregarded by authors of floras and taxonomic studies. Probably many other *Solanum* species are even less well known. It would seem, therefore, that greater knowldege of individual species, based upon adequate collections, intensive study, and full appreciation of juvenile growth forms is essential to understand the woody Solanums.

I am especially indebted to Dr. H. H. Iltis for his interest and guidance in my research and his critique of the manuscript. The work was supported, in part, by a predoctoral fellowship from the National Institutes of Health, and by the John R. Heddle Fund administered by the Department of Botany, University of Wisconsin.

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STUDIES IN AMERICAN RUBIACEAE
1. NEW AND NOTEWORTHY COSTA RICAN SPECIES

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In a small collection of Costa Rican Rubiaceae sent by William H. Hatheway, of the Tropical Science Center, San José, Costa Rica, several species did not fit any of those included by Standley in the Flora of Costa Rica (Field Mus. Publ. Bot. vol. 18) and could not be matched in the U. S. National Herbarium, or with any species published since the Flora. They are described here, along with critical notes on several other species. Most of the collection came from the slopes of Volcán Barba, a very rich botanical area, a good part of which has been protected in its natural state by the owner, Sr. Botho Steinvorth, who is to be congratulated on his farsightedness in saving for the future a bit of Costa Rica as it was when European man arrived on the scene.

GALIUM **hypocarpium** (L.) Fosberg, comb. nov.

Valantia hypocarpia L., Syst. Nat. ed. 10, 1307, 1759.

Relbunium hypocarpium (L.) Hemsl., Biol. Centr. Amer. Bot. 2: 63, 1881.

So far as I can determine, the genus *Relbunium* differs from *Galium* only in the presence of 2 or 4 bracts forming an involucre immediately beneath the flower. The fleshy fruit is characteristic of a number of other groups within *Galium*. Although the "bracts" that surround the flower are somewhat smaller than the leaves at other nodes, they do not seem essentially different. What this amounts to, when looked at critically, is that *Relbunium* differs in having sessile rather than pedicellate flowers. The flowers are sessile in a whorl of reduced leaves.

This seems an extraordinarily weak basis for a genus. If this philosophy were followed through, *Galium* would be segregated into a large number of ill-separated genera. I prefer to retain it as a single genus, including the plants of this affinity with stipules so modified as to appear to be additional leaves, and rotate flowers. The distinctions from *Rubia*, *Asperula*, *Sherardia*, and several other Old World genera are dubious enough, but need not be examined here.

I have been using the name *Galium hypocarpium* for years, ascribing the combination to Bentham, but cannot find that he or anyone else ever published it.

SIDA 2 (5): 386—389. 1966.

GONZALAGUNIA **longithyrsa** Fosberg, sp. nov.

Arbor parva, folia lanceo-oblonga maxime 10 x 2.5 cm acuminata supra glabra infra sparse sericea glabrata stipulis triangularibus marginibus valde distinctis, thyrsus elongatus maxime 35 cm subcongestus cymulis pedunculatis, fructus maxime 6 mm latus albus coccis 4 seminibus nigris.

Small tree, 4 m tall, with glabrate branchlets; leaves lance-oblong, up to 10 cm long, 2.5 cm wide, apex acuminate, base strongly contracted, obtusish, glabrous above, thinly sericeous beneath, glabrate except on nerves, blade very slightly decurrent on the 4-6 mm petioles; stipules broadly triangular, strongly mucronate or cuspidate, thinner margin sharply set off from inner thickened portion; thyrses very elongate, to 35 cm, rachis strong, sericeous, rather densely flowered, cymules subtended by subulate bracts, pedunculate, peduncles 2-4 mm long, several flowered; flowers not available, calyx lobes (in fruits) minute, triangular, appressed to fruit; fruit white, to 6 mm across, depressed globose, 4-coccous, seeds black, irregularly compressed.

Possibly close to *G. rosea* Standl. but leaves narrower, glabrous above, pubescence closely appressed, rather than spreading, fruit larger.

Costa Rica: Prov. Cartago, Tapanti, 1200 m, at edge of wet forest, Nov. 1, 1964, *Hatheway and Rodriguez 1241* (US, type)

HILLIA **hathewayi** Fosberg, sp. nov.

Ramuli articulati quadrangulares, folia elliptica, 2-4 × 1.2-1.6 cm, nervis obscuris, stipulae obovatae obtusae 5-12 mm longae; corolla tubo 2.5-3 cm longo lobis late orbicularibus revolutis emarginatis 10 mm longis, 12-13 mm latis, capsula valvis ellipticis 15-27 mm longis 6-7 mm latis.

Epiphytic shrub, glabrous, branchlets 4-angled, appearing articulate, with deep sutures around nodes, internodes very short, mostly 3-8 mm on branchlets, up to 2 cm on main twigs; leaves elliptic to slightly obovate, 2-4 cm long, 12-16 (20) mm wide, apex rounded, base obtuse, venation obscure, 3-4 pairs of lateral veins at a small angle to midrib, petiole 2-3 mm long, flattened; stipules obovate, obtuse 5-9 (-12) mm long, early caducous; flowers terminal on branchlets, calyx lobes spatulate oblong, 5-6 mm long, 1.5 mm wide rounded at apex, corolla tube greenish white, 25-30 mm long, 2.5 mm thick, slightly swollen near top, lobes more or less orbicular or wider than long, strongly revolute, emarginate, 10 mm long, 12-13 mm wide, sub-fleshy, creamy white, anthers well included, narrowly oblong, 5 mm long; style 14 mm long, upper 6 mm bifid; valves of fruit elliptical 15-27 mm long, 6-7 mm wide.

Related to *H. maxonii* Standl. but with corolla tube 2.5-3 rather than 5 cm long, lobes 1.2-1.3 cm across, broader than long, capsule smaller. Perhaps closer to *H. palmana* Standl. which has a similar but longer corolla but rather differently shaped leaves.

Costa Rica: Prov. Heredia: south slope of Volcán Barba, in cool wet woodland pasture, 1950 m, May 26, 1965, *Hatheway 1371* (US, type); Prov. Alajuela: Palmira, Cant. Alfaro Ruiz, 2400 m, *Austin Smith P2678* (US).

HOFFMANNIA **steinvorthii** Fosberg, sp. nov.

Frutex, folia anguste elliptica vel oblanceolato-obovata, glabrata, cymae subsessiles trichotomae laxe glomeratae, calyx lobis 1 mm longis pilosulis, corolla tubo glabro 8-11 mm longo dilatato lobis ovatis acutis extus pilosis 4-6 mm longis, ovarium triloculare, stigma vix trilobatum.

Shrub 1.5 m tall, stems glabrous, with tiny mostly elongate white dots, with 4 obtuse ridges, somewhat fistulose; leaves narrowly elliptic to oblanceolate-obovate, apex strongly acuminate, almost caudate, base cuneate-attenuate, blades up to 23 cm long and 7 cm wide, slightly hirtellous when very young, glabrate, petioles 1-2 cm long; stipules very low-triangular, obtuse, early caducous.

Cymes subsessile, primarily trichotomous, branches to 2.5 cm long, two of them in some instances suppressed, the remaining one originating from a pulvinus-like reduced bracteate peduncle, the cymules loosely glomerate, irregularly branched to secund, scorpioid, peduncle of cymule 1 cm long, pedicels about 1.5-3 mm long, whole cyme sparsely pilosulous, with minute scale-like bracts or their scars at nodes; flowers with hypanthium turbinate, very sparsely pilosulous, calyx lobes oblong-ovate, about 1 mm long, pilosulous, corolla tube glabrous, slender, 8-11 mm long, dilated somewhat near top, lobes ovate, acute, pilosulous without, about 4-6 mm long, orange-yellow; anthers oblong-linear, 3 mm long, slightly sagittate at base, exserted, attached 2 mm below sinuses, on filaments 2 mm long, dorsifixed well below middle; style filiform, longer than corolla tube, glabrous, stigma capitate, obscurely trilobed, somewhat exserted at anthesis, ovary 3-locular; mature fruit* dark cherry red, fleshy, subglobose, 9-10 mm long, about 7 mm or more wide, with tough epidermis; seeds reddish brown, orbicular, flattened, lenticular, reticulate, 0.7 mm across.

Costa Rica: Prov. Heredia: south slope of Volcán Barba, growing in colony along stream in cool, moist forest, 2000 m, 26 June 1965, *W. H. Hatheway & Alfonso Jimenez 1461* (US, type).

This species keys, in Standley's Flora of Costa Rica, to *H. piratarum* Standl. of Cocos Island, from which it differs in its rather open subsessile cymes, 3-celled ovaries and trilobed stigmas. It is unique among Costa Rican species in its 3-celled ovaries, the rule there being 2-celled ovaries. In this respect it resembles *H. cauliflora* Hemsl. of Guatemala, from which it differs in its few-branched cymes and differently shaped leaves, with more widely spaced nerves. It may be closest to *H. angusti-*

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* Description of fruit from preserved material supplied later by Dr. Hatheway from the same colony as the type.

folia Standl. which, however, has a much shorter corolla tube and bilocular ovaries. It is dedicated to Sr. Botho Steinvorth, on whose land it was collected, in appreciation of his protection of this area, rich in Rubiaceae.

RONDELETIA AMOENA (Planch.) Hemsl.?

Costa Rica: Prov. Heredia: south slope of Volcán Barba, in rich wet forest, 1940 m, *Hatheway 1280* (US, Fo)

This plant has stiff, strongly reticulate venulose leaves which are much less pubescent than is usual for this species.

PSYCHOTRIA GRANDISTIPULA Standl.?

Costa Rica: Prov Heredia: south slope of Volcán Barba, near San José de la Montaña, 1600 m, *Hatheway 1460* (US)

This is a small tree growing in the shade of oaks in a rich moist forest. It differs from the type in its attenuate rather than subtruncate leaf-bases, longer leaf blades with more numerous veins, in the sheathing stipules much longer and more strongly marked with white (when dry), and in the truncate, rather than shallowly dentate calyx.

The material referred to this species in the U.S. National Herbarium is rather diverse and may represent more than one species. However, with only a few sheets at hand it is hard to know if the variation is individual, or if distinctive populations exist. So it seems best, for the present, to accept a broad concept of the species.

NOTES

JUNCUS CAPITATUS WEIGEL (JUNCACEAE) IN LOUISIANA: NEW TO THE UNITED STATES.—In May, 1964, while collecting weedy plants along the recently created Interstate Highway 20 between Monroe and Ruston, Louisiana, I came across an annual *Juncus* which was growing in considerable abundance on the sandy shoulders of the highway. These tiny plants were growing amongst an abundance of *Juncus bufonius* L., which to my knowledge is the only annual rush previously reported for the United States, and were of such evidently different appearance that I resolved to investigate further. Dr. L. H. Shinners, of Southern Methodist University, was kind enough to send a loan of annual *Juncus* from other parts of the world, and from the material he sent I have been able to make an identification. My plants are *J. capitatus* Weigel.

Rendle (in Bentham & Hooker, Handbook of the British Flora, ed. 7, 1930) has the following comments regarding this species: "In sandy situations, in western and southern Europe, and again in the Netherlands, north Germany, and southern Scandinavia. In the British Isles only recorded from West Cornwall and the Channel Islands. Fl. summer." Clapham, Tutin and Warburg (Flora of the British Isles, ed. 2, 1962) report it as follows: "Native. On damp heaths, especially where water has stood during the winter and characteristically associated with *Radiola*, *Isoetes histrix*, etc. Rare; Cornwall, Anglesey; reported from Hebrides (Raasay, Barra, Rhum). 3, S. S. and W. Europe and sparingly through C. Europe to S. Sweden, Finland and N.W. Russia; east to lower Don; Africa; Newfoundland (?introduced), S. America and Australia." Evidently this find is a considerable extension of known range. Since the species is presumed new to our flora, a dscription of it is included herewith.

Juncus capitatus Weigel, Obs. Bot. 28. 1772. Glabrous, tufted annual, the plants greenish, aging maroon. Leaves all basal, linear-filiform, 1.5-3.5 cm. long, flat, the margins thin, somewhat inrolled, the apex acuminate, the base loosely sheathing and with broad, short, scarious margins tapering without auricles into the blade proper. Scape linear-filiform but stiff, 4-9 cm. long, channelled, angled or somewhat flattened in cross section, terminating in headlike, bracteate glomerules of 2-6 subsessile, prophyllate flowers, the glomerules (not including bracts) ca. 4 mm. high. Bracts 1 or 2, lanceolate-attenuate, the longest 1 cm. long or slightly longer, somewhat keeled, the blade translucent, pale save for a broad, dark green (later maroon), thickened midrib which projects as a long-tapering cusp, this terete and somewhat scabrous distally. Flowers much shorter than the longer bract, the sepals ca. 3-4 mm. long, lance-ovate, attenuate, keeled, similar to the bracts in character and prolongation of midrib. Petals oblong or ovate, ca. 2.0-2.5 mm. long, obtuse or broadly

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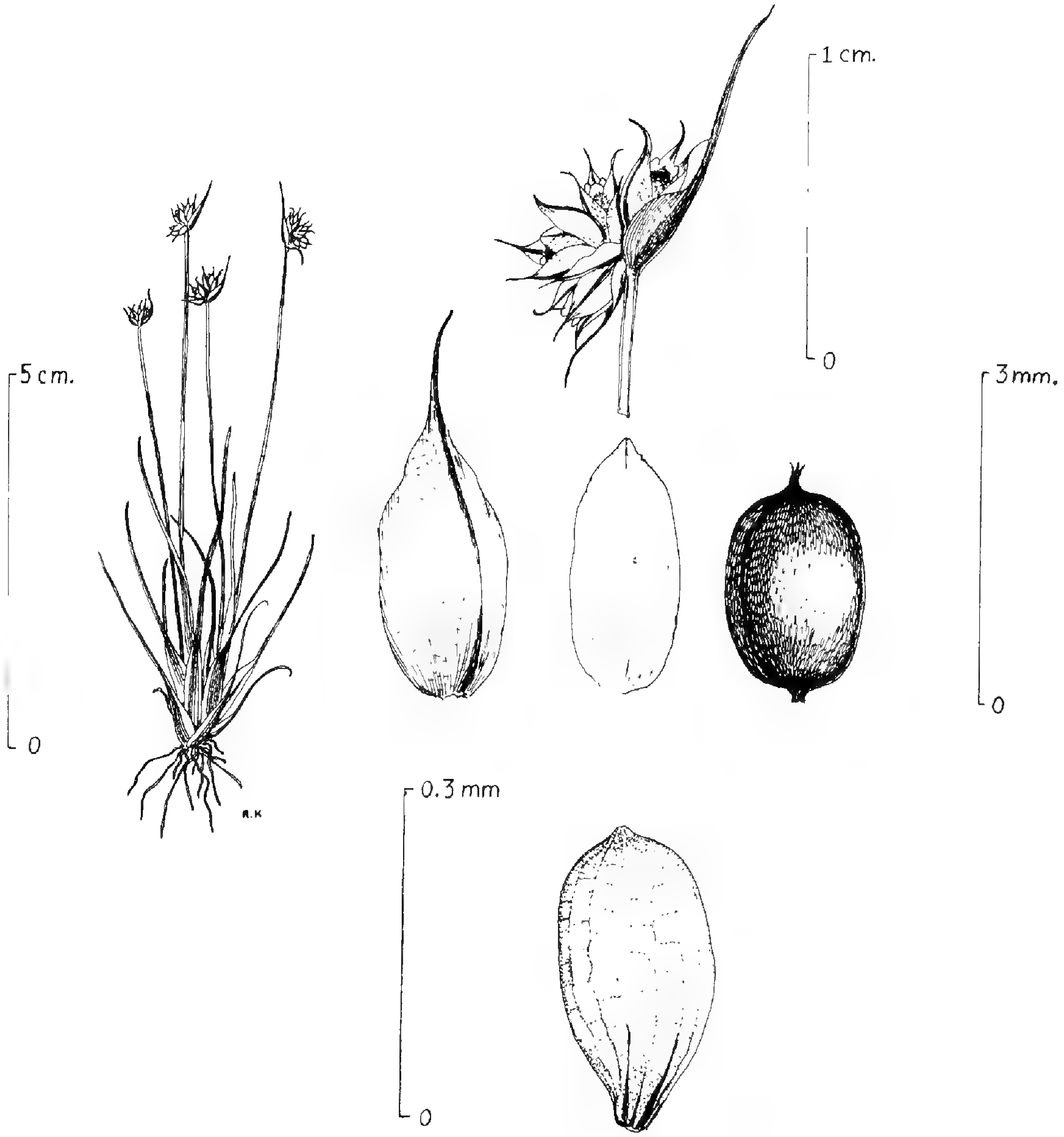
acute, entirely scarious or with faint midrib. Stamens 3. Capsules slightly shorter than the petals, broadly oblong to ovoid, truncate, short-stipitate, apiculate. Seeds obovoid to ellipsoidal, 0.2-0.3 mm. long, reticulate with 12-14 longitudinal striae and quite numerous, fainter, horizontal lines. It is shown in Clapham, Tutin and Warburg's Flora of the British Isles—Illustrations, Part IV, Monocotyledons (1965).

Collection data for the present report are as follows: LOUISIANA, Ouachita Parish: sandy shoulders of Interstate 20, by turnoff to Cheniere, particularly abundant where highway traverses large *Nyssa* bottom, *R. Kral 20029,* 6 May 1964 (VDB, SMU).—*Robert Kral, Department*



Juncus capitatus Weigel. Left, habit sketch of plant. Upper right, inflorescence (enlarged). Middle right, from left to right: sepal, petal, capsule. Lower right, a seed.

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CERASTIUM GLUTINOSUM FRIES (CARYOPHYLLACEAE) IN MISSISSIPPI: NEW TO NORTH AMERICA.—In routinely checking a key to Southeastern *Cerastium* prepared early in 1962 with some newly mounted collections, I was embarrassed to find that it did not work with one sheet of specimens collected by myself. This proved to have a mixture of the common *C. glomeratum* Thuill. (*C. viscosum* of American authors) and three plants of a different species, finally identified with the help of the key in W. Möschl's "Über einjährige europäische Arten der Gattung *Cerastium (Orthodon-Fugacia-Leiopetala)*" (Feddes Repertorium Sp. Nov. 41: 153-163, 1936) as *C. glutinosum* Fries of Europe, Asia Minor and North Africa, and matched with one sheet each from France and Germany in the SMU Herbarium. Collection data are as follows. MISSISSIPPI, Wayne Co.: 3.6 miles southeast of Waynesboro, sandy clay road shoulder, *Shinners 29,342*, 8 April 1961. The sheet contains two plants of *C. glomeratum* at left (it was originally labeled as that species), and three of *C. glutinosum* at upper right. The latter are less conspicuously pubescent and have somewhat narrower leaves and less congested flowers, but in general appearance are very similar to those of *C. glomeratum*. Numerous collections have been made since in hopes of finding more *C. glutinosum*, but all proved to be *C. glomeratum* but one. The exception *(31,204*, from vacant lot in Hamilton, Marion Co., Alabama, 22 April 1966) was *C. brachypetalum* Persoon, which also greatly resembles *C. glomeratum*. I suspect that closer examination of herbarium specimens filed as *C. viscosum* would bring to light additional records of different species. My revised key to *Cerastium* in the Southeastern United States is as follows:

1a. Petals 1½-2½ times as long as the sepals; sepals obtuse to subacute
  2a. Floral bracts scarious-margined; plant perennial . 1. *C. arvense*
  2b. Floral bracts herbaceous throughout; plant annual
    3a. Pedicel 1-3 times as long as calyx in flower, up to 5 times in age . . . . 2. *C. nutans*
    3b. Pedicel ½-1¼ times as long as calyx in flower, up to 3 times in age . . . . 3. *C. brachypodum*
1b. Petals slightly longer to shorter than the sepals, or absent; sepals subacute to short-acuminate
  4a. Sepals with long hairs on back becoming shorter and stopping below apex
    5a. Floral bracts pilose on upper surface . . . . 4. *C. tetrandrum*
    5b. Floral bracts glabrous on upper surface
      6a. Sepals 5.0-6.6 mm. long; plant perennial (but may flower in its first year) . . . . 5. *C. holosteoides*

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6b. Sepals 3-5 mm. long in flower; plant annual
  7a. Floral bracts prominently scarious-margined . . . . 6. *C. semidecandrum*
  7b. Floral bracts herbaceous throughout . . 7. *C. glutinosum*
4b. Sepals with long hairs on back up to and projecting beyond apex
  8b. Petals about equalling to slightly exceeding calyx, or petals absent; pedicels shorter than calyxes . . . . 8. *C. glomeratum*
  8b. Petals present, about half as long as calyx; pedicels rapidly elongating, exceeding calyxes while in flower 9. *C. brachypetalum*

In accordance with current European practice I have used the name *C. holosteoides* Fries for the plant listed in most American floras as *C. vulgatum.* The matter is discussed in Nils Hylander's "Studien über nordische Gefässpflanzen" (Uppsala Univ. Arsskr. 1945: 7, pp. 150-151). —*Lloyd H. Shinners.*

HYPOCHOERIS MICROCEPHALA VAR. ALBIFLORA (COMPOSITAE) IN SOUTHEASTERN TEXAS: NEW TO NORTH AMERICA.— White-flowered cichoriaceous Compositae are not very numerous, and it was a surprise to find one growing abundantly along a roadside in extreme southeastern Texas. I at first suspected it was a *Crepis,* but later examination revealed a plumose pappus, characteristic of *Hypochoeris.* Because the associated plants included several weeds introduced from South America—*Sisyrinchium exile, S. rosulatum, Verbena brasiliensis, V. litoralis, Gnaphalium pensylvanicum (G. peregrinum)*—recourse was had to Cabrera's *Manual de la Flora de los Alrededores de Buenos Aires* (1953). The unknown plant keyed readily to *Hypochoeris microcephala* (Sch.-Bip.) Cabrera var. *albiflora* (Kuntze) Cabrera, but there were no specimens of this in the SMU Herbarium. A duplicate was sent to Dr. Arthur Cronquist, who kindly confirms the identification after comparison with Kuntze's type at the New York Botanical Garden. Collection data are as follows. TEXAS. Orange Co.: 6 miles north of Orange on State Highway 87 (from north-side junction with Interstate 10), *Shinners 31,370,* 17 May 1966 (SMU, NY, G, LAF, MO, TEX). "Shallow roadside ditch bank, sandy silt. Seen in abundance for 2 miles north from here. Heads nearly closed (10 A.M., partly cloudy); ligules white." Plants 40-60 cm. tall from a rather thick taproot, glabrous. Basal leaves rather few, sometimes still green but mostly withered, deeply pinnatifid with acute lobes; stem leaves similar but smaller, also few and confined to basal ½ of plant or less, passing to lance-linear, entire, acuminate bracts. Involucres 10-16 mm. tall. Pappus bristles white, very plumose.

This is the second South American species of this genus to be found in the Southern United States. The other, *H. Tweedii* (Hook. & Arn.) Cabrera, is known from Georgia and South Carolina. According to Joseph

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Monachino (Castanea 22: 110-111, 1957) this was first collected in 1918 by John K. Small on Tybee Island, Chatham Co., Georgia, and reported by him in his *Manual of the Southeastern Flora* (1933) as *Crepis foetida.* Monachino, calling the plant *H. elata* (Wedd.) Griseb. (but with the comment that this is "probably a synonym" of the earlier *H. Tweedii)* reports another collection from Allendale Co., South Carolina, made in 1956 by C. Ritchie Bell. I have seen the following three specimens (all at SMU). GEORGIA, Grady Co.: Cairo; common as lawn weed, *R. Kral 4752,* 30 May 1957. SOUTH CAROLINA, Marlboro Co.: roadside, Beaverdam Creek 1½ miles south of McColl near S. C. 381, *A. E. Radford 12639,* 10 June 1956. ARGENTINA. La Plata: Bosque, *A. L. Cabrera 3414,* 29 November 1936. The two European species previously known from the Southeastern United States give a total of four, which includes all those known from North America. They may be separated as follows:

1a. Pappus bristles of two types: inner ones long-plumose, outer merely scabrous and mostly shorter than the inner; flowering stems leafless or nearly so (at most with reduced leafy bracts abruptly much smaller than the numerous basal rosette leaves)
  2a. Corollas 1½-2 times as long as the involucre; leaf blades rather densely hispid-pilose . . . . *H. radicata L.*
  2b. Corollas 1½ times as long as the involucre or less; leaf blades glabrous or nearly so . . . . *H. glabra L.*
1b. Pappus bristles all alike, all long-plumose; flowering stems leafy in lower portion; corollas equalling or only slightly exceeding the involucre
  3a. Involucre cup-shaped in flower, nearly as broad as high or broader, moderately hispid-pilose . . *H. Tweedii* (Hook. & Arn.) Cabrera
  3b. Involucre ovoid-cylindric in flower, half as broad as high or less, glabrous . . . *H. microcephala* (Sch-Bip.) Cabrera var. *albiflora* (Kuntze) Cabrera

The collection of *H. microcephala* var. *albiflora* was made in the course of field work toward a Flora of the Gulf Southwest supported by a grant from the National Science Foundation, for which grateful acknowledgment is made.—*Lloyd H. Shinners.*

SIDA CONTRIBUTIONS TO BOTANY

VOLUME 2 NUMBER 6 DECEMBER 1966

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SIDA is privately published by Lloyd H. Shinners, SMU Box 473, Dallas, Texas 75222, U.S.A. Subscription price $6 (U.S.) per volume of about 360—400 pages, parts issued at irregular intervals.

OBSERVATIONS ON THE FLORA OF THE SOUTHEASTERN UNITED STATES WITH SPECIAL REFERENCE TO NORTHERN LOUISIANA

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The appearance in the lower portions of the Gulf Coastal Plain of northern woodland elements has long aroused the curiosity and subsequent comment of botanists. A consensus of opinion has it that these plants are leftovers of Pleistocene floras; certainly their almost invariably "insulated" location in steep, highly shaded ravines or in deep, relatively undisturbed mesic woodlands, is strongly suggestive of such a history. Particularly noteworthy areas are to be found in northwestern Florida (Marianna Caverns State Park, the Apalachicola River bluff country) and in southern Alabama. Certainly these regions of the Gulf Coastal Plain are far richer in such species than are the more monotonous physiographies of Mississippi and Louisiana. The same may also be said of endemic species, the number being far higher in Florida and Alabama than is true for Mississippi or Louisiana; again the explanation is probably tied in with the greater topographic and geologic diversity in the former two areas.

In the spring of 1959 and again in the period from 1962 to 1964 I became interested in locating habitats which would yield similar species in northern Louisiana. The northern parishes of Louisiana have long been known to harbor certain species more typical of the Interior Highlands, Appalachians, or woodlands and prairies of the central lowlands. Several species had already been reported on or collected by Dr. John Moore, Dr. Clair Brown, Miss Caroline Dormon or Dr. L. H. Shinners (i.e. some noteworthy finds such as *Uvularia sessilifolia, Erythronium rostratum, Lilium michauxii, Cypripedium calceolus, Quercus macrocarpa, Silene virginica, Sanguinaria canadensis, Geranium maculatum, Dodecatheon meadia, Viola eriocarpa, Silphium terebinthinaceum, S. laciniatum, Cacalia plantaginea*, and many more). Thus the results of my own field work have not been very exciting in terms of new finds. Often a full day of investigating what seemed to be fine collecting areas of hardwood forested tracts, richly endowed with deep rich soils, would net me nothing in the way of species which would have abounded in similar habitats to the north in the mid-west. Yet, when I would, with much walking and a little luck, finally come on a northern woodland element it would be in considerable, often breathtaking, abundance. However, such finds would usually be only of one or two species. For example, a wooded area of alluvial high bank might yield clouds of yellow *Ery-*

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thronium, but hardly another species while a similar habitat in Missouri or Illinois would have *Trillium recurvatum, Anemonella, Phlox, Sanguinaria, Mertensia, Viola (missouriensis, eriocarpa,* and others), etc. Searches of wooded ravine floras were often more disappointing. In the course of some of these long, often fruitless, walks, I finally began to see what a possible explanation could be. Most of the discoveries appeared to be of clones rather than dispersed populations of many clones; this is an indication that some barrier to development of seedlings is active or at least intermittently active.

Reasoning further, and on the basis of observations in northern Louisiana and east Texas, there appear to be two sorts of habitat complexes of northern woodland plants. One group is comprised of ravine bank species, i.e. *Adiantum pedatum, Woodsia obtusa, Carex jamesii, Chamaelirium luteum, Lilium michauxii, Campanula americana, Cypripedium calceolus, Quercus borealis, Magnolia acuminata, Silene virginica, Saxifraga virginiensis, Hydrangea arborescens, Amelanchier arborea, Cynoglossum virginianum, Erigeron pulchellus, Senecio obovatus.* Another appears to be found on alluvial sites: *Uvularia sessilifolia, Polygonatum biflorum, Erythronium rostratum, Trillium recurvatum, Sanguinaria canadensis, Dentaria laciniata, Podophyllum peltatum, Gillenia stipulacea, Senecio aureus, Polymnia uvedalia,* etc. A third and smaller group does not appear to be as selective and may be fairly abundant in either sort of habitat, i.e. *Botrychium virginianum, Podophyllum peltatum, Phlox divaricata, Arisaema triphyllum, Lindera benzoin.*

The first group appears to be hanging on where cold air drainage is most likely to be impounded, where there is more cool air because of less intense insolation, where rough topography more likely maintains their narrow foothold on life simply by making an area less suitable for crop farming, pasture, or logging.

The second group persists like shallow pools left by a retreating Pleistocene tide, namely on "older" alluvial soils. These areas must be little disturbed; grazing or logging, however light, appear to have a final effect. In the midwestern United States, where all of this alluvial complex of species is far more abundant, succession on newly formed alluvium is quite rapid. Thus, as rapidly as a meandering stream cuts through older alluvium, newly created area is being occupied by seedlings and the species remain abundant. In northern Louisiana this does not seem to be the case. One is struck by the size, also the infrequency of the population there.

A possible explanation, in the case of the first group, is that the ravine species are being eroded out of suitable habitats by headward cutting of streams. This first of all relates to the immensely greater amount of erosion water during the wet cycles of the Pleistocene, a period during which much sharp cutting was occurring with the creation of many good ravine habitats for such plants to occupy. Probably these situations at close of the Pleistocene were similar to the spring woodlands of northern Illinois and were filled with an abundance of species, all of course reproducing prolifically by seed. After the Pleistocene, and accompanying a warming and drying, the number of suitable habitats to the south decreased and therefore the area of such species decreased, becoming confined to the coolest localities (i.e. deeper ravines, north-facing steep wooded slopes). As the erosion cycle progressed, ravines widened and warmed save at their heads; hence the surviving populations migrated headward in the ravines and branch ravines. Most of such migration was, and is, through lateral movement of vegetative propagules. This would account for the presence of isolated populations in the branches of major drainages such as the Bayou D'Arbonne in northern Louisiana, and their usual absence along the larger, broader valley slopes. Thus, as erosion continues, and as warmer conditions poor for reproduction by seed persist, the fate of the few remaining stands of plants is predictably poor. This may also explain the sparse number of species in any one locality.

In the case of the second, or alluvial woodland, group there again appears to be a maintenance primarily by vegetative reproduction. Populations of *Podophyllum*, for example, are large, luxuriant, and probably very ancient. The same is true for *Erythronium, Trillium, Sanguinaria, Dentaria, Polygonatum, Uvularia*. They invariably occupy older alluvial terraces of streams. In northern Louisiana west of the present delta the bulk of the streams reside in quite old valleys, which often have two definable terraces. The older terraces probably represent the boundary of oscillation of streams whose load was vastly greater; confined within these boundaries are the more recent floodplains of the present streams. In the newer floodplains, portions of the older floodplains exist as low, gradually eroding, islands; if such are wooded and relatively undisturbed they are often abundantly carpeted by one or more of the above-mentioned types of plants. Little or no reproduction by seed seems to go on, but vegetative reproduction does. Gradually, these populations are worked away by the cutting of the streams, become more and more isolated from one another and ultimately disappear. Again, as is the case with the ravine plants, their fate is plain unless the weather pattern in the region should again change. It is interesting to see these old "islands" of *Podophyllum, Erythronium, Trillium* etc. being melted away by the inexorable cutting action of the streams. Many such examples are presently in evidence along the Bayou D'Arbonne, the Bayou Bartholemew, Sugar Bayou and on a grander scale along the Red River and its tributaries to the west.

In northern Louisiana west of the big delta of the Mississippi which is bounded to the west by the Ouachita River, a sort of axis of parishes exists south of which many of the above-mentioned plants do not seem to occur. This axis, from my observations, appears to be through Ouachita, Lincoln, Bienville, Webster, and Caddo Parishes and it is only broken by the Red River system. *(Erythronium, Uvularia, Polygonatum* have been found south of this axis but only along the Red River). While mesic woodland elements are plentiful south of the axis, they are of a different history. In fact these (i.e. *Trillium maculatum, Magnolia grandiflora, Viburnum acerifolium, Ilex longipes, Asimina parviflora, Acer barbatum, Acer leucoderme, Magnolia pyramidata, Lilium michauxii, Ilex vomitoria, Hydrangea quercifolia)* appear to be part of an older forest whose movement into Louisiana was from the east in the Gulf Coastal Plain. In fact, and as commented on by earlier workers, there is a striking similarity between the floras of Sabine Parish, Louisiana and the Big Thicket of eastern Texas, and that of northwestern Florida and southern Alabama. Some species have been winnowed out from east to west, but a great many are shared by all areas.

It would seem to me that one of the most critical areas for descriptive or floristic ecology remains literally untouched in northern Louisiana and eastern Texas. Many extensive stands of hardwood forest still remain relatively undisturbed as the region is still not very heavily populated. However, such studies must be done soon. Industry in the form of hardwood pulp, veneer, and furniture mills is rapidly moving into the region; in many other parts of these areas hardwoods are being cleaned out to make room for pine. Many of the beautiful streams of northern Louisiana are being dammed up with a subsequent destruction of bottomland hardwood communities.

ANNOTATED LIST OF NOTEWORTHY SPECIES

Most of the collection of plants here cited have been gotten from the Gulf Coastal Plain by the present author during a period extending from 1958 to the present; a few represent earlier field activity in Florida or records now in the Herbarium of Vanderbilt University from other sources. While several do not constitute state records, they are reported as significant toward a better understanding of floras of the states involved. Certainly these reports should indicate the value of further field exploration of the region.

Species are cited in accordance with Engler and Prantl.

Voucher specimens of all collections are deposited in the Herbarium of Vanderbilt University (VDB), Nashville, Tennessee.

Costs of field work contributing to this research were met in large part by grants to the author by the National Science Foundation (NSF GB-159, NSF GB-3255).

Woodsia obtusa (Spreng.) Torr.

LOUISIANA. UNION PAR.: 3 mi. s. Farmerville on arenaceous open slope, s. side Bayou D'Arbonne, 1 June 1963, *Kral 17280.*

Previously reported from Louisiana, but certainly infrequent and a record for the Parish.

Adiantum pedatum L.

LOUISIANA. UNION PAR.: ca. 4 mi. s.w. Farmerville on shaded sandy loam of bluff above Bayou D'Arbonne, 30 May 1963, *Kral 17264*.

Previously reported from Louisiana, but from the bluff regions along the Mississippi. Locally abundant in the loess in the vicinity of Vicksburg and Natchez, Mississippi. Certainly a record for Union Parish, over 100 miles to the west.

Festuca dertonensis (All.) Aschers. & Graebn.

LOUISIANA. Ouachita Par.: 15 mi. s.w. West Monroe; occasional on moist sandy clay of edge of beech bottom, 1 May 1959. *Kral 8756:* 3 mi. n. Schwartz on exposed sandy clay of open oak-pine woods, 24 Apr. 1959, *Kral 8642*.

Considered by Hitchcock (1950) as a waif in the eastern United States. Hitherto reported from Texas, Florida and Virginia but not from Louisiana.

Festuca magalura Nutt.

LOUISIANA. Ouachita Par.: n.w. side West Monroe along Arkansas Road; common on sandy roadbank, 10 April 1959, *Kral 8447;* 7 mi. s.s.w. West Monroe; frequent on sandy clay of railroad embankment, 1 May 1959, *Kral 8735*. LINCOLN PAR.: Ruston; sands and gravels of railroad grade, 15 April 1963, *Kral 16738*.

Sacciolepis indica (L.) Chase.

FLORIDA. FRANKLIN CO.: Lanark Station; black peat-muck of pineland ditch, 23 Sept. 1964, *Kral 23006*. GULF CO.: roadside ditch bordering flatwoods just s. of Wewahitchcka, *Godfrey & Clewell 62627*. MANATEE CO.: 19 mi. e. Bradenton on sandy peat of pineland savanna-bog, 21 July 1963, *Kral 17959*. MARTIN CO.: 3 mi. s. Stuart on sandy peat of pine flatwoods ditch, 1 Aug. 1963, *Kral 18294*. NASSAU CO.: 4.3 mi. s. Hilliard on moist sandy peat of pineland clearing, 15 Sept. 1964, *Kral 22747*. ORANGE CO.: 15 mi. e. Orlando; sandy peat of grass-sedge bog; bases decumbent, rooting at nodes, *Kral 5444* (12 Aug. 1957). S. LUCIE CO.: 1 mi. n. Martin Co. line along US 1; sandy peat of pine flatwoods ditch, 3 Aug. 1963, *Kral 18355*. *GEORGIA*. BULLOCH CO.: ditch. 6.5 mi. s. Statesboro; bog-sandridge complex, 31 Aug. 1964, *Kral 22390*. SCREVEN CO.: roadside ditch 7 mi. s. Sylvania; bog and adjacent sandy pasture, 31 Aug. 1964. *Kral 22362*.

This species has been reported from the Carolinas and Georgia, but not from Florida. This adventive appears to be making itself rapidly at home in the gress-sedge bogs of the coastal plain.

Cyperus articulatus L.

LOUISIANA. Ouachita Par.: plupwood siding in Cheniere Brake ca. 7 mi. s.w. West Monroe, 9 June 1964, *Kral 20347*.

This sedge is common on more brackish soils toward and along the Louisiana coast, but is an unusual find this far north in the state; found here in association with *Lythrum lineare L. (Kral 20343)* and *Cyperus acuminatus* Torr. & Hook. *(Kral 20342).*

Cyperus cayennensis (L.) Britton.

FLORIDA. ESCAMBIA CO.: sandy roadbank on Escambia County side of Perdido River, w. of Pensacola, 8 July 1963, *Kral 17709.*

Hitherto not reported from east of Louisiana.

Hemicarpha aristulata (Coville) Smyth.

FLORIDA. Charlotte Co.: 15 mi. n.n.w. Fort Myers; rare on moist sandy peat of roadside ditch, 29 July 1958, *Kral 7533b.*

Argument exists as to the distinctness of this species, some workers assigning it to *Hemicarpha micrantha* (Vahl.) Britt. as a variety (var. *aristulata* Cov.). It is primarily distinguished by its long-tapering, recurved bracts; I inadvertently collected it along with *H. micrantha* and did not for some time recognize the find. This entity has not previously been reported from east of Missouri.

Scirpus cubensis Poepp. & Kunth.

LOUISIANA. JACKSON PAR.: Chatham Lake, Chatham; forming floating mats in shallow water of lake, 1 Nov. 1963, *Kral 19427.*

Previously reported from Louisiana, but certainly rare within its range. (According to Small (1933), a native of the tropics and occurring in the U.S. from La. to Fla.) However, a good find for so far north in Louisiana.

Carex jamesii Schwein.

LOUISIANA. CALDWELL PAR.: Columbia; occasional on loam of oak-beech forested slope, 1 May 1959, *Kral 8773.*

Not previously reported from south of Missouri.

Xyris ambigua Beyr.

LOUISIANA. UNION PAR.: bog 1 mi. n. Bernice, 5 July 1965, *Kral 24560.*

A common *Xyris* of pine flatwoods southward in the state; however, this is a record from close to the Arkansas line and an indication that *X. ambigua* may soon be added to the Arkansas flora. Certainly there are habitats just as favorable in southern Arkansas.

Xyris drummondii Malme.

ALABAMA. BALDWIN CO.: 9.8 mi. n.e. Bay Minette in flatwoods bog, 6 Sept. 1965, *Kral 25933.* ESCAMBIA CO.: 2.2 mi. s.w. Brewton; seepage bog in longleaf pine, 6 Sept. 1965, *Kral 25951.* WASHINGTON CO.: 5.0 mi. s. Tibbie in seepage bog, 6 Sept. 1965, *Kral 25896. GEORGIA.* BRANTLEY CO.: 2 mi. s. Nahunta on wet exposed sandy peat of flatwoods, 15 Sept. 1964, *Kral 22797.*

This diminutive perennial species is probably much more abundant than its scarcity in collections would indicate. Hitherto not reported from the above-mentioned states.

Xyris difformis Chapm. var. *floridana* Kral.

LOUISIANA. WASHINGTON PAR.: just n. Varnado on wet sandy clay of ditch through pine flatwoods, 5 Sept. 1963, *Kral 19385*.

This variety, easily recognized by its maroon tinted leaf bases and its farinose seed, was identified by J. K. Small as *X. serotina* Chapm., a totally different species. However, in that the Manual includes neither entity for Louisiana, it is safe to admit the collection as a record.

Xyris iridifolia Chapm.

ARKANSAS. OUACHITA CO.: margins of Bragg Lake, Bragg City, P. O. Chidester, 9 Sept. 1964, *D. Demaree 51312*.

The first known collection of this species from Arkansas, although it is fairly common in southern Louisiana and Texas.

Xyris serotina Chapm.

ALABAMA. BALDWIN CO.: flatwoods ditch, 5.4 mi. s. Foley, 25 Sept. 1964, *Kral 23133*. *GEORGIA*. LIBERTY CO.: just n. of Liberty Co. line vicinity Walthourville, 17 Aug. 1963, *Kral 18853*. LONG CO.: 21 mi. n.w. Darien on wet sandy peat of low pine flatwoods in Altamaha River basin, 17 Aug. 1963, *Kral 18881*. McINTOSH CO.: 3 mi. s. Eulonia on heavy sandy clay peat of pothole in oak-pine barrens, 14 Aug. 1963, *Kral 18683;* 10 mi. w.n.w. Darien on moist to wet sandy peat of potholes and ditch in low pine flatwoods, 15 Aug. 1963, *Kral 18746 A*. *NORTH CAROLINA*. COLUMBUS CO.: 11 mi. s.e. Whiteville on wet sandy peat of ditch in longleaf pine flatwoods, 24 Aug. 1963, *Kral 19035*. *SOUTH CAROLINA*. BEAUFORT CO.: 9 mi. n. Savannah on black sandy peat of cypress-pine flatwoods, 21 Aug. 1963, *Kral 18926*.

This species, long ago described by Chapman, is distinct in being the only farinose seeded *Xyris* that lacks maroon or red pigmentation in its leaf bases. It is similar in size and habit to *X. difformis* and has sometimes been so identified. Not previously known from the above-mentioned states.

Xyris stricta Chapm.

GEORGIA. BRYAN CO.: s. side Richmond Hill on wet peat of ditch through wet pine flat woods, 17 Aug. 1963, *Kral 18813*. COLQUITT CO.: 6 mi. s.e. Moultrie on ditch through pine-palmetto flatwoods, 24 Aug. 1964, *Kral 22099*. IRWIN CO.: 2 mi. w.s.w. Ocilla on wet peat by pineland pond, 25 Aug. 1964, *Kral 22155*. LIBERTY CO.: just n. of Liberty Co. line vicinity Walthourville on peaty margin of cypress-gum swamp, 17 Aug. 1963, *Kral 18852*. LONG CO.: 11 mi. w. Eulonia on moist to wet sandy clay peat of dried up pothole in pine flatwoods, 14 Aug. 1963, *Kral 18711;* 21 mi. n.w. Darien on wet sandy peat of low pine flatwoods in Altamaha River basin, 17 Aug. 1963, *Kral. 18882*. McINTOSH CO.: 3 mi. s. Eulonia on heavy sandy clay peat of pothole in oak-pine barrens, 14 Aug. 1963, *Kral 18682;* 10 mi. w.n.w. Darien on wet sandy peat of ditch in low pine flatwoods, 15 Aug. 1963, *Kral 18747;* Darien, on peaty bottom of dried up cypress-pond pine slough, 21 Aug. 1963, *Kral 18891. SOUTH CAROLINA.* BEAUFORT CO.: 9 mi. n. Savannah on wet sandy peat of ditch in pine-cypress flatwoods, 21 Aug. 1963, *Kral 18922.* GEORGETOWN CO.: 315 mi. s. Andrews on sandy peaty ditch in pineland savanna, 28 Aug. 1963, *Kral 19160.* HAMPTON CO.: 4 mi. s. Estill on peaty edge of cypress-gum swamp, 29 Aug. 1963, *Kral 19219.* JASPER CO.: 13 mi. n. Hardeeville on peaty clearing in low pine flats, 21 Aug. 1963, *Kral. 18901.*

This long overlooked species (treated however by Small as distinct), has not been reported previously from the above states.

Xyris scabrifolia Harper.

ALABAMA. BALDWIN CO.: 4 mi. e. Elberta in sphagnous pineland bog, 25 Sept. 1963, *Kral 23158.*

This, the rarest of U.S. *Xyris* and a suspected hybrid, has not previously been found in Alabama.

Eriocaulon texense Korn.

ALABAMA. WASHINGTON CO.: piney woods bog 7.8 mi. n. Citronelle along Ala. 17, 8 May 1966, *Kral 26468;* seepage area, Tibbie, 8 May 1966, *Kral 26483;* Bassett Creek bottoms just n. Chatom along Ala. 17, 9 May 1966, *Kral 26602. LOUISIANA.* BEAUREGARD PAR.: 7 mi. e. DeRidder in peaty depression in longleaf pine savanna bog, 29 Apr. 1963, *Kral 16992;* 5 mi. s. Singer on muck of sphagnous sarracenia bog, 9 May 1963, *Kral 20158.* VERNON PAR.: ca 3 mi. s. Ft. Polk; seepage area of sandy peat, depression in longleaf pine hills, 30 Apr. 1963, *Kral 17233;* ca. 4 mi. s. Ft. Polk, 29 Apr. 1963, *Kral 16772;* ditch between Rosepine and Ludington, 9 May 1963, *Kral 20078.*

This *Eriocaulon* was not previously known from outside Texas, but more localities for it are being found each spring in the Gulf states. Dr. Shinners has collected it from Mobile and Baldwin counties in Alabama and George County in Mississippi; Mr. McDaniel has collected it from northwestern Florida.

Chamaelirium luteum (L.) Gray

LOUISIANA. LINCOLN PAR.: ca. 4 mi. w. Ruston on loam of beech forested draw; flowers white, 15 Apr. 1963, *Kral 16742.*

Not previously reported from south of Arkansas.

Erythronium albidum Nutt.

TEXAS. SABINE CO.: 4.7 mi. w. Geneva; beech-oak-pine wood above Palo Gaucho Creek; sandy loam pockets in sandstone outcrop area, 18 Mar. 1965, *Kral 23362.*

Not a usual find in eastern Texas and quite distinct from the var. *coloratum* which is so frequent around Dallas. Mentioned not as a record for the state but because of its proximity to similar habitats in Louisiana.

Erythronium rostratum. Wolf.

LOUISIANA. BIENVILLE PAR.: ca. 4 mi. e.s.e Gibsland in beech maple bottom, 23 Mar. 1963, *Kral 16367;* 0.9 mi. e. Gibsland on high banks of hardwood bottom, 17 Mar. 1965, *Kral 23340.* CLAIBORNE PAR.: 5 mi. n.n.e. Arcadia on shaded high spot in alluvial bottom, 29 Mar. 1963, *Kral 16415.* LINCOLN PAR.: 2.5 mi. n.w. Vienna on higher alluvial terraces of mesic-forest Cypress Creek bottom, 20 Mar. 1963, *Kral 16349. TEXAS.* SABINE CO.: 4.7 mi. w. Geneva; beech-oak-pine wood above Palo Gaucho Creek; silty bottomland, *Kral 23369.* SAN AUGUSTINE CO.: ca. 8 mi. n.e. San Augustine along branch of Paulo Gaucho Creek on sandstone outcrop area under beech-oak-hickory; soil a sandy silt loam, *Kral 23355.*

This species is previously known from Louisiana, the Lincoln Parish locality has already been cited. However, it is much more abundant in the northern parishes of Louisiana than collection records indicate. Yellow *Erythronium* has not, according to Dr. Shinners, been known from Texas save as a sight record. In the above-mentioned Texas localities it is so abundant as to cover whole slopes.

Trillium recurvatum Beck.

LOUISIANA. CADDO PAR.: bluffs at Ft. Humbug, Shreveport, 13 Mar. 1964, *Kral 19449;* 17 Mar. 1965, *Kral 23388.* CLAIBORNE PAR.: ca. 12 mi. n. Arcadia in alluvial bottom: T20N, R5W, Sec 33: overstory of beech, oak, maple, 29 Mar. 1963, *Kral 16420;* 14 Mar. 1965, *Kral 23337;* Sugar Bayou bottoms e. Aycock, T20N, R5W, Sec 27 on higher alluvium of hardwood bottom, 29 Mar. 1963, *Kral 16412;* 5 mi. n. Gibsland along Leatherman Creek; infrequent in alluvial woods, 22 Mar. 1964, *Kral 19489.* LINCOLN-CLAIBORNE PARS.: 15.6 mi. n.w. Vienna along La. 146; sandy silt loam of Sugar Bayou, a high spot, 14 Mar. 1965, *Kral 23338.* UNION PAR.: 4 mi. s.e. Farmerville; higher alluvium of small, hardwood-shaded, creek bottom, 12 Apr. 1963, *Kral 16679.*

Although this species has been reported from Louisiana, actual specimens of it appear hard to come by. It does not appear to be able to stand grazing; ungrazed woodlands along Sugar Bayou have an abundance while the same habitat, if grazed, is devoid of this *Trillium.* It was doubtless much more abundant in alluvial situations in northern Louisiana before the advent of such disturbance.

Uvularia sessilifolia L.

LOUISIANA. LINCOLN PAR.: 2 mi. w.n.w. Ruston on sandy alluvium of stream-bank in beech woods, 27 Mar. 1963, *Kral 16401;* 15 Apr. 1963, *Kral 16743;* 2 mi. n. Ruston in beech bottom on low rises, 12 Apr. 1963, *Kral 16652.*

Previously reported from as far south as Natchitoches, and from Lincoln Parish by Dr. John Moore, but mentioned here to cover a large distribution soon to go out.

Nolina atopocarpa Bartlett.

FLORIDA. FRANKLIN CO.: 6 mi. below Sumatra; sandy peat of pine flatwoods, *Kral & Godfrey 15049.*

Of such limited distribution (pinelands, eastern peninsular Florida) that this represents an interesting extension of known range.

Smilax herbacea L. var. *lasioneuron* (Hook.) DC.

LOUISIANA. LINCOLN PAR.: ca. 2 mi. n.w. Vienna; a vine on sandy railroad embankment, 15 Apr. 1963, *Kral 16725.*

Hitherto not reported west of Alabama in the coastal plain, and a record for Louisiana for the species.

Iris verna L.

ALABAMA. MOBILE CO.: 20 mi. s.e. Citronelle in sandy longleaf pine-turkey oak hills by Ala 41, 4 Apr. 1966, *Kral & Henderson 26188.* WASHINGTON CO.: 0.6 mi. s. Tibbie along US 17 in pine flatwoods, 5 April. 1966, *Kral & Henderson 26197.*

Already reported from Alabama, but mentioned for its southerly location and proximity to northwestern Florida from which there are sight records for the species.

Corylus americana Walt.

LOUISIANA. UNION PAR.: tall shrubs in recently cut over bottom ca. 3 mi. s.s.e. Farmerville above Lake D'Arbonne on Farmerville-Monroe Rd., *Kral 16322* (flowers, 28 Feb. 1963); 1 June 1963, *Kral 17284; Kral 23220* (fruit).

Collected by Dr. John Moore (Louisiana Tech) from Morehouse Parish and reported on that basis by John Thieret (in Sida). Thus the above collections represent a Parish record for this northern shrub which is so rare in Louisiana.

Quercus borealis Michx. f.

LOUISIANA. UNION PAR.: 3 mi. s. Farmerville; tree ca. 80', 12" d.b.h., only lower bark deeply furrowed, quickly becoming gray with broad, smooth, long flat ridges above, 1 June 1963, *Kral 17283.*

First reported from Louisiana by Cocks, a record being sent to Prof. Sargent. This however is a record from east of the Mississippi River while the above is the first report from west of the river in Louisiana. This collection came from amongst a rather large number of trees, these mainly confined to the steep bluffs above the Bayou D'Arbonne. I visited the locality for three successive autumns in search of mast, but was unable to obtain any. However, on the basis of leaf, bark and twig characteristics, this is definitely Northern Red Oak, being quite distinct from its cohabitant, *Q. shumardii*, in its reddish, lustrous twigs and its reddish buds. (*Q. shumardii* has grayish twigs and buds and very different, deeply lobed, leaves). Reproduction of the species is almost non-existent. It must produce only enough seedlings (during extremely cold cycles) to barely maintain populations in northern Louisiana.

Ranunculus arvensis L.

MISSISSIPPI. BOLIVAR CO.: fine soil of roadbank 2 mi. s. Winstonville, 17 Apr. 1963, *Kral 19916.*

Hitherto unreported from Mississippi. Reported in Britton & Brown (1952) as a native of Europe and occasionally introduced along the Atlantic coast. The above find is a common roadside weed in the vicinity of Winstonville.

Thalictrum mirabile Small.

ALABAMA. FRANKLIN CO.: 1.2 mi. n. Hackleburg on dripping sandstone bluff above Bear Creek, 7 May 1966, *Kral 26455.*

So far as I can determine known only from the type locality, namely "sandstone bluffs, Little Mt. in the Appalachian Plateau, Alabama." This therefore represents a significant increase in known range of the species within Alabama. A most unusual plant, growing in the shade of dripping sandstone cliffs. Very distinct in its pinkish flowers, having as its closest relative *T. clavatum* DC. of the higher parts of the Appalachian province.

Sanguinaria canadensis L.

LOUISIANA. BIENVILLE PAR.: ½ mi. s. Gibsland on sandy loam of hardwood shaded ravine, 23 Mar. 1963, *Kral 16366;* ca. 4 mi. s.s.e. Gibsland in beech-maple bottom, 23 Mar. 1963, *Kral 16368;* 17 Mar. 1965, *Kral 23339. TEXAS.* SABINE CO.: 4.7 mi. w. Geneva; beech-oak-pine woods above Palo Gaucho Creek in sandy loam pockets in sandstone outcrop area, 18 Mar. 1965, *Kral 23367.* SAN AUGUSTINE CO.: ca. 8 mi. n.e. San Augustine along branch of Palo Gauch Creek on sandstone outcrop area under beech-oak-hickory; soil a sandy loam, 18 Mar. 1965, *Kral 23350.*

Previously reported from Louisiana (C. Dormon and John Moore; a specimen from Bienville Parish collected by Dr. Moore is in the Herbarium, Louisiana Polytechnic Institute) but mentioned here to cover added localities. Mentioned by Dr. Shinners as occurring in Texas, but cited here to add distributional data on the species.

Dentaria laciniata Muhl. ex Willd.

LOUISIANA. CADDO PAR.: bluffs above Red River at Ft. Humbug, Shreveport, *Kral 19448;* 17 Mar. 1965, *Kral 23387.* CLAIBORNE PAR.: Sugar Bayou bottoms e. if Aycock, the plants abundant on higher alluvium under mixed hardwoods, 29 Mar. 1963, *Kral 16413.* LINCOLN PAR.: ca. 5 mi. n. Ruston along Cypress Creek in beech bottom, 26 Mar. 1963, *Kral 16397.* UNION PAR.: sandy silt loam of small creek bottom s. of Farmerville along Bayou D'Arbonne, 16 Mar. 1963, *Kral 16344. TEXAS.* SABINE CO.: 4.7 mi. w. Geneva; beech-oak-pine wood above Palo Gaucho Creek; sandy loam pockets in sandstone outcrop area, 18 Mar. 1965, *Kral* 23366 SAN AUGUSTINE CO.: ca. 8 mi. n.e. San Augustine along branch of Palo Gaucho Creek on sandstone outcrop area under beech-oak-hickory; soil a sandy loam, 18 Mar. 1965, *Kral 23350.*

Previously reported both from Louisiana and Texas, but mentioned here to add known localities in an area where such are scarce. *Lilium Michauxii* Poir., is here reported as a sight record from the San Augustine Co. locality; the plants were in abundance in the area, but were barely above the ground.

Hydrangea arborescens L.

LOUISIANA. UNION PAR.: ca. 4 mi. s.w. Farmerville on shaded sandy loam of bluff above Bayou D'Arbonne; a shrub, fls. white, 30 May 1963, *Kral 17266*.

Frequent on the loess in the vicinity of Vicksburg and Natchez, Mississippi, and reported from Louisiana. However, this may well represent a western record for the species in Louisiana.

Saxifraga virginiensis Michx.

LOUISIANA. UNION PAR.: 3 mi. s. Farmerville; abundant locally on moist shaded outcrop of ferrugineous shale, *Kral 8251* (6 Mar. 1959); 6 Mar. 1963, *Kral 16394*.

This small herb has not previously been reported from further south than the interior highlands of Arkansas. Dr. Steyermark, in his treatment in *Brittonia* of the *Saxifraga virginiensis* complex, categorically stated that the species did not occur souh of Arkansas. However, these Louisiana plants are no different in character than those of the Ozarks or Appalachians.

Cassia deeringiana Small & Pennell.

FLORIDA. CALHOUN CO.: frequent on drier sandy peat of savanna 5 mi. w. Blountstown, 6 June 1957, *Kral 4818*.

An extension of known range northward from southern peninsular Florida and the Keys. Probably more frequent than present sparse records indicate in that the plants very strongly resemble the common *Cassia*, *C. fasciculata*, but for their very large, woody, rootstocks.

Hypericum brachyphyllum (Spach) Steud.

LOUISIANA. VERNON PAR.: grass-sedge bog 2 mi. e. LaCamp, 12 Sept. 1962, *Kral 15803*.

A first report from Louisiana; the plants are not infrequent in northwest Florida.

Epigaea repens L.

ALABAMA. WASHINGTON CO.: 2.5 mi. w. Chatom along US 84; oak-pine woods, sandy soil, 4 Apr. 1965, *Kral & Henderson 26204*. *MISSISSIPPI*. WAYNE CO.: ravine above Chickasawhay River, 14.2 mi. w. Alabama line along US 84; sandy loam of magnolia-spruce pine stand, 22 Mar. 1965, *Kral 23401*.

Reported in Small (1.c.) from both Alabama and Mississippi, but infrequent enough in the Gulf Coastal Plain to warrant mention here.

Salpichroa origanifolia (Lam.) Baill.

LOUISIANA. LINCOLN PAR.: Ruston, Louisiana; a garden weed, 5 July 1959, Mr. Herran.

This weed, treated by Small as *Perizoma rhomboidea* (Hook.) Small, has been known previously only from Florida and the Carolinas. It is a native of South America.

Lycopus virginicus L.

LOUISIANA. LINCOLN PAR.: 4.5 mi. e. Ruston on sandy clay of stream bottom, 4 Sept. 1962, *Kral 15726;* 10 mi. e. Ruston in oak-virginia bay botton, sandy clay soil, 4 Sept. 1962, *Kral 15782.*

Stated by Henderson in his current revision of the genus as occurring west into Texas, nonetheless of infrequent occurrence in the Gulf Coastal Plain.

Wahlenbergia marginata (Thunb.) DC.

LOUISIANA. VERNON PAR.: ca. 3 mi. s. Ft. Polk; longleaf pine and hills and roadbank, 29 May 1963, *Kral 17237.*

This plant is adventive in many of the southern states (Florida, Alabama, Mississippi, the Carolinas) and is here reported to add Southwestern Louisiana to its range.

Eupatorium aromaticum L.

LOUISIANA. LINCOLN PAR.: ditchbank along Interstate 20, 10 mi. e. Ruston, 15 Sept. 1962, *Kral 16020.*

Reported from Louisiana by Fernald (1950), but evidently rare there; not reported from that state by Gleason (1952).

Solidago hispida Muhl.

LOUISIANA. UNION PAR.: ca. 4 mi. s.e. Farmerville; steep sided, heavily shaded sandstone-shale slope, 16 Oct. 1963, *Kral 19418.*

Solidago juncea Ait.

FLORIDA. LEON CO.: occasional on red sandy clay in shortleaf pine forest 1 mi. n. Tallahassee along Meridian Road; flowers pale yellow, *Kral 3633* (9 Oct. 1956). Seemingly this plant is not reported from south of Georgia.

Coreopsis gladiata Walt.

LOUISIANA. NATCHITOCHES PAR.: fine sandy soil of mature longleaf-loblolly stand, 2 Nov. 1962, *Kral 16178.*

Presently known only from as far west as Mississippi.

Bidens vulgata Greene.

LOUISIANA. NATCHITOCHES PAR.: fine sandy soil of depression in mature longleaf loblolly stand, ca. 4 mi. e. Bellwood, 2 Nov. 1962, *Kral 16187.*

Considered rare in the coastal plain and, in the longitude of Louisiana, not reported south of Missouri.

Ratibida columnifera (Nutt.) Woot. & Standl.

LOUISIANA. JACKSON PAR.: n.e. side Eros; sandy clay of roadbank, locally abundant, 9 June 1964, *Kral 20349.*

Occasional as an adventive in the Gulf Coastal Plain, but heretofore not reported for Louisiana.

Senecio aureus L.

TEXAS. SABINE CO.: 4.7 mi. w. Geneva; beech-oak-pine wood above Palo Gaucho Creek; sandy loam pockets in sandstone outcrop area, 18 Mar. 1965, *Kral 23365*.

Some difference in interpretation may exist here, in that my plants may be referred to *Senecio obovatus* Muhl.[1] However, these plants, in character of basal leaves, rosette leaves, and in general appearance differ little from the *Senecio aureus* I have collected from wet woods in western Virginia. In my opinion, *Senecio obovatus* is invariably on higher drier sites than is the case with *S. aureus*. In the gulf coastal plain this also seems to be the case. For example, *S. obovatus* is not infrequent on mesic woodland soils in northern Florida; it is extremely abundant in the woods of Marianna Caverns State Park. *S. aureus* is also in Florida but rare, thus far being found only in wet woodlands in the vicinity of Quincy, Gadsden Co., Florida. To the west in Louisiana *S. obovatus* is a plant of rich upland woods. The Senecios of the alluvial woods further west in eastern Texas need reappraisal; the above mentioned collection is noteworthy.

Carduus nutans L.

LOUISIANA. LINCOLN PAR.: N side Ruston on sandy embankment of Interstate 20, 1 June 1963, *Kral 17292*.

Previously reported from Louisiana by Shinners, but a parish record. Frequent on the disturbed alluvium of the Red River near Shreveport. This plant, a pernicious abundant weed of interior provinces eastward, appears locally in northern Louisiana on recently constructed road shoulders but does not seem to persist.

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[1] After Dr. Kral's paper was written a duplicate of this collection at SMU was identified by Dr. T. M. Barkley as a form ("rotundus phase") of *S. obovatus*.—*Editor's note.*

RORIPPA WALTERI AND R. OBTUSA SYNONYMS OF R. TERES (CRUCIFERAE)[1, 2]

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Most manuals treating the vascular plants of the southern and the western United States include both *Rorippa walteri* (Elliott) Mohr and *Rorippa obtusa* (Nuttall in Torrey and Gray) Britton as two distinct and taxonomically valid species. My studies show that both names are based on types that belong to the same species. Furthermore, neither of these names can be maintained since there is an older valid name in the literature which has heretofore not been considered to belong in the genus *Rorippa*. Therefore, *R. walteri* and *R. obtusa* fall into synonymy under a new combination in *Rorippa* based on the name *Cardamine teres* Michaux.

The nomenclatural bibliography of this species is as follows:

RORIPPA **teres** (Michaux) Stuckey, comb. nov.

Cardamine teres Michaux, Fl. Bor. Am. 2: 29. 1803.

("Hab [itat] in Nova Anglica." Holotype: "Etat de Vermont Lac Champlain," *s.d.*, [*A. Michaux s.n.*], P. Photo at GH! Isotype, GH!)

Sisymbrium tanacetifolium? [sensu] Walter, Fl. Carol. 174. 1788. Non Linnaeus 1753.

[No specimen is cited. If any of Walter's specimens are extant, they would be at BM.]

Nasturtium palustre ("Leysser" [Linnaeus][3] A. P. DeCandolle delta? *tanacetifolium* (Walter) A. P. DeCandolle, Syst. Nat. 2: 192. 1821.

Sisymbrium walteri Elliott, Sketch 2: 145. 1824.

[A substitute name for *Sisymbrium tanacetifolium* Walter. Elliott's specimen[4] was originally labeled by him as "Sisymbrium tanacetifolium Walt."]

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[1] Modified from a portion of the author's doctoral dissertation, "The Taxonomy and Distribution of the Genus *Rorippa* (Cruciferae) in North America." The University of Michigan, Ann Arbor, xiv + 482 p. 1965.

[2] Paper No. 722 from the Department of Botany and Plant Pathology, The Ohio State University, Columbus 43210.

[3] DeCandolle should have cited Linnaeus instead of Leysser, since the epithet had its origin with Linnaeus rather than with Leysser.

[4] SOUTH CAROLINA: [Probably CHARLESTON CO.]: ["Common around Charleston and Beaufort," (Elliott, 1824)], in humidis, Flor. Maio, [*S. Elliott s.n.*], CHARL. Photo GH! NY!

SIDA 2 (6): 409—418. 1966.

Erysimum walteri (Elliott) Eaton, Man. Bot. N. Am. ed. 5, 213. 1829.

Nasturtium tanacetifolium ("Walter") Hooker and Arnott, Hook. Jour. Bot. 1: 190. 1834.

[Hooker and Arnott cited both Walter and DeCandolle, so the name was evidently intended to be merely a new combination.[5]]

Nasturtium micropetalum Fischer and Meyer, Ind. Sem. Hort. Petrop. 3: 41. 1837.

("Hab [itat] in Americae septentrionalis provincia New Orleans dicta. . . " Type not seen.)

Nasturtium obtusum Nuttall in Torrey and Gray, Fl. N. Am. 1: 74. 1838. ("Banks of the Mississipsi [sic] [River]." Holotype: LOUISIANA: [JEFFERSON]: In abundance in the borders of a cultivated field on the western side of the Mississippi [River]—opposite the city of N[ew] Orleans, 2 Mar. *s.d.*, *H[enry] Little s.n.*, PH!)

Sisymbrium ?teres (Michaux) Torrey and Gray, Fl. N. Am. 1: 93. 1838.

Nasturtium walteri (Elliott) Wood, Class Book. 228. 1861.

Cardamine indica (Linnaeus) O. Kuntze delta *tanacetifolia* ("Walter") O. Kuntze, Rev. Gen. 1: 24. 1891.

Cardamine palustris ("Leysser" [Lynnaeus][6] O. Kuntze *alpha brevipes* (A. P. DeCandolle) O. Kuntze 2. *obtusa* (Nuttall in Torrey and Gray) O. Kuntze, Rev. Gen. 1: 24. 1891.

Roripa [sic] *obtusa* (Nuttall in Torrey and Gray) Britton, Mem. Torrey Club 5: 169. 1894.

Roripa [sic] *tanacetifolia* ("Walter") Heller, Contr. Herb. Franklin & Marshall College 1: 40. 1895.

Roripa [sic] *walteri* (Elliott) Mohr, Bull. Torrey Club 24: 23: 1897.

Radicula obtusa (Nuttall in Torrey and Gray) Greene, Leafl. Bot. Obs. & Crit. 1: 113. 1905.

Radicula walteri (Elliott) Greene, Leafl. Bot. Obs. & Crit. 1: 114. 1905.

Nasturtium plebejum Polakowsky *f. latifolia* O. E. Schulz, Repert. Sp. Nov. 34: 133. 1933.

("Mexico: chiefly in the valley of the Rio Grande, below Doñana C. C. Parry, J. M. Bigelow, Charles Wright, A. Schott in Mexic[an] Boundary Survey, under the direction of Major W. H. Emory." Holotype: Presumably at B. [In addition to the printed data on the labels as cited by Schulz, I find isotypes as follows: [Probably TEXAS: MAVERICK CO.]: Near Eagle Pass, *s.d.*, *[J. M.] Bigelow 27*, NY! US!]

The taxonomic position of Michaux's *Cardamine teres* has never been adequately understood. Citing Michaux, A. P. DeCandolle (Syst. Nat. 2: 259. 1821) retained it in *Cardamine*, but asked if it might be a *Nastur-*

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[5] LOUISIANA: [ORLEANS]: New Orleans, 1832, *T. Drummond s.n.*, presumably at K, duplicates at GH! and a probable duplicate is at NY!

[6] Kuntze also cited Leysser instead of Linnaeus. See footnote 3.

tium. Torrey and Gray (Fl. N. Am. 1: 93. 1838) in questioning its affinities transferred it to *Sisymbrium.* Watson (A. Gray, Syn. Fl. N. Am. 1(1): 149. 1895) and Schulz (Repert. Sp. Nov. 34: 131. 1933) were aware of its proper taxonomic relationship, since they treated it in synonymy under *Nasturtium tanacetifolium* (Walter) Hooker and Arnott, the then commonly accepted name for the species. Critical examination of an isotype and photograph of Michaux's type reveals that the name belongs to those plants of *Rorippa* that have minute yellow petals, vesicular trichomes, pinnately-divided leaves, and decumbent stems, and that grow on the Southern Atlantic and Gulf Coastal Plains of the United States and the coastal lowlands of eastern and western Mexico.

Michaux's original specimen is in the Museum d'Histoire Naturelle, Paris, and a photograph of that specimen and a fragment of possible original material are in the Gray Herbarium of Harvard University. Michaux's material very much resembles plants from South Carolina in having short siliques (ca. 5.0-7.5 mm. long), rather than long siliques (ca. 9.0-17.0 mm. long) which are more common of plants in the western portion of the species range in the United States. An unfortunate situation is that the holotype at Paris is labeled "Cardamine teres Etat de Vermont Lac Champlain." The fragment in the Gray Herbarium contains no habitat or locality data, except a note written by Asa Gray "Never from L. Champlain! Cardamine teres. Michx! Hb. Richard 1839." The Richard mentioned is L. C. Richard who anonymously edited Michaux's *Flora.* Later annotations by Gray include "Nasturtium tanactefolium" [sic] and "Sisymbrium ?teres." I see no problem in accepting this fragment as an isotype. When Michaux described *Cardamine teres* he cited the material as having come from "Nova Anglica." Plants of this species are not known to grow in eastern United States north of South Carolina. The only explanation I can offer for the inconsistent locality information in Michaux's *Flora* and on his specimen at Paris is that either Michaux or someone else associated incorrect habitat and locality data with his plants. It is very possible that the plants came from the neighborhood of Charleston, South Carolina, where Michaux made his headquarters while he was in North America (Michaux, 1889).

Fifteen years before Michaux described *C. teres,* Walter (1788) had identified plants of this taxon as "Sisymbrium tanacetifolium?" Although Walter did not cite Linnaeus, who had described a *S. tanacetifolium* in the *Species Plantarum* of 1753, Walter's use of the question mark is an indication that he was uncertain of the application of the name, rather than that he was proposing a new name. Elliott (1824), who evidently thought Walter's species was distinct from the one of Linnaeus, provided a substitute name, *Sisymbrium walteri,* based on Walter's publication. Elliott's interpretation is considered acceptable since a photograph of the specimen that Elliott labeled as *Sisymbrium walteri* also belongs to

Fig. 1. Photograph of a portion of the holotype of *Nasturtium obtusum* Nuttall in Torrey and Gray. *(Henry Little s.n.*, PH); belongs to *Rorippa teres* (Michaux) Stuckey.

the now understood *R. teres*. Elliott's *S. walteri* was later transferred to *Rorippa* by Mohr (1897), and therefore *R. walteri* was previously considered to be the oldest name for this taxon (Rollins, 1961).

Nasturtium micropetalum Fischer and Meyer (1837) has been considered synonymous with *Nasturtium tanacetifolium* by Hemsley (Biol. Cent. Am. Bot. 1: 29. 1879), Kuntze (Rev. Gen. 1: 24. 1891), and Watson (A. Gray, Syn. Fl. N. Am. 1(1): 149. 1895). Schulz (Repert. Sp. Nov. 34: 134. 1933) placed it in synonymy under *Nasturtium brevipes* (A. P. DeCandolle) Grisebach. The latter name is a synonym of *Rorippa portoricensis* (Sprengel) Stehlé. I have not seen a specimen upon which Fischer and Meyer may have based their name, but it is evident from their description and their citation of the plant's locality as New Orleans, that this taxon also belongs to *R. teres*.

It was disturbing to learn that the holotype of *N. obtusum*, a species published by Torrey and Gray (1838) from Nuttall's manuscript, belongs to *R. teres*. The specimen in the herbarium of the Academy of Natural Sciences of Philadelphia was collected by Henry Little, rather than by Nuttall himself, as is the usual situation with these Nuttall types. The data on this specimen have been written by three different individuals. The date, habitat, and locality data, except the "rleans" of N[ew] Orleans, are all similarly written and believed to be those of the original collector. The collector's name, "H[enry] Little," is added at the bottom of the label in the handwriting of Charles Pickering. The name of the plant, "N. *obtusum Nutt," was written by Thomas Nuttall. Virtually nothing is known of Little's botanical work, but Joseph Ewan (*in litt.*, 11 May 1964) tells me that Little visited in the New Orleans area probably sometime between 1818 and 1827. Little's collections later came into the hands of Charles Pickering, curator of the Academy herbarium from 1827 to 1838, where they were deposited.[7] At the Academy, Little's specimens were accessible to Nuttall.

Nuttall's own collections taken after 1818, which were used as a basis for most of his descriptions in his manuscript, are, if they exist, considered holotypes and are in the British Museum (Pennell, 1936, p. 45). The specimens at the British Museum which were used by Nuttall as the basis of names in the genus *Nasturtium* were photographed by F. G. Meyer, and I have seen photographs of all of these at the Gray Herbarium, except one.[8] Conspicuously absent are photographs of any type specimens for *N. obtusum* and *N. limosum*, suggesting that they are not

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[7] A card file in the Academy Herbarium listing donors of plant specimens contains a card with a note stating that Little's Herbarium was presented to the Academy before 1837 by Charles Pickering.

[8] The one exception is *N. sessiliflorum*, the type of which is at BM, where it was examined for me by Dr. Rogers McVaugh.

[9] This specimen bears a label prepared in a manner similar to that described above for Little's specimen of *N. obtusum*.

in the British Museum. Both of these species are represented by collections of Henry Little at the Academy. Rogers McVaugh has kindly searched for duplicates of these collections in the British Museum, but he did not find any. It therefore appears that Nuttall did not have any duplicates of these collections when he returned to England with his herbarium, since none have been photographed nor found in the British Museum. We are therefore forced to the conclusion that Henry Little's collections of *N. obtusum* and *N. limosum*[9] at the Academy are the holotypes for these two species.

N. obtusum was subsequently transferred to *Rorippa* by Britton (1894), and both names have been widely used in the literature for a variable group of plants that have a geographical range primarily from the Mississippi River westward to the Pacific Ocean. In addition, no less than eight taxa *(Rorippa sphaerocarpa* (A. Gray) Britton, *R. alpina* (S. Watson) Rydberg, *R. integra* Rydberg, *R. underwoodii* Rydberg, *R. tenerrima* Greene, *R. curvipes* Greene, and *Radicula sinuata* (Nuttall in Torrey and Gray) Greene var. *integra* Jepson and var. *truncata* Jepson) have been considered synonymous with *Rorippa obtusa.* The latter has been the anchor species on which many varietal combinations involving the above epithets have been made. None of them, however, are synonyms. In this variable group, I recognize four of them *(R. curvipes* Greene, *R. sphaerocarpa* (A. Gray) Britton, *R. tenerrima* Greene, and *R. truncata* (Jepson) Stuckey[10]) as distinct species (Stuckey, 1965). An important point is that there are no known records that plants of these four species grow natively at New Orleans, the type locality for *N. obtusum.* The nearest known localities for any plants of these taxa *(R. tenerrima* and *R. truncata)* are the Rio Grande, near El Paso, Texas, and the shore of the Mississippi River at East St. Louis. All of the floristic manuals known to me (those cited in Stuckey, 1965), that report *R. obtusa* as occurring in the plains and mountainous states of the United States west of the Mississippi River are incorrect. Reports by Gates (1940) for Kansas and Steyermark (1963) for Missouri should be referred to *R. truncata.* Steyermark's illustration of *R. obtusa* represents *R. truncata* (p. 759, pl. 185, no. 4). Fassett's (1940) illustration of *R. obtusa* in his *Manual of Aquatic Plants* was evidently drawn from a specimen of *R. curvipes.* To further add to the confusion, these variable plants of the western United States have often been misidentified in herbaria as *R. curvisiliqua* and its varieties and synonyms, *R. sessiliflora, R. islandica* and its varieties and synonyms, and *R. sinuata.* East of the Mississippi River, the reports of *R. obtusa* from Michigan (Walpole, 1927), Washing-

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[10] **Rorippa truncata** (Jepson) Stuckey, comb. nov. Based on *Radicula sinuata* (Nuttall in Torrey and Gray) Greene var. *truncata* Jepson, Man. Flowering Pl. Calif. 424. 1925. (Holotype: CALIFORNIA: [LOS ANGELES CO.]: Crystal Lake—North Fork San Gabriel Riv[er], San Gabriel Mountains, 5500 ft, 19 Jun 1921, *Frank W. Peirson 2450*, JEPS!)

Fig. 2. Photograph of a portion of the holotype of *Radicula sinuata* (Nuttall in Torrey and Gray) Greene var. *truncata* Jepson. (*Frank W. Peirson 2450*, JEPS); equals *Rorippa truncata* (Jepson) Stuckey.

ton D. C. (Hitchcock and Standley, 1919), and the St. Lawrence River valley (Marie-Victorin, 1930) were based on specimens of *R. islandica.* Deam (1940), Jones and Fuller (1955), and Strausbaugh and Core (1953) correctly excluded *R. obtusa* from the states of Indiana, Illinois, and West Virginia, respectively. All specimens I have seen from these states labeled as *R. obtusa* belong to *R. islandica.* In northern Canada, the plant from the Mackenzie River Delta (*Porsild 7225* GH!) and reported by Porsild (1943) as *R. obtusa* is *R. islandica.* Although I have not seen any specimens, reports of *R. obtusa* by Raup (1936 and 1947) also from northern Canada, doubtless should be referred to *R. islandica.* Such anonymous sentences or phrases on herbarium sheets as "There seem to be at least three species passing as obtusa," and "about what is usually taken for obtusum But see Nuttall's type!—quite different in pod," are indicative that there were both taxonomic and nomenclatural problems in the plants we have commonly referred to as *R. obtusa* in the past.

To point out more specifically some of the confusion that has existed in interpreting *R. obtusa,* one only needs to turn to the *Britton and Brown Illustrated Flora* (Gleason, 1952) and look at the drawing of *R. obtusa* on page 241 of volume 2. This drawing portrays two species in one. In the herbarium of the New York Botanical Garden I found the material from which this drawing was made. It is a collection labeled St. Louis, Missouri, by N. Riehl *(958)* and contains three plants representing three different species. The top specimen, which has long fruits pointed at the apex, is *R. teres,* or similar to the type of *R. obtusa.* From this specimen the artist drew the upper part of the plant consisting of the stem, racemes, and fruits, and the long single fruit at the left of the plant. Two young specimens are contained on the lower part of Riehl's sheet. One of these is *R. tenerrima;* the other is *R. truncata.* It appears that the basal leaves for Gleason's illustration were taken from the plant of *R. truncata.* The enlarged, but short silique to the right of the drawing of the whole plant is a fruit of *R. truncata* evidently drawn from either a specimen collected 11 June 1895 at East St. Louis, Illinois *(Letterman s.n.* NY!) or one collected from Jackson County, Missouri *(Bush 11,* NY!). Each one of these sheets bears the stamp "This specimen used for illustration ed 3 Britton & Brown Flora." Gleason was aware of the differences between these two species, but wrote "there seems to be no significant differences between forms with long (4.5-11 mm.) fruits and short (3.3-4.5 mm.) fruits," and so he grouped them together under *R. obtusa.* Nomenclaturally, he correctly interpreted the long-fruited plants as *R. obtusa* since the measurements agree with those of the type of *R. obtusa.* For the short-fruited ones he gave the measurements of *R. truncata,* but he erroneously thought the name of them to be *R. sphaerocarpa,* a species whose fruits are globose and measure only ca. 0.8-2.5 mm. long.

R. truncata represents those plants which have most consistently been identified as *R. obtusa* in herbaria and described in many, if not all, of the floristic manuals of the United States. There is a very marked similarity in growth habit and leaf shape between *R. teres* (*R. obtusa*) and *R. truncata.* Nuttall's original description of *N. obtusum* could apply to *R. truncata* as well as to *R. teres.* On casual examination and without careful detailed measurements, the siliques of *R. teres* appear to be twice as long as the pedicels. Thus, Nuttall's statement under *N. obtusum* "siliques . . . twice the length of the pedicels" superficially characterizes *R. teres,* but after critical measurements of the pedicels and siliques are made on numerous plants of both species and compared, Nuttall's statement actually applies to the now understood *R. truncata.* Without knowing the type of *N. obtusum,* it is understandable why *R. truncanta* has been interpreted as *R. obtusa.*

The characters that distinguish *R. teres* from *R. truncata* are as follows:

Character	*R. teres*	*R. truncata*
Silique length in mm.	(5.2-) 8.5-12.5 (-17.0), ca. 3.5 times as long as the pedicels	(2.3-) 3.0-5.0 (-8.2), ca. 1.5-3.0 (-4) times as long as the pedicels
Silique apex	acute	obtuse to truncate
Seed coat (terminology follows Murley, 1951)	foveolate	colliculate
Vesicular trichomes	present	absent
Style in fruit	thick, usually over 0.3 mm. wide	slender, less than 0.3 mm. wide

Annotated specimens of these two species may be found in the following herbaria: FSU, GH, MICH, MO, MSC, ND, ND-G, NY, OS, PH, US, WIS.

ACKNOWLEDGMENTS

My thanks are extended to many people who have aided in my study of *Rorippa*; special thanks go to Dr. Rogers McVaugh (The University of Michigan) for searching for certain of Nuttall's type specimens in the British Museum, to Dr. Reed C. Rollins (Harvard University) for bringing to my attention type materials of Michaux's *Cardamine teres,* to Dr. Alfred E. Schuyler (The Academy of Natural Sciences of Philadelphia) for help in locating type specimens, to Dr. Edward G. Voss (The University of Michigan) for help and encouragement as adviser during this study, and to the curators of the various herbaria whose specimens were studied.

This research was supported by the Horace H. Rackham School of Graduate Studies (The University of Michigan) while I held a Pre-doctoral Fellowship in Botany and by the National Science Foundation while I held a Summer Fellowship for Graduate Teaching Assistants.

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GENETIC AND MORPHOLOGICAL RELATIONSHIPS OF THE TEXAS ENDEMIC RUELLIA DRUMMONDIANA (ACANTHACEAE)

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The genus *Ruellia* is represented by approximately 20 species in the United States that may be conveniently placed into 3 sections following the classification offered by Lindau (1895): sect. Dipteracanthus, represented by *R. caroliniensis* (J. F. Gmel.) Steud., and *R. humilis* Nutt. of southeastern and midwestern distribution respectively, characterized by axillary, nearly sessile flowers with straight corolla tubes; sect. Euruellia, represented by *R. occidentalis* (A. Gray) Tharp and Barkley of wide distribution in Texas, with flowers in terminal racemes, and corolla tubes slightly bent; and sect. Physiruellia, represented by *R. malacosperma* Greenm. and *R. brittoniana* Leonard, both taxa introduced and naturalized from Central America and West Indies, with large flowers on long, axillary peduncles. Dipteracanthi and Euruelliae produce fruits with mostly 6-10 seeds per capsule; Physiruelliae produce longer capsules with 16-20 seeds.

One of the taxonomically most perplexing species among Dipteracanthi is *R. drummondiana* (Nees) Gray (Fig. 1). The plant was first described by Nees as *Dipteracanthus drummondianus* based on a specimen collected by Drummond in Texas "between Brazosia and San Felipe" (DeCandolle, 1847). Nees said that in certain characters the species resembled the widespread Midwestern species *R. strepens* L., differing chiefly in having linear sepals and in being uniformly pubescent. It can be added that *R. drummondiana* differs from all other U. S. species in normally having only 2-4 seeds per fruit, rather than 6-20 of other taxa. In this respect the species resembles *Dyschoriste* and, except for the absence of characteristic anther appendages, it might be confused with species of this genus. *Gray* (1878) transferred *D. drummondianus* Nees to *Ruellia* but made no comment regarding any apparent morphological relationships for the plant, nor do Tharp and Barkley (1949) suggest affinities within the genus. In addition to morphological distinctiveness, *R. drummondiana* is endemic to east-central Texas where it is partially sympatric with *R. caroliniensis*, *R. humulis*, *R. strepens* and *R. occidentalis*.

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[1] Contribution no. 26 from the Botanical Laboratories, University of South Florida. The investigation was aided by grant no. GB-1026 from the National Science Foundation. I wish to acknowledge the research assistance given by Mr. Allen Burdett.

SIDA 2 (6): 419—427. 1966.

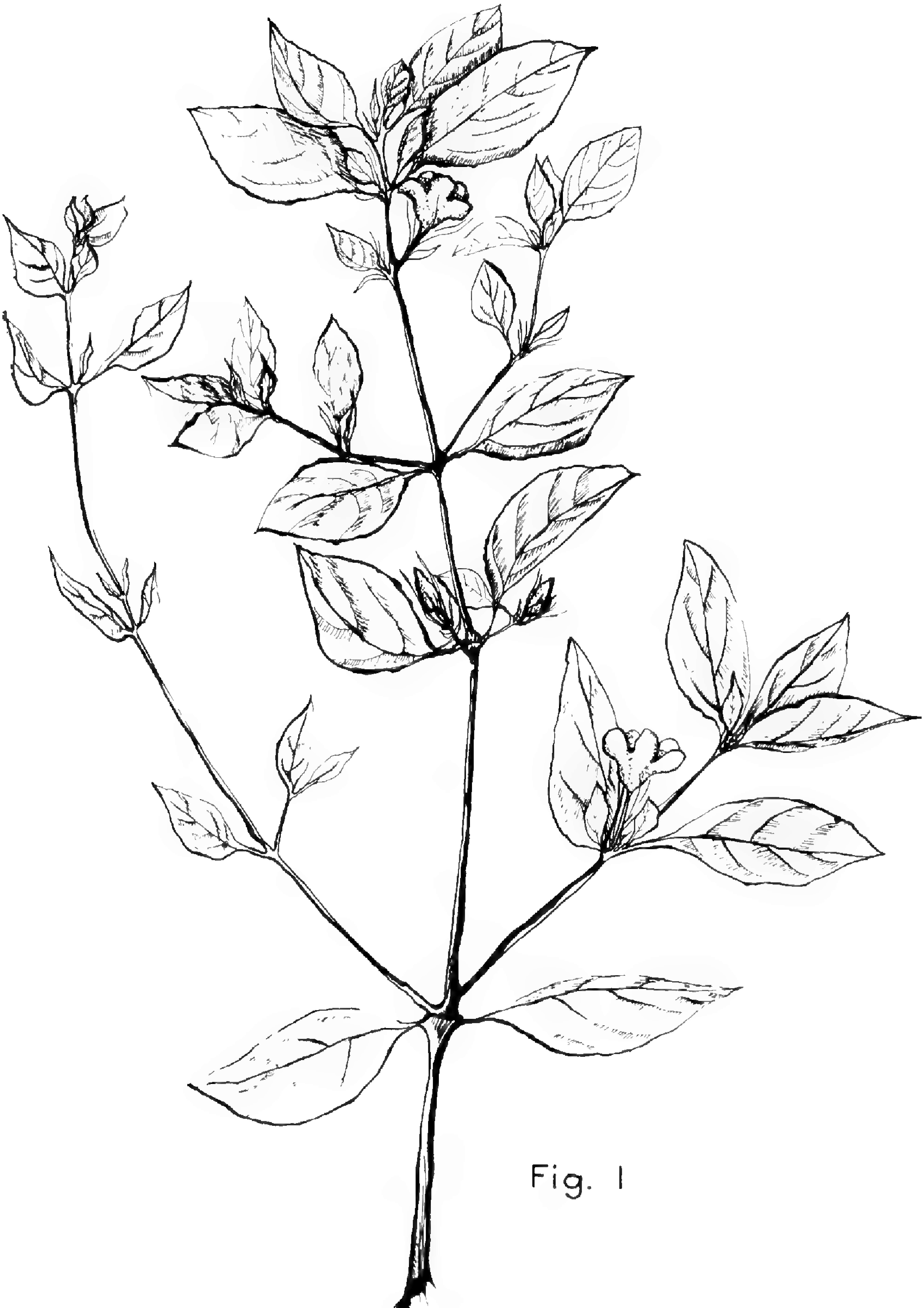

Fig. 1

Fig. 1. *Ruellia drummondiana*, approx. × ½.

MORPHOLOGICAL COMPARISONS.—The following paragraphs will summarize the nature of various structures in *R. drummondiana* with observations and comments on similarities and differences with other U.S. species.

The plants grow erect from a fibrous, wiry root-system composed of laterals that tend to grow from a single crown at the base of the stem. Roots may be fleshy and slightly thickened near the stem base. These characters are found throughout U.S. Dipteracanthi. Stems are herbaceous, green or dark-green, ridged, and canescent-pubescent, usually simple but with branching arising near the base if optimum growth conditions are present. Leaves are opposite, generally decussate, broadly ovate-truncate but with the blade partially decurrent on a definite petiole. Blades are dark-green and softly canescent especially along the veins. *Ruellia drummondiana* resembles *R. strepens* more closely than any other species in general leaf morphology.

Flowers are produced singly in upper leaf axils, subsessile or on short peduncles, they are large and conspicuous with slight bilateral symmetry because the lower corolla lobe forms a lower "lip", and the upper 4 extend radially outwards. *Ruellia drummondiana* generally resembles *R. pedunculata* Torr. of the Ozark plateau and certain populations of *R. humilis* in corolla shape. Another useful character of the corolla is the pigment pattern: heavier streaks of dark-brown color are found on the lip with lighter radial streaks extending between the lobes in *R. drummondiana* resulting in an asymmetric pigment pattern. This character is also found in *R. humilis* and *R. pedunculata*, but a symmetric pattern with 5 even radial streaks extending into the lobes is found in *R. caroliniensis.*

The sepals are linear-subulate, usually about 1-2 mm. wide at the base. The morphology clearly places *R. drummondiana* with *R. humilis, R. caroliniensis* and all other U.S. Dipteracanthi excepting *R. strepens* which has broad, foliaceous sepals 4-5 mm. wide. A very useful character in classifying Ruelliae that apparently has been overlooked is the position of the stamens and relative length of filaments. In *R. drummondiana* the didymous stamens are clustered together below the upper corolla lobe, and each pair has one filament longer than the other. These characters are found in *R. humilis,* and also in other taxa such as *R. occidentalis* and *R. malacosperma,* but not in *R. caroliniensis* where stamens are not clustered but are alternate with corolla lobes and filaments are approximately of equal length.

Another very useful character is the morphology of the stigma: *R. drummondiana* essentially has 1 stigma branch, again resembling *R. humilis, R. occidentalis, R. malacosperma, R. pedunculata* and *R. strepens* as well, but differing from *R. caroliniensis* which has two equal stigma branches. Artificial hybrids between species with 1 and with 2 stigma branches produce 1½ stigma branches. Obviously natural hybrids could be detected by examination of stigma morphology. Capsules of *R. drummondiana* contain 2-4 seeds but frequently there are no fertile seeds owing to seed-abortion and insect depredation. Total reproductive capacity of plants appears to be very low, judging from behavior of plants grown in garden cultures.

BREEDING SYSTEM.—*Ruellia drummondiana* resembles all U.S. species in being completely self-compatible but nevertheless producing large, conspicuous, colored flowers that are visited by bees, moths, and butterflies. Long styles are exserted and the stamens inclosed well within the throat of the corolla in an arrangement obviously adapted to cross-pollination. In addition to the chasmogamic forms, very small, tubular, greenish-white cleistogamous flowers are produced either before, during, or after chasmogamic flowering. It is now known that cyclic cleistogamy occurs in all U.S. species (Long and Uttal, 1962; Long, unpubl.). Both kinds of flowers may form fruit in *R. drummondiana*, and judging from observations made in the greenhouse and garden neither appears to be a more effective seed-producer than the other. This is in sharp contrast with *R. strepens* which is strongly cleistogamic, having a short, ineffective chasmogamic phase followed by a prolonged, seed-prolific cleistogamic phase. Greenhouse cultures of *R. strepens* were strictly cleistogamic making it impractical to test compatibility with plants of *R. drummondiana*. In *R. caroliniensis*, *R. succulenta* Small, *R. heteromorpha* Fernald and other southeastern species-populations, chasmogamic flowering is prolonged, cleistogamy occurring later and of shorter duration; both flower-forms appear to be equally seed-prolific although local ecological factors strongly influence conditions of flowering. The method of seed dispersal is by sudden opening of matured capsules resulting in the propulsion of seeds for short distances. In general *R. drummondiana* appears to fall between the types of effective breeding systems of *R. strepens* and of *R. caroliniensis*. The preponderance of seeds produced are formed by cleistogamic flowers, a fact that is evident when one examines local populations. The conditions that determine the type of breeding system are probably ecological in nature. From the standpoint of reproductive biology the plant should be classified as a facultative cleistogamic species (Uphof, 1938) or, perhaps more accurately, a facultative inbreeder (Fryxell, 1961). Cleistogamic or chasmogamic flowering occurs in response to moisture or nutritional stress similar to that reported for *Bromus* (Harlan, 1945) and for *Stipa* (Brown, 1952). Lack of effectiveness of chasmogamy, the relatively small number of seeds per fruit, frequent capsule abortion, relatively slow seed germination and consequent difficulty in becoming established may account in part for the restricted range for the species.

ARTIFICIAL HYBRIDIZATIONS.—During the past three years an extensive artificial hybridization program has been carried out in *Ruellia* in order to obtain information regarding genetic relationships of the species, and to get some estimate of the possible role of natural hybridization in generating variation within and between species by comparing artificial hybrids with population samples. A further aim of these investigations was to determine chromosomal homologies of species but this has been only partially successful owing to the small size of chromosomes and difficulty in obtaining and staining appropriate meiotic figures. A summary of the results of these hybridization experiments and cytological observations together with sources of materials and techniques of hybridizing and growing hybrid *Ruellias* has been presented elsewhere (Long. 1966).

Table 1 lists interspecific artificial hybridizations that involve *R. drummondiana* as one of the parental species. Fertile, vigorous hybrids were produced with *R. caroliniensis, R. humilis, R. heteromorpha,* and *R. succulenta.* Intermediate morphological characters were noted especially in stem vestiture, leaf size and pubescence, petiole length, corolla size and symmetry, and stigma morphology. Character dominance apparently occurs in such features as corolla pigment markings and stamen position. Table 2 presents a detailed comparison of the morphological characters of *R. caroliniensis* × *R. drummondiana,* and *R. humilis* × *R. drummondiana* hybrids and the parental species. In these hybrids character intermediacy can be noted in general habit, leaf size,

parental species	no. pollinations	no. plump capsules	no. seeds produced	% seed germination	no. F_1 produced	% non-stainable pollen range
R. drummondiana X						
R. caroliniensis	6	1	6	66	4	10-24
R. drummondiana	7	6	20	91	18	19-52
R. heteromorpha	5	5	21	71	15	5-16
R. humilis	3	2	8	88	7	15-21
R. malacosperma	9	0	--	--	--	--
R. occidentalis	3	3	16	56	7	no pollen
R. pinetorum	2	1	0	--	--	--
R. succulenta	5	2	20	30	6	17-35

Table 1. Artificial hybridization experiments involving *Ruellia drummondiana.* (Measurements for both tables made from greenhouse-grown plants; voucher specimens deposited in the U.S.F. Herbarium.)

petiole length, sepal length, corolla length and symmetry, and stigma morphology.

Sterile, weak F_1 hybrids were formed by the intersectional cross *R. drummondiana* × *R. occidentalis*. These plants have persisted in greenhouse culture for 2 years but have never produced flowers. No hybrids were formed in crosses with the southeastern coastal plain endemic *R. pinetorum* Fernald or with *R. malacosperma*.

DISCUSSION.—A biosystematic classification of U.S. species of sect. Dipteracanthus, *i.e.*, one based on crossability, hybrid sterility, and ecological adaptation as well as morphological comparisons, results in the grouping of taxa into at least 4 polytypic ecospecies: (1) *R. caroliniensis*, and closely related southern Florida endemics *R. succulenta* and *R. heteromorpha;* (2) *R. humilis;* (3) *R. strepens*, and the related Appalachian endemic *R. purshiana* (Uttal, 1965); and, (4) *R. pedunculata* and the related coastal plain endemic *R. pinetorum* (Long, 1966). Additional ecospecies may be recognized as work progresses, but these 4 constitute the most important sources of variation. The results of hybridization experiments lead me to conclude that *R. drummondiana* is related genetically to both *R. caroliniensis* and *R. humilis* ecospecies. Fertile, vigorous F_1 hybrids are produced when these plants are crossed with *R. drummondiana*. Garden-grown hybrids of *R. humilis* × *R. drummondiana* are unusually vigorous and they spread aggressively; hybrids of *R. caroliniensis* × *R. drummondiana* are somewhat less vigorous, and 2 did not survive into the second year. Preliminary examination of meiotic configurations during microsporogenesis indicates chromosome pairing is normal in artificial hybrids, with only an occasional chain of four chromosomes. We may conclude, therefore, that the chromosomes are closely homologous.

The morphological evidence leads me to believe that *R. drummondiana* is more closely related to *R. humilis* than to *R. caroliniensis* or *R. strepens*. Pubescence patterns, corolla symmetry and pigmentation, stamen size and position, and stigma morphology are closely similar for both species. Thus, *R. drummondiana* appears to be morphologically a well-marked element of the *R. humilis* ecospecies, but one also having close genetic relationships with *R. caroliniensis* that suggest affinities for both ecospecies.

Before concluding this report it may be useful to consider the problem of endemism in *Ruellia* with special reference here to *R. drummondiana*. Fryxell (1962) has defined an endemic as one with a relatively restricted range which may be (1) a young, expanding species; (2) an evolving but not expanding species ("stationary endemic"); (3) a contracting relict

Table 2. Morphological comparisons of parental species and their artificial hybrids in *Ruellia*.

character	caroliniensis	drummondiana X caroliniensis	drummondiana	drummondiana X humilis	humilis
culture no.	(60-35)	(63-107w X 60-35)	(63-107w)	(63-107w X 64-329)	(64-329)
stem:					
general habit	erect, few laterals	erect, branching from base	erect, branching from base	decumbent, spreading	decumbent
maximum height	41.5 cm.	20.0 cm.	23.0 cm.	14.1 cm.	28.5 cm.
vestiture	glabrous	glabrous	hirsute	hirsute	hirsute
leaf:					
maximum length	4.7	4.8	8.5	4.5	6.2
maximum width	1.8	2.6	5.0	2.4	2.5
leaf index	0.45	0.54	0.59	0.53	0.40
vestiture	puberulent on veins	generally strigose	canescent	canescent	hirsute on veins
petiole length	0.7	0.8	1.0	0.3	0.0
flower:					
maximum sepal length	1.4	2.0	2.9	2.0	2.0
sepal vestiture	few short hairs	ciliate	canescent	carely ciliate	ciliate
maximum corolla length	4.7	3.8	4.0	3.5	2.8
corolla symmetry	radial	nearly radial	bilateral	nearly bilateral	nearly radial
corolla pigment markings	radial	stronger on lowest lobe	stronger on lowest lobe	stronger on lowest lobe	stronger on lowest lobe
stamen position	alt. with lobes	paired convergent below upper lobes	convergent below upper lobes	convergent below upper lobes	convergent below upper lobes
stigma branches	two equal	1 short, 1 long	1	1	1

species. Stebbins (1942) has suggested that lack of variability was one characteristic of endemic species. The morphological uniformity of *R. drummondiana* populations may be accounted for on the assumption of predominant autogamy, although outbreeding may occur, and the apparent genetic homogeneity of the species is a reflection of effective breeding system rather than a character of the species because it is endemic. Stebbins' genetic explanation of the basis of endemism cannot account for restricted distributions of certain other species of *Ruellia*, as *R. succulenta* and *R. heteromorpha*, where local populations may be morphologically uniform or highly variable, apparently depending on predominant breeding system, availability of new habitats, and proximity of related populations that may result in introgression (Long, 1964). The lack of variabiliy in *R. drummondiana* and certain other *Ruellia* endemics cannot be based on genetic incapacity that results in lack of variability, but rather is dependent on the ecological factors that affect breeding systems. Morphological uniformity does not appear to be a causative factor of endemism in *Ruellia (cf.* James, 1961).

Any discussion of endemism should include not only the genetic approach to factors affecting population structure, but also the historical factor relating to geological events and past distributions. *Ruellia* is largely a tropical and subtropical group of plants that probably belonged to the Neotropical-tertiary flora that ranged northward ino southern United States from the Antilles, Central America, and Mexico. In eastern United States most of the warm temperate and subtropical species had been eliminated by Miocene times, and the retreat of this flora left numerous relict species with Neotropical affinities (Chaney, 1947). The center of variation of North America Dipteracanthi is in Southeastern U.S.; this suggests that they may have entered Texas from the north rather than from Mexico. The present distribution of *R. drummondiana* is near the Balcones Fault on the Edwards Plateau, a position that places it on the southern periphery of the range for *R. humilis*.

Natural populations of *R. drummondiana* observed thus far have all been relatively small in number, usually composed of approximately 20-30 individuals and all morphologically very similar except for minor differences probably caused by ecological factors. An examination of the collections in the University of Texas Herbarium showed that the plant may be found in roadside areas, near footpaths, in dry stream beds and in similar disturbed areas where selection pressure is at a minimum. The total evidence leads to the conclusion that *R. drummondiana* is a "stationary endemic", or more likely, a "relict species" that was once part of a much larger and more varied population system that is now also represented by numerous races of *R. humilis*. Endemism in U.S. species of *Ruellia* also includes examples of "young, expanding" endemics as *R. heteromorpha* and *R. succulenta,* as well as stationary or relict endemics as *R. drummondiana,* and perhaps others such as *R. purshiana* and *R. pinetorum.*

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WAITZIA CONICA (COMPOSITAE-INULEAE), A NEW SPECIES FROM WESTERN AUSTRALIA

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The species is apparently most closely related to *Waitzia podolepis* (Gaud.) Steetz, but differs from the latter in its large conical receptacle and obliquely-beaked achenes, and yellow (upper) involucral bracts (those of *W. podolepis* being white). According to Ray Smith (personal communication) there is a fragmentary collection of *Waitzia conica* from the Gascoyne River area made by Pollack in 1882 (MEL). I have seen a sheet of what might yet be another related, but undescribed, species at Kew (Western Australia: "In fruticetis arenosis inter flumina Moore et Murchison," *E. Pritzel 621*. Sept., 1901). The latter specimen seems closest to *W. podolepis,* differing from that species in possessing an ununited pappus.

WAITZIA **conica** Turner, sp. nov.

Erect delicate annuals 15-20 cm. high, leaves and branches moderately pubescent with short, often gland-tipped, scabrous hairs. Leaves alternate, sessile ,lanceolate, 10-40 mm. long, 1-4 mm. wide, with peculiar capitate apices. Inflorescences 1-10 on peduncles up to 10 cm. long. Involucres hemispheric, 1 cm. long, 1-2 cm. across. Receptacle conical, 10-12 mm. high, 4-5 mm. across. Involucral bracts, 4- to 5-seriate, yellowish-green, scarious, ciliate, the outer bracts short, ovate, the innermost series up to 2 cm. long with bright yellow, terminal appendages, the latter 5-6 mm. long, 2 mm. wide, spreading at right angles to the involucre at anthesis, assuming the appearance of ray florets. Florets numerous, 8-10 mm. long. Corolla yellow, tubular, 5-lobed, glandular-pubescent. Style branches linear, truncate. Achenes brown, somewhat laterally compressed, minutely papillose, terminated by a slender, pale, oblique beak, 2-3 cm. long. Pappus of 16, finely plumose setae arising from the beak of the achene, united below for 1-5 mm. on the adaxial side.

Annuae erectae graciles 15-20 cm. altae; folia ramique sat dense scabro-pubescentes pilis brevibus saepe glanduloso-capitatis. Folia alterna sessilia lanceolata 10-40 mm. longa 1-4 mm. lata apice morate capitellata. Inflorescentiae 1-10 pedunculis usque 10 cm. longis. Involucrum hemi-

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Fig. 1-12, *Waitzia conica.* 1. Habit. natural size. —2. Inner involucral bract, ×3.—3. Middle bract, ×3.—4. Outer bract, ×3.—5. Floret, ×6.—6. Pappus, ×6.—7. Staminal tube, ×16, with single anther base showing tails, ×40.—8. Style branches, ×16.—9. Receptacle, natural size.—10. Achene (side view), ×12.—11. Achene (front view), ×12. —12. Stem fragment, × 3.

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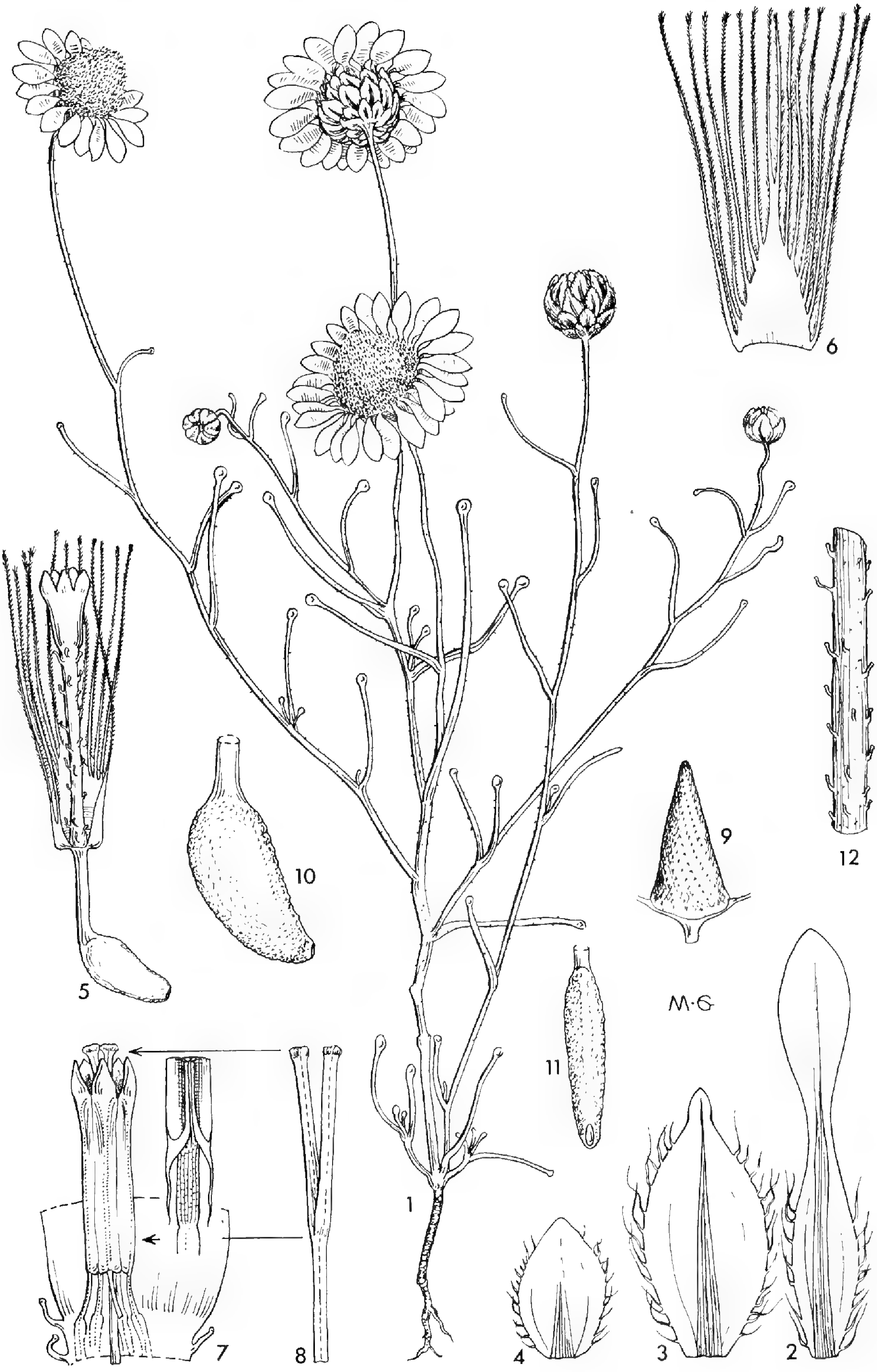
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sphericum 1 cm. longum 1-2 cm. latum. Receptaculum conicum 10-12 mm. altum 4-5 mm. latum. Phyllaria 4-5-seriata flavo-viridia scariosa ciliate, exteriora brevia ovata, interiora seriatim longiora anguistiora, intima usque 2 cm. longa cam appendiculis apicalibus laete flavis 5-6 mm. longis 2 mm. latis sub anthesi angulo recto patentibus quasi floribus radiatis. Flosculi numerosi 8-10 mm. longi. Corolla flava tubulose 5-fide glanduloso-pubescens. Styli rami lineares truncati. Achaenia brunnea lateraliter modicum compressa minute papillosa rostrata rostro tenui pallido obliquo 2-3 cm. longo. Pappi setae 16 tenuiter plumosae in rostro achaenii, basin versus 1-5 mm. latere adaxiali junctae. Chromosomata (meiotica visa) $n = 12$.

Chromosome number, as determined from meiotic material, $n = 12$ pairs.

Holotype (K): Western Australia. 11 miles west of Gascoyne Junction. Foetid annual growing in rocky shale outcrops along road to Carnarvon. 24 Aug. 1965, *B. L. Turner 5405*. Isotypes (MEL, PER, TEX).

Supported in part by N.S.F. grant GB 1216. I am grateful to Ray Smith of the Royal Botanic Gardens, Melbourne for suggesting the generic position of this taxon and to L. H. Shinners for preparation of the Latin description. The drawing is by Mary Grierson, Kew, England.

TAXONOMY OF OXYPAPPUS (COMPOSITAE)[1]

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Oxypappus is a monotypic Mexican genus belonging to the polyphyletic tribe Helenieae of the Compositae. Rydberg (1914) included the genus in his subtribe Amaurianae, which itself is a polyphyletic group (Turner and Flyr, 1965). The relationship of *Oxypappus* appears to be with members of the subtribe Peritylanae (including *Amauria),* a group of closely related genera whose tribal relationships appear to lie with either the Heliantheae or Senecioneae (Powell and Turner, unpubl.).

Chromosome counts of $n = 10$ have been reported for only two collections (Turner and Flyr, 1965).

OXYPAPPUS SEEMANNII (Sch.-Bip.) Blake, Contrib. U.S. Natl. Herb. 26: 261. 1930. *Pectis seemannii* Sch.-Bip., Seem. Bot. Voy. Herald 309. 1856. Isotypes (GH!, NY!): "N.W. Mexico. *Seemann.*"

Oxypappus scaber (H. & A.) Benth., Bot. Voy. Sulph. 118. 1845.

Chrysopsis scabra H. & A., Bot. Beech. Voy. 434. 1841. Not *Chrysopsis scabra* Ell., 1823.

Pentachaeta gracilis Benth., *in* Hook. Icon. Pl. 12: 1, pl. 1101. 1872. MEXICO. Oaxaca: Gneiss rocks, near Juquila Zacatepeque, 4000-6500 ft., *Galeotti 2057.* (Holotype, BR!).

Oxypappus gracilis (Benth.) Gray ex Hoffm., *in* Engl. & Prantl., Pflanzenfam. 4^5: 257. 1890.

Annual or short-lived perennials, 20-30 cm. high, glandular-pubescent throughout; stems erect, delicate, covered with slender, crisp, glandular trichomes (with age often glabrate); leaves simple, opposite below (at first forming a rosette), sessile, or nearly so, becoming reduced and alternate in the inflorescence, lanceolate, 3-8 mm. wide, 20-50 mm. long, with 2 to 4 inconspicuous dentations along each margin, upper surface green, reticulate-veined, lower surface pale green and not so prominently veined. Inflorescence a relatively open panicle of 10 to 40 small heads; involucre subturbinate to hemispheric, 3.5-5.0 mm. high, 3-5 mm. wide; involucral bracts, 13 to 15, concave, linear, rounded on the back, in a single series; receptacle about 2 mm. across, slightly convex; ray flowers, pistillate, fertile, about 11, bright yellow, the ligule 3-6 mm. long, 1.3-2.0 mm. wide, prominently 5-nerved, with 2 or 3 teeth at the apex, the tube 2 mm. long; disc flowers yellow or yellowish-orange (?), 3.5-4.5 mm. long; corolla 5-lobed, tubular, with a poorly defined throat, 2.2-2.4 mm. long, glandular-pubescent below; style branches filiform, hirtellous, more or less enrolled with indistinct stigmatic lines, 0.60-0.75 mm. long; achenes black, 1.3-1.5 mm. long, 0.3-0.4 mm. wide, sparsely pubescent with sharp, rigid hairs, more or less flattened radially, with

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[1] Supported by National Science Foundation Grant GB 1216.

Distribution of *Oxypappus seemannii.*

3 to 4 indistinct ribs and lacking a callous margin; pappus of 3 to 5 subulate squamellae (the peripheral florets more often with 3 or 4, the inner florets with 5), the mid-rib extending as long, scabrous awns.

Chromosome number, $n = 10$ pairs.

DISTRIBUTION: West coast of Mexico from southern Sinaloa to Oaxaca (Fig. 1). Occurring in mountainous areas usually in pine or oak forests at 1200 to 2200 meters, occasionally at lower elevations in grassy areas of semi-deciduous forests *(McVaugh & Koelz 697;* etc.). Flowering from October to February.

The species, except for the rather remarkable collection at MICH, is poorly represented in herbaria, presumably because of its winter flowering period. It is quite variable in head size and in flower color, some of the labels noting the disk as yellow and the rays orange *(Feddema 2191,* MICH) or else the disk orange and the rays yellow *(Feddema 2672,* MICH). The populations which I have examined have had both rays and disk yellow; most collectors record the flower colors as light or, rarely, bright yellow. In Jalisco, populations are found with relatively small heads (e.g. *Feddema 2191, Cronquist 9777, McVaugh 20164, 21244)* but intermediate- and large-headed collections have been made in the same area so, lacking other features, these populations are treated as part of the variation of the species.

REPRESENTATIVE SPECIMENS:

GUERRERO: District Mina: Chilacayote—Soledad, 29 Nov. 1939, *G. E. Hinton et al. 14913* (MO, NY, US).

JALISCO: 10 miles s.w. of Autlan, 1 Nov. 1962, *A. Cronquist 9777* (MICH, NY, TEX); s.w. of Talpa de Allende, Sierra de Cuale, 19-21 Nov. 1952, *R. McVaugh 14294* (MICH, US); San Sabastian, Hacienda del Cura; 1425 m, 2 Jan. 1927, Y. *Mexia 1350* (GH, MICH, MO, NY, UC, US); dry gravelly bluffs near Guadalajara, 30 Sep. 1889, *C. G. Pringle 2373* (GH, MICH, MO, NY, UC, US); La Resolana, near El Corte, Colorado, 16 Nov. 1960 *Rzedowski 15044* (Tex).

MICHOACAN: Coalcoman: Pine forest at Villa Victoria 15 Nov. 1938, G. B. *Hinton 12573* (MICH, MO, NY, UC).

NAYARIT: Tepic, Feb. 1895, *F. H. Lamb 598* (GH, MO, NY, US); 9 mi n. of Compostela, 12 Nov. 1959, *R. McVaugh* & *W. N. Koelz 491* (MICH.).

SINALOA: 25 mi. w. of El Palmito, on Mex. Hwy. 40, 29 Jan. 1964, *D. Flyr 141* (TEX).

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DOCUMENTED PLANT CHROMOSOME NUMBERS 1966:1

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Figures 1-6 are camera lucida drawings.

RANUNCULACEAE

North American species of *Clematis* Section *Viorna* Subsection Integrifoliae.

CLEMATIS OCHROLEUCA Ait.[a] (Fig. 1) n = 8. Va., Mecklenberg Co.: *Keener 1771d* (NCSC).

CLEMATIS COACTILIS (Fernald) Keener[b] *(Clematis albicoma* var. *coactilis* Fernald). (Fig. 2) n = 8. Va., Botetourt Co.: Keener 1801c (NCSC).

CLEMATIS VITICAULIS Steele[b] (Fig. 3) n = 8. Va., Bath Co.: *Keener 1797f* (NCSC).

CLEMATIS ALBICOMA Wherry.[b] (Fig. 4) n = 8. W. Va., Pendleton Co.: *Keener 1782d* (NCSC).

CLEMATIS FREMONTII Watson[a] (Missouri race = var. *riehlii* Erickson). (Fig. 5) n = 8. Mo., Jefferson Co.: *Keener 1807i* (NCSC).

CLEMATIS FREMONTII Watson[a] (Kansas race = var. *fremontii)*. (Fig. 6) n = 8. Kans., Ellis Co.: *Keener 1810g* (NCSC).

[a] Species for which a similar chromosome count has been published previously.

[b] No chromosome numbers reported previously for this species.

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0.01 mm

NOTE

JUNCUS CAPITATUS (JUNCACEAE) PREVIOUSLY REPORTED FROM THE UNITED STATES.—Dr. Marshall C. Johnston of the University of Texas and Dr. F. J. Hermann of the U.S. Forest Service Herbarium have kindly called my attention to errors on my part* in SIDA 2 (5). In a note (pp. 390-392) I indicated that my collection of *Juncus capitatus* Weigel was a new record for the United States. While it may serve as a first record for Louisiana, the species has been reported previously for California (Munz, A California Flora, 1959) and for Texas (Gould, Texas Plants, 1962). Also Dr. Hermann advises me that *J. bufonius* is not the only other annual rush known from the United States, but that several other annual species occur in the West. I wish to thank the above-mentioned men for their kindness (and tactfulness) in pointing out my blunder.—*Robert Kral, Department of General Biology, Vanderbilt University, Nashville, Tennessee.*

*The Editor (*cujus maxima culpa*) received letters not only from Drs. Johnston and Hermann, but also from Margaret Bergseng of the University of California (Berkeley; including comment from Annetta Carter) and John Thomas Howell of the California Academy of Sciences. —*Lloyd H. Shinners*

SIDA 2 (6): 436. 1966.

REVIEW

A MONOGRAPH OF LEMNACEAE. Edwin Horace Daubs. 118 pp. Illinois Biological Monographs 34. University of Illinois Press, Urbana. 1965. $4.50.

World Lemnaceae have been studied only by Hegelmaier (1868, 1896) and by Daubs. *A Monograph of Lemnaceae* is Dr. Daubs' Ph.D. work at the University of Illinois. The major part of the book contains keys to, and discussions and descriptions of, the 4 genera, 28 species, and 1 variety recognized by Daubs. Twenty plates of illustrations and distribution maps are appended.

Lemnaceae are cosmopolitan. Nevertheless, in this "world-wide" study, Daubs examined specimens from only *nine* herbaria, all of them in the United States (but not including such major ones as Gray and New York). These specimens were perhaps sufficient for a study of United States duckweeds, but to base a world monograph on them is stretching things a bit. Daubs' offhand attitude toward foreign specimens is well revealed by his distribution maps, described by him as "detailed." We would describe them as superficial. Some of the reasons for our doing so are set forth below.

Daubs excludes duckweeds from Canada north of about 57°. Yet there are published records—and easily obtainable voucher specimens—that extend the Canadian range of *Lemna trisulca* to 68° and that of *L. minor* to 62°. Published records also extend the Canadian range of *Spirodela polyrhiza* far beyond that shown on Daubs' map. The maps of United States duckweeds contain similar lapses. If North American distributions are so poorly shown, then the distributions shown for other continents (from which, remember, Daubs borrowed no specimens) must be farcical indeed. In the preparation of a monograph, published range records and the voucher specimens for such records should not be ignored. Daubs apparently did not bother to seek such records. That his literature search was not altogether painstaking (even though he lists about 200 references) is revealed also by the fact that a number of seemingly significant papers on the Lemnaceae are not included in his bibliography.

Daubs' statement—"No one has seriously questioned the generic status of *Spirodela* since its establishment by Schleiden, although Hutchinson (1934) considered it a subgenus of *Lemna*"—is an enigmatic one that seems to suggest that Dr. Hutchinson was perhaps not serious in his work. Daubs apparently did not examine the recent (1962) *Flora of the British Isles,* in which Clapham, Tutin, and Warburg (also non-serious workers?) submerge *Spirodela* in *Lemna.*

Daubs' species keys make some use of characteristics that are not usually altered or obliterated in drying (e.g., frond outline, penetration of the prophyllum by primary roots, etc.)—a useful feature. Regrettably, no mention is made of possible methods of restoring dried specimens to their original form so that other important characteristics (e.g., papillae, curvature of *Wolffiella* fronds, shape of *Wolffia* fronds, etc.) may be renewed. Neither does Daubs discuss methods of collection and preservation of duckweeds, even though some investigators (Harrison and Beal) have noted that "Dried herbarium specimens of the duckweeds are extremely difficult if not impossible to identify."

All too evident in Daubs' monograph is a startling lack of attention to detail: incorrect citations in the bibliography; dots on the distribution maps in places from which no specimens are cited in the text; citation of specimens from places for which no dots appear on the maps; citation of collections in the "Index to Numbered Exsiccatae" at the end of the book but not in "Collections Examined" under the appropriate species; etc. Each of these errors is, perhaps, minor in itself, but all of them together make one wonder where carelessness stops and careful work begins. We cannot, for this reason, feel completely confident in accepting Daubs' keys, synonymy, and descriptions as the final authority. We have given the keys what we consider to be a fair trial in the determination of our collections of Louisiana Lemnaceae. Some of them appear to work well enough; others appear to lead nowhere. The descriptions appear to be at least adequate—although some of them do not embrace the range of variation we find in our material.

We have been eagerly awaiting the publication of *A Monograph of Lemnaceae*. Now that the book has appeared, we are disappointed that the long-felt need for an up-to-date study of Lemnaceae has not been filled as well as we had hoped it would be.—*Howard L. Clark and John W. Thieret, University of Southwestern Louisiana, Lafayette.*

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Names of contributing authors are in capital letters. New scientific names are in boldface followed first by page on which formally published (in some cases this is not the first page on which mentioned). Synonyms are in italics. Illustrations are indexed only by captions, in some cases on an opposite page.