Rhodora

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PLANTAE AUSTRO-AMERICANAE XI
DE PLANTIS PRINCIPALITER EX COLOMBIAE ORIENTALIBUS PARTIBUS NOTULAE

RICHARD EVANS SCHULTES

The following miscellaneous notes on new or otherwise interesting plants, mainly from Colombia, are offered as a continuation of studies on the phytogeography of the northwestern part of the Amazon. This research has been in part supported by a grant from the National Science Foundation, which also has provided a grant for the illustrations. The families are arranged in accordance with the Engler-Gilg system.

CYCLANTHACEAE

Asplundia ponderosa *R. E. Schultes ex Harling* in Acta Hortii Bergiani 18 (1958) 217, fig. 57, g-m.

COLOMBIA: COMISARÍA DEL AMAZONAS, Río Apaporis, Raudal de Jirijirímo, March 1951, *R. E. Schultes 12093;* August 12, 1951, *R. E. Schultes et I. Cabrera 13514;* September 16, 1961, *R. E. Schultes et I. Cabrera 14058.*

The Taiwano Indians living along the Río Kananarí (which enters the Apaporis immediately above Jirijirímo) reduce to ashes the leaves of this plant to add to the food of pregnant women. The Taiwano name of *Asplundia ponderosa* is *ka-ma-té-pa.*

With the original description of this species, Harling published analytical drawings of floral parts. The drawings published in the present article show the characteristic leaf and illustrate the habit of the plant.

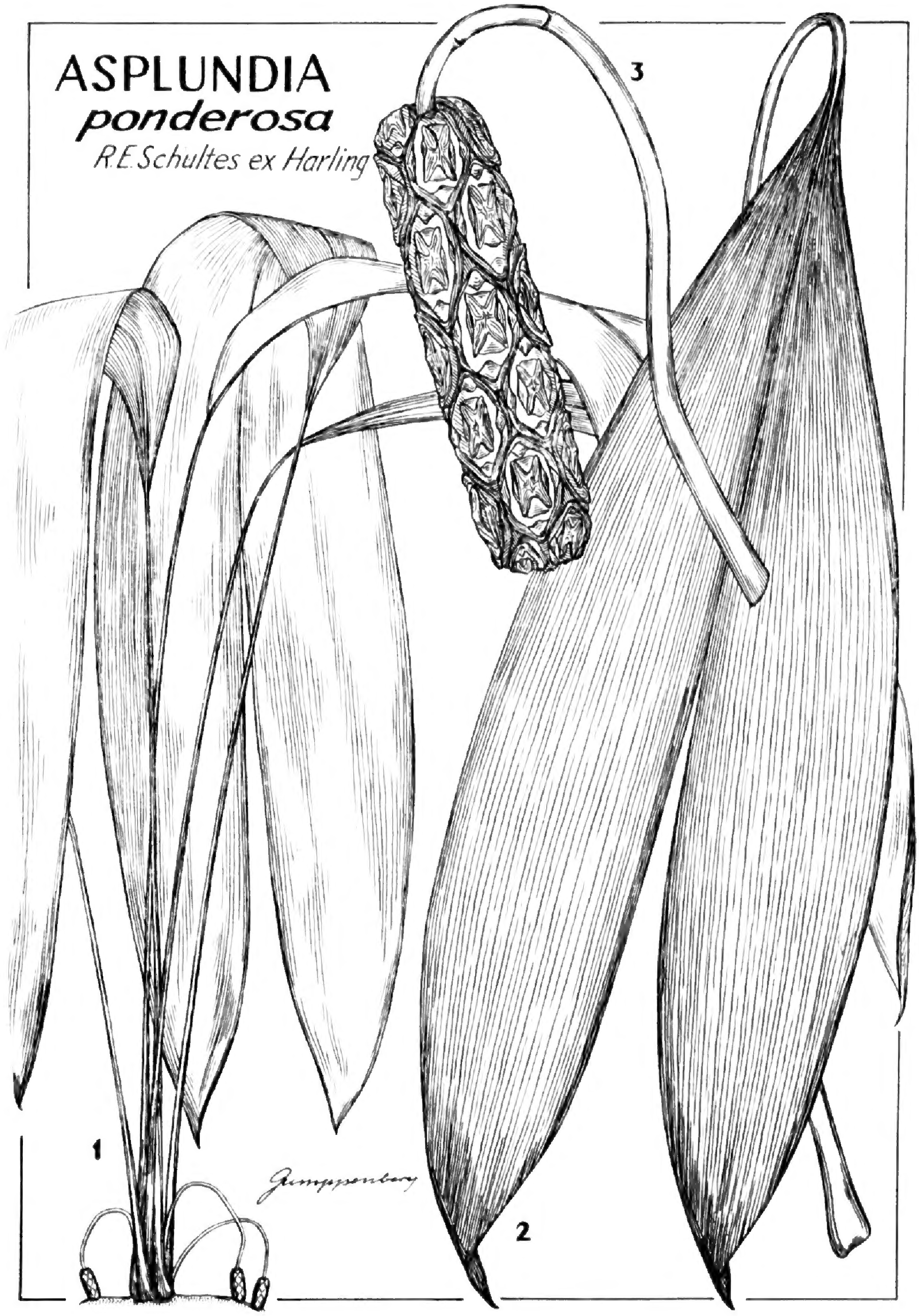


Figure 1. *Asplundia ponderosa* R. E. Schultes ex Harling. 1) Habit, × 1/4. 2) Leaf, × about 1/3. 3) Inflorescence, × about 1 1/2. Drawn by John Gumppenberg.

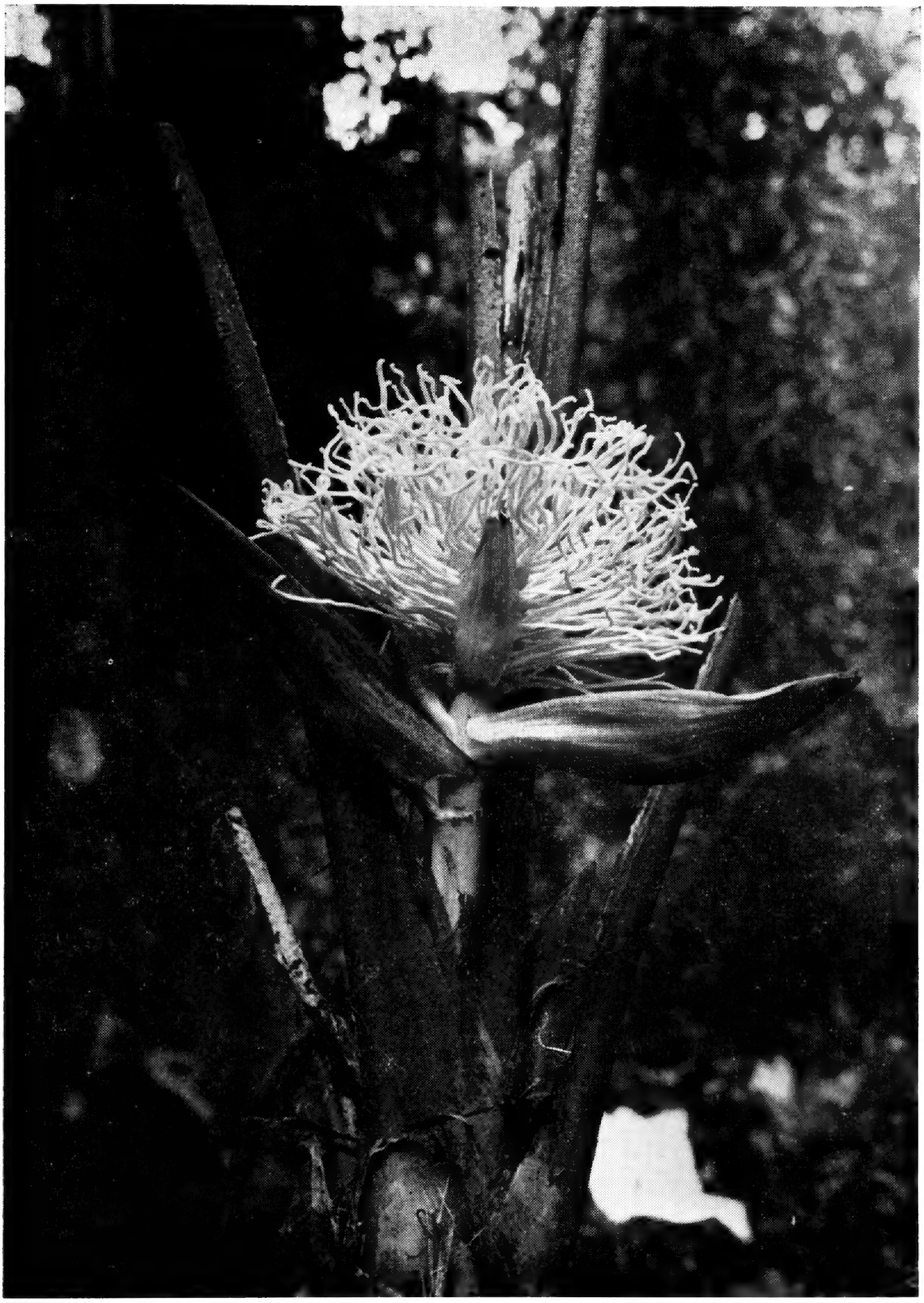


Figure 2. *Asplundia rhodea* R. E. Schultes ex Harling. Inflorescence of *Idrobo et Schultes 933*. Photograph by R. E. Schultes. Plate 1274

Asplundia rhodea *R. E. Schultes ex Harling* in Acta Hortii Bergiani 18 (1958) 214, fig. 57, d-f, t. 34.

COLOMBIA: INTENDENCIA DEL META, Sierra de La Macarena, eastern slope of Mt. Renjifo, alt. 600-1300 m., December 30, 1950 — January 5, 1951, *J. M. Idrobo et R. E. Schultes 933.*

When *Asplundia rhodea* was originally described, techni-

Figure 3. *Asplundia rhodea* R. E. Schultes ex Harling. Roots of *Idrobo et Schultes 933.* Photograph by R. E. Schultes. Plate 1275

cal drawings of floral parts and an illustration of an herbarium specimen were published. Two photographs of *Idrobo et Schultes 933* are herewith offered as an aid in understanding the habit of the plant.

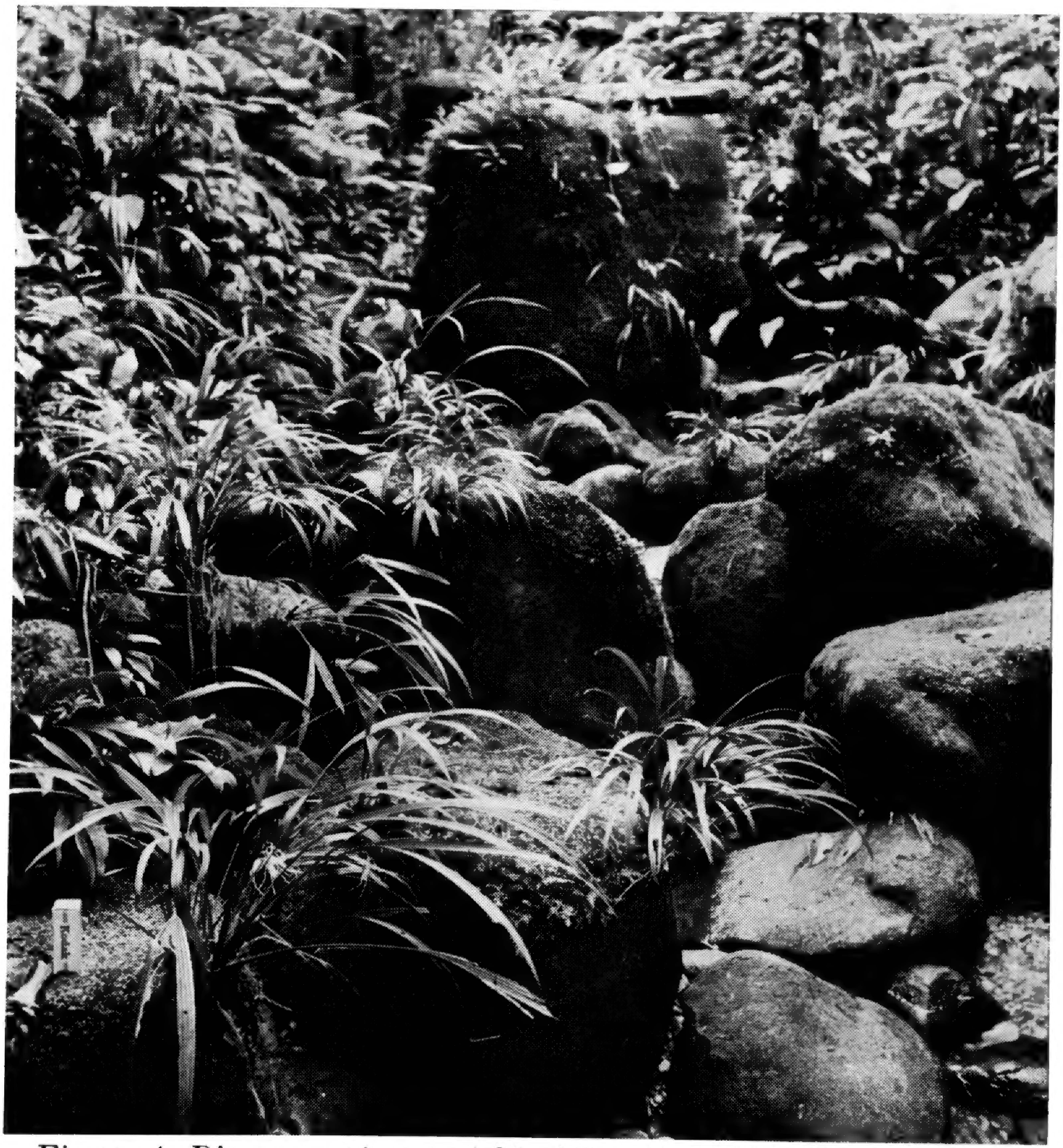


Figure 4. *Dicranopygium omichlophilum* R. E. Schultes ex Harling. Habit of the plant at the locality of *Idrobo et Schultes 1184*. Photograph by R. E. Schultes. Plate 1276

Dicranopygium omichlophilum *R. E. Schultes ex Harling* in Acta Hortii Bergiani 18 (1958) 294, fig. 76, a-c, t. 67.

COLOMBIA: Intendencia del Meta, Sierra da La Macarena, Mt. Renjifo, summit and environs, alt. 1300-1900 m., January 6-20, 1951, *J. M. Idrobo et R. E. Schultes 1184*.

Dicranopygium omichlophilum is extremely abundant on moss-covered rocks in the cold streams at the top of the Sierra de La Macarena, where almost perpetual mist creates a dark and constantly wet environment. It covers the rocks in dense colonies together with a beautiful species of *Spathiphyllum*. The flowers of both plants are excessively fragrant.

Figure 5. *Dicranopygium omichlophilum* R. E. Schultes ex Harling. Flower of *Idrobo et Schultes 1184*. Photograph by R. E. Schultes.
Plate 1277

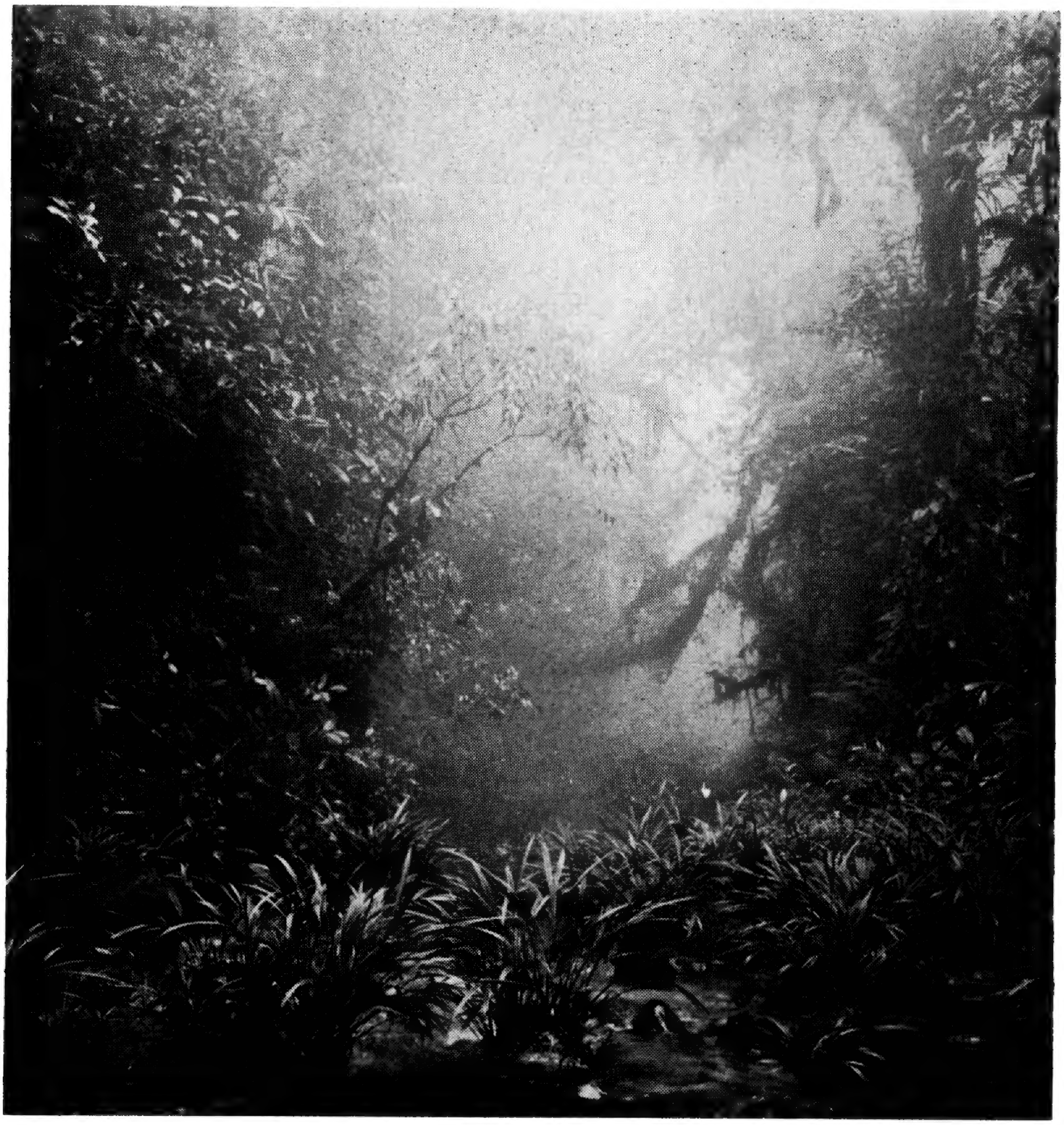


Figure 6. Habitat of *Dicranopygium omichlophilum* R. E. Schultes ex Harling at the summit of La Macarena, Meta, Colombia. Photograph by R. E. Schultes. Plate 1278

The accompanying photographs illustrate the habit of *Dicranopygium omichlophilum* and two views of the habitat of the plant at the summit of La Macarena.

BROMELIACEAE

Pitcairnia mituensis *L. B. Smith* sp. nov. A *Pitcairnia Maguirei* L. B. Smith atque *P. Wurdackii* L. B. Smith, quibus maxime affinis, lamina foliorum subtus haud lepidota valde latiore differt.

Florifera ultra 2 m. alta; foliis ad 1 m. et ultra longis; vaginis suborbicularibus, quam laminis paulo latioribus, intus castaneis; laminis linearibus, acuminatis, pungentibus, 7.5 cm. latis, planis, utrinque glabris, spinis atris curvatis 3 mm. longis laxe armatis; scapo erecto; scapi vaginis ignotis; inflorescentia pauciramosa, glabra; bracteis primariis parvis, ovatis, 25 mm. longis, quam basi sterili ramorum multo brevioribus; ramis adscendentibus, ad 6 dm. longis, robustis, viridibus; bracteis florigeris late ellipticis, acutis, ad 20 mm. longis, pedicellos superantibus; floribus suberectis, flavo-viridibus, pedicellis cylindricis, 5 mm. longis; sepalis lineari-lanceolatis, acutis, ad 45 mm. longis, ecarinatis; petalis 6 cm. longis, nudis; staminibus inclusis; ovario ca. 1/2 infero; ovulis late alatis.

Figure 7. *Pitcairnia mituensis* L. B. Smith. Habit photograph taken at the type locality, near the summit of Cerro de Mitu, Vaupes, Colombia. Photograph by R. E. Schultes. Plate 1279

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Cerro de Mitú. alt. about 270 m. "Common on bare top of mountain, in clumps on rocks." August 20, 1960, *Richard Evans Schultes 22711* (TYPE in Herb Gray).

Pitcairnia mituensis is a member of the group of species characterized by broadly alate ovules and seeds and ranging through the Guayana Highland from British Guiana to southeastern Colombia.

MARANTACEAE

Calathea acuminata *Steyermark* in Fieldiana, Bot. 28, no. 1 (1951) 161.

COLOMBIA: Comisaría del Vaupés, Río Negro, San Felipe. "Flowers white." December 12, 1947, *R. E. Schultes et F. López 9332;* "Flowers white." *R. E. Schultes et F. López 9337 A.*

The natives of the Río Guainía in Colombia and Venezuela boil the crushed leaves and stems of this (and possibly other) species of *Calathea* with the leaves of a species of *Nectandra* to prepare a poultice or dressing for infected ulcers of the legs and thighs.

BALANOPHORACEAE

Ombrophytum zamioides *Weddell* in Ann. Sci. Nat., ser. 3, 14 (1850) 184, t. 10.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu, Isla Zancudo. "White saprophyte." *R. E. Schultes et G. Black 8615.*

This curious saprophyte, identified by Dr. João Murça Pires of the Instituto Agronômico do Norte in Belem do Pará, has apparently not been reported from the Amazon Valley of Colombia or Brazil. The type was collected in Peru.

MALPIGHIACEAE

Banisteriopsis Caapi *(Spruce ex Griseb.) Morton* in Journ. Wash. Acad. Sci. 21 (1931) 485.

PERU: Departamento de San Martín, provincia de Lamas, San José de Sisa-Nauta, alt. c. 550 m. "Flores rosadas. Trepador voluble (soga) cultivado. *Shimba-ayahuasca.*" July 26, 1958, *O. Velarde Nuñez 6577.* (Herb. Morton Arb.; Econ. Herb. Oakes Ames).

Departamento de San Martin, Provincia de Lamas, San José de Sisa-Nauta, alt. c. 600 m. "Trepador voluble. Cultivado. Su tronco se usa para preparar una bebida alucinógena. *Ayahuasca legítima.*" July 29, 1958, *O. Velarde Nuñez 6586.* (Herb. Morris Arb.).

DEPARTAMENTO DE SAN MARTIN, PROVINCIA DE LAMAS, San José de Sisa-Nauta, alt. 600 m. "Flores rosadas. Trepador voluble. Cultivado. Su tronco se usa para preparar una bebida purgante y alucinógena. N.v. *Cuchi-ayahuasca*." July 29, 1959, *O. Velarde Nuñez 6587*. (Herb. Morris Arb.; Econ. Herb. Oakes Ames).

It is rare that flowering material of *Banisteriopsis Caapi* is collected in the field. In fact, with the exception of several collections from vines brought to flower in botanical gardens or experiment stations *(Ducke 25258, 25260; Murça Pires 19; Cuatrecasas et Dryander 14372)*, *Banisteriopsis Caapi* has been found in a flowering state only once since Spruce's type — when Ducke collected topotypical material from the Río Curicuriarí in Amazonian Brazil *(Ducke 153)*.

Velarde's two excellent collections *(6577, 6587)*, which are abundantly flowering, come from vines cultivated by natives on the eastern or Amazonian slope of the Peruvian Andes. An examination of the flowers discloses little if any significant variation from the general pattern of the flower of *Banisteriopsis Caapi* (see Cuatrecasas in Webbia 13 (1958) 506). *Velarde 6586* is sterile, as are most collections of *Banisteriopsis* cultivated for medicinal or narcotic use, but may safely be referred to *B. Caapi*.

Through the Velarde collections, we are able to cite several new vernacular names. *Velarde 6586* is said to represent *ayahuasca legítima* or "true ayahuasca"; *Velarde 6577* is called *shimba-ayahuasca;* and *Velarde 6587* has the name *cuchi-ayahuasca*.

Banisteriopsis inebrians *Morton* in Journ. Wash. Acad. Sci. 21 (1931) 485.

PERU: DEPARTAMENTO DE SAN MARTÍN, PROVINCIA DE LAMAS, San José de Sisa-Nauta, alt. 600 m. "Flores rosadas. Trepador voluble. Su tronco se utiliza como purgante y para preparar una bebida alucinógena. *Purga-huasca*." July 29, 1958, *Octavio Velarde Nuñez 6585* (Herb. Morris Arb.; Econ. Herb. Oakes Ames).

This collection, in abundant (albeit young) flower, has the very firm-coriaceous leaves which seems to be the principal character separating *Banisteriopsis inebrians* from *B. Caapi.*

Banisteriopsis inebrians, described from the Putumayo of

Colombia, has apparently not hitherto been reported from Peru.

Banisteriopsis Rusbyana *(Ndzu.) Morton* in Journ. Wash. Acad. Sci. 21 (1931) 487.

PERU: DEPARTAMENTO DE SAN MARTÍN, PROVINCIA DE TARAPOTO, Tarapoto, alt. 600 m. "Trepador voluble. Cultivado. Su tronco se utiliza para preparar una bebida purgante y alucinógena. N.v. *ayahausca amarilla.*" August 2, 1958, *O. Velarde Nuñez 6589* (Herb. Morris Arb.).

This collection is sterile, but the membranaceous leaves match very closely what we have been accepting as representative of *Banisteriopsis Rusbyana. Velarde 6589* is, indeed, a very close match for *Klug 1971* from the Putumayo of Colombia. The vernacular name *ayahuasca amarilla,* might possibly refer to the colour of the flowers.

The type of *Banisteriopsis Rusbyana* was collected in Bolivia, and the species has hitherto been known only from Bolivia and Colombia.

STERCULIACEAE

A number of collections of *Herrania* have been studied subsequent to the publication of my synopsis of the genus in 1958 (Journ. Arn. Arb. 39 (1958) 216) and are herewith cited since some of them extend known ranges or are the source of interesting taxonomic details.

Herrania albiflora *Goudot* in Ann. Sci. Nat. Paris, sér. 3, 2 (1844) 230, t. 5, figs. 1-10.

VENEZUELA: ESTADO DE BARINAS, Fundo Paiva, Santa Bárbara de Barinas, February 1953, *L. Aristeguieta 1598.*

This represents the second Venezuelan collection of a species predominantly Colombian in distribution.

Herrania Cuatrecasana *García-Barriga* in Caldasia 2 (1941) 57, t. 2.

COLOMBIA: COMISARÍA DEL PUTUMAYO, Río San Miguel, Quebrada de Sipanae, alt. 400 m., December 12, 1940. *J. Cuatrecasas 11012.*

This collection was inadvertently omitted from the synopsis.

Herrania kanukuensis *R. E. Schultes* in Caldasia 2 (1943) 11.

BRAZIL: ESTADO DO AMAZONAS, Jarú, Rio Branco. January 1913, *J. G. Kuhlmann 3082.*

Herrania kanukuensis is known from Brazil through only two collections, both from the Rio Branco. The species is otherwise registered from British and Dutch Guiana.

Herrania nitida *(Poepp.) R. E. Schultes* in Caldasia 2 (1943) 16, t. p. 17.

BRAZIL: Estado do Pará, Belem. Cultivated in Museu Paraense, February 4, 1926, *A. Ducke 21050.* Rio Jary, December 16, 1912, *E. Snethlage 12444.* Estado do Amazonas, Rio Solimões, San Antonio do Içа, August 26, 1906, *A. Ducke 7618;* Rio Japurá, November 20, 1904, *A. Ducke 14748;* São Paulo de Olivença, October 10, 1931, *A. Ducke 23977;* Rio Tocantíns, November 12, 1927; Rio Parintíns, January 20, 1936, *A. Ducke 35406.* Botanical Garden, Rio de Janeiro, ("from Amazonas"), March 31, 1922, *Ducke 248.* Territorio do Acre, Seringal Orion, October 23, 1923, *J. G. Kuhlmann 702.* COLOMBIA: Comisaría del Caquetá, Morelia, November 24, 1941, *K. von Schneidern A 1366 bis.* ECUADOR: Provincia Napo-Pastaza, Tiputini-Lagatococha, January-May, 1953, *F. Fagerlind et G. Wibom 2283; 2348;* Tena, October 18, 1939, *E. Asplund 9428;* December 30, 1939, *E. Asplund 10198;* Mera, December 7, 1955, *E. Asplund 18720;* Canelos, November 15-23, 1958, *G. Harling 3171; 3290; 3331.*

These newly cited collections, with the exception of *Kuhlmann 702* from the Brazilian Acre, do not alter our concept of the range of *Herrania nitida.*

Herrania nitida *(Poepp.) R. E. Schultes* fma. **sphenophylla** *R. E. Schultes* in Bot. Mus. Leafl. Harvard Univ. 14 (1950) 131.

PERU: Departamento del Loreto, Iquitos, November 20, 1940, *E. Asplund 14780.*

This form has previously been cited twice from Amazonian Peru and once from Amazonian Brazil and Colombia.

Herrania Mariae *(Mart.) Decaisne ex Goudot* in Ann. Sci. Nat., sér. 3, 2 (1844) 233. *Abroma Mariae* Martius in Denkschr. Regensb. Bot. Gesell. 3 (1841) 297, tt. 6, 9. *Theobroma Mariae* (Mart.) Schumann in Martius Fl. Brasil. 12, pt. 3 (1886) 71, t. 15. *Herrania atrorubens* Huber in Bull. Soc. Genève, ser. 2, 6 (1914) 187.

BRAZIL: Estado do Pará, Rio Trombetas, Castanhões do Rio Cuminá-mirim, December 12, 1906, *A. Ducke 7935.*

In my monograph of *Herrania*, I included *H. atrorubens* as a synonym of *H. nitida* (Poepp.) R. E. Schult. An opportunity for me to examine the type of Huber's concept has now arisen, and I find that it is referable to *H. Mariae.* Huber himself, in describing *H. atrorubens*, noted that it differed

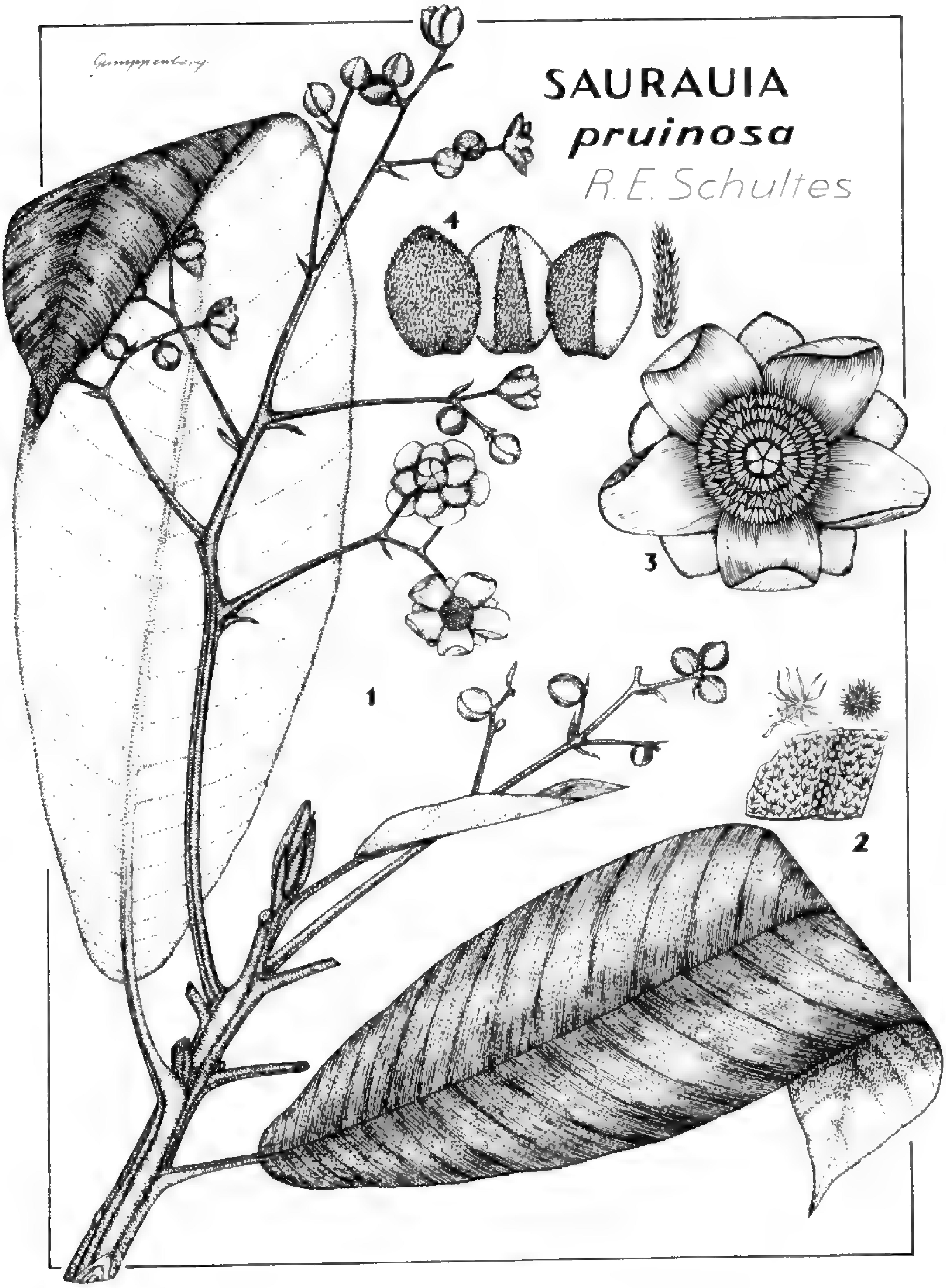


Figure 8. *Saurauia pruinosa* R. E. Schultes. 1) Habit, × 1. 2) Nether surface of the leaf, × about 10 (single hairs × about 50). 3) Flower, × 3. 4) Sepals × 3 (single hair × about 30). Drawn by John Gumppenberg.

from *H. Mariae* in being smaller and in having dark red flowers.

Herrania pulcherrima *Goudot* var. **pacifica** *R. E. Schultes* in Bot. Mus. Leafl. Harvard Univ. 14 (1950) 131, t. 28, low. fig.

ECUADOR: PROVINCIA ESMERALDAS, Río San Miguel, March 28-April 6, 1959, *G. Harling 4569.*

Harling 4569 represents the second collection of this Pacific coastal variety from Ecuador and the first from Esmeraldas.

DILLENIACEAE

Saurauia pruinosa *R. E. Schultes* in Bot. Mus. Leafl. Harvard Univ. 16 (1953) 81.

COLOMBIA: COMISARÍA DEL PUTUMAYO, Valley of Sibundoy, Sibundoy, alt. about 2225-2300 m. May 29, 1946. *R. E. Schultes et M. Villarreal 7651.*

One of the most beautiful of the South American species of Saurauia because of the rose-pink hue of the leaf and petiole indumentum, this species has not hitherto been illustrated.

CARYOCARACEAE

Caryocar gracile *Wittmack Martius* in Fl. Bras. 12, pt. 1 (1886) 350.

COLOMBIA: AMAZONAS-VAUPÉS, Río Apaporis, Jinogojé (at mouth of Río Piraparaná) and vicinity, alt. about 700 feet, lat. 0°15′ S, long. 70°30′ W. "Small tree, 25-35 feet tall. Flowers yellow. Fruit crushed for barbasco to poison fish. Makuna: *gaw-gě*. Puinave: *ho*." June 8, 1952, *R. E. Schultes et I. Cabrera 16668.*

Caryocar gracile, known from the Colombian Amazon basin through only several collections, is employed by the Indians of the Vaupés as a fish poison. The fruits are crushed and cast into still water. The oily seeds are sometimes eaten as a food, and the bark is said by the Makunas to be employed like soap in washing.

FLACOURTIACEAE

Mayna muricida *R. E. Schultes* sp. nov.

A *Mayna amazonica* foliis lanceolatis (non ovatis), subtus grossiuscule sparsissimeque (non molliter denseque) pilosis et supra glabris (non sparse pilosis) atque fructus aliis conspicue crispaturis (non integris) differt.

COLOMBIA: COMISARÍA DEL AMAZONAS, Trapecio amazónico, interior regions of trapecia between Amazon and Putumayo Rivers, alt.

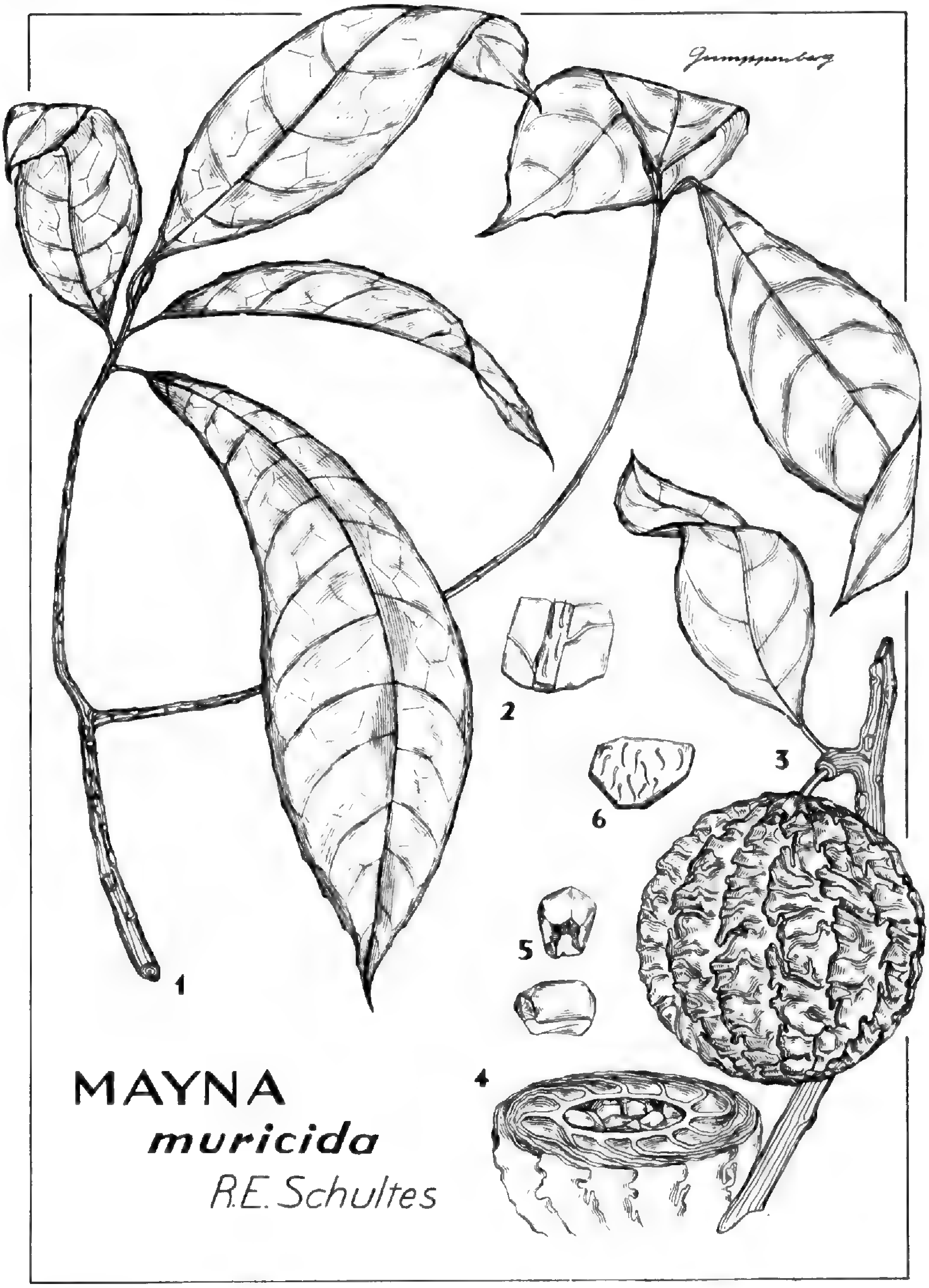


Figure 9. *Mayna muricida* R. E. Schultes. 1) Branch with leaves, × 1. 2) Nether surface of the leaf, × 20. 3) Branch with fruit, × 1. 4) Cross section of fruit, × 1. 5) Seeds, ×5. 5) Surface of fruit, × 20. Drawn by John Gumppenberg.

slightly over 100 m. "Treelet. 20 ft. tall. Fruit white. Seeds used by Tikunas to kill rats. Tikuna name = *ka-té-bǒ*. In varial." October 1945, *Richard Evans Schultes 6760* (TYPE in Herb. Gray).

Mayna muricida, so named because the Tikuna Indians gather the seeds to scatter around their houses in the belief that they kill rodents, differs from *M. amazonica* especially in lacking a soft indumentum on the nether surface of the leaves and in having curiously crispate (marginally eroded and curled) wings on the fruit. Both species occur in the light "caatinga" or "varial" forest growing on sterile sand, not, as with most other species, in dense forests; *M. amazonica*, however, in many parts of its range (the western Amazon in Brazil, Colombia, Peru and Venezuela) is a typical jungle tree.

Mayna toxica *R. E. Schultes* sp. nov.

A *Mayna amazonica* foliis subtus maxime mollissimis pilosis atque fructu chryseo-viride (non atroviride) et sine aliis (aliis ad costas reductis) principaliter differt.

COLOMBIA: COMISARÍA DEL VAUPÉS, Río Vaupés, Tipiaca, (between Mitú and Javareté). "Bark poison for dogs, rats, man. Bush up to 12 ft. tall. Fruit light yellow-green. Desano name = *bě-ra-man-o-hě-ree-gě*." May 14-24, 1953. *Richard Evans Schultes et Isidoro Cabrera 19337* (TYPE in Econ. Herb. Oakes Ames). COMISARÍA DEL AMAZONAS, Río Apaporis, Caño Peritomé, tributary below Raudal Yayacopi, alt. about 750 ft. "Height 12 ft." February 18-20, 1952, *R. E. Schultes et I. Cabrera 15519*. COMISARÍA DEL VAUPÉS, Río Apaporis, Soratama, April 2, 1952, *R. E. Schultes et I. Cabrera 16142*.

Mayna toxica is easily distinguished from related species by its golden yellow fruit which, instead of having conspicuous wings, is armed only with slightly thickened ribs.

The specific name refers to the general belief amongst the natives that the bark (and, according to some, the seeds) are poisonous. It is stated that the rasped bark is employed to kill dogs and rodents. The active principle is not known. A test for alkaloids with modified Dragendorf reagent (see R. F. Raffauf in Econ. Bot. 16 (1962) 171) gave negative results. The fact that at least two species — *Mayna muricida* and *M. toxica* — are similarly employed for their toxic properties by Indians in far-separated parts of the Colombian Amazon suggests that an investigation into the chemical constituents of this genus might be of interest.

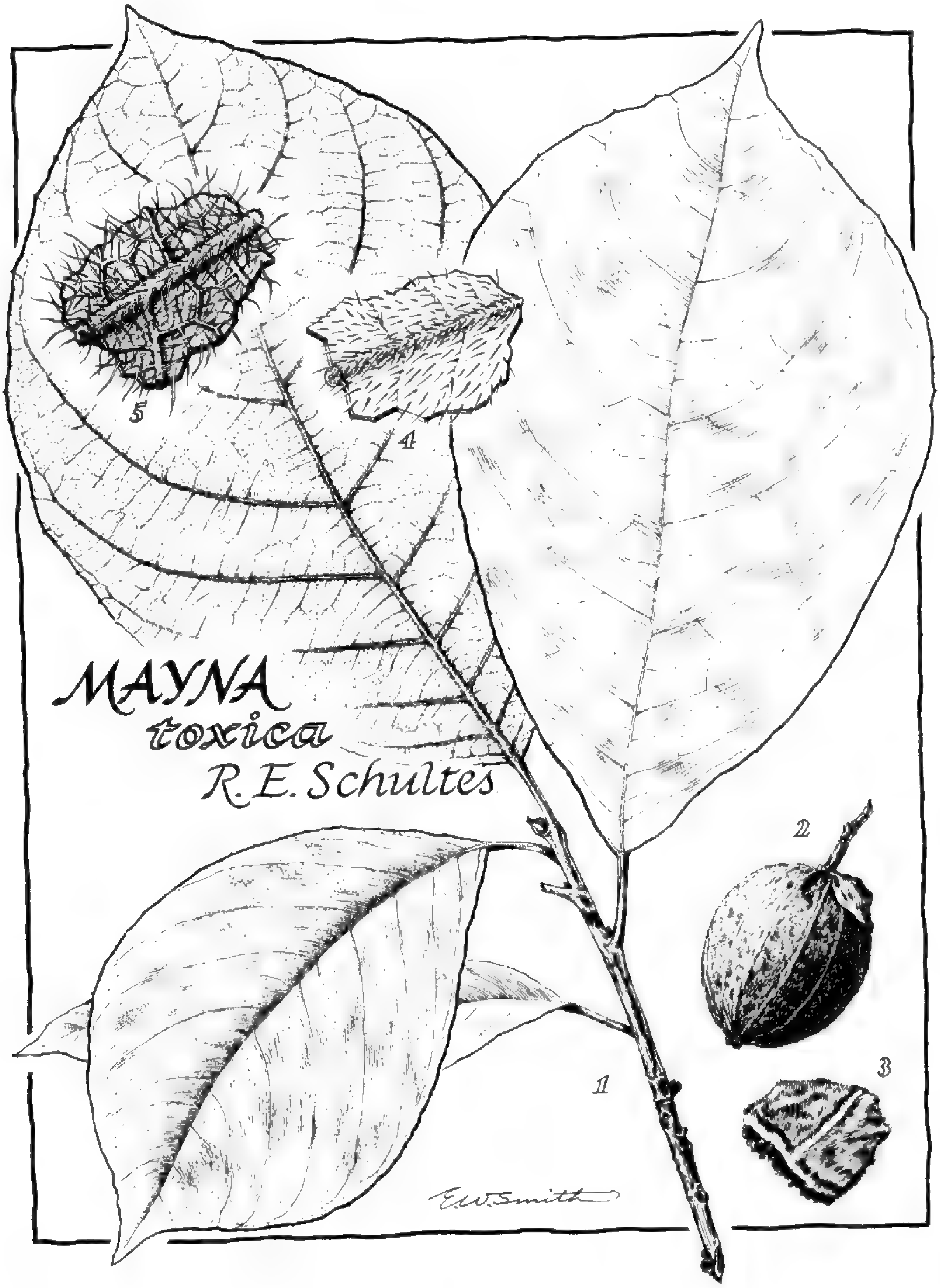


Figure 10. *Mayna toxica* R. E. Schultes. 1) Branch with leaves, × 1. 2) Fruit, × 1. 3) Enlargement of the surface of the fruit. 4) Enlargement of the upper surface of the leaf. 5) Enlargement of the nether surface of the leaf. Drawn by E. W. Smith.

MELASTOMACEAE

The following notes on melastomaceous plants have been submitted by Dr. J. J. Wurdack of the Smithsonian Institution, who writes: "Among the collections thus far studied by me are represented a number of new records of Melastomataceae for Colombia. Dr. Schultes' Vaupés collections have especially emphasized the strong linkage with the flora of Dept. Loreto, Peru."

Adelobotrys barbata *Triana* in Trans. Linn. Soc. 28 (1871) 68.

COLOMBIA: Comisaría del Vaupés, Río Piraparaná. *R. E. Schultes et I. Cabrera*, March 9, 1952, *15908;* May, 1952, *17129;* September 19, 1952, *17574.*

Limited to the upper Río Negro drainage-area, this shrubby species in a predominantly vining genus, is now well represented from the Colombian Vaupés.

Adelobotrys macrophylla *Pilger* in Verhandl. Bot. Ver. Brandenburg 47 (1905) 165.

COLOMBIA: Comisaría del Vaupés, Río Piraparaná, Caño Teemeeña, September 4, 1952, *R. E. Schultes et I. Cabrera 17216;* Río Pacoa, February 8, 1952, *R. E. Schultes et I. Cabrera 15223.*

This species previously has been known only from the Department of Loreto in Peru. Branches of this bush are burned and the ashes are added to clay for the manufacture of pottery.

Adelobotrys praetexta *Pilger* in Verhandl. Bot. Ver. Brandenburg 47 (1905) 167.

COLOMBIA: Comisaría del Vaupés, Río Piraparaná, September 1952, *R. E. Schultes et I. Cabrera 17127;* Río Apaporis, Río Popeyaca, February 25, 1952, *R. E. Schultes et I. Cabrera 15661.*

Adelobotrys praetexta has hitherto been known only from Amazonian Bolivia and Peru.

Bellucia umbellata *Gleason* in Bull. Torr. Bot. Club 58 (1931) 257.

COLOMBIA: Comisaría del Vaupés, Río Piraparaná, March 9, 1952, *R. E. Schultes et I. Cabrera 15916;* Jinogojé, June 5, 1952, *16628;* September 6, 1952, *17349.* Río Apaporis, September 1952, *R. E. Schultes et I. Cabrera 17094.*

Hitherto *Bellucia umbellata* has been reported only from Loreto, Peru. The Barasana Indian name of this bush is *teé-ña-mö.*

Graffenrieda candelabrum *Macbride* in Field Mus. Publ. Bot. 13, pt. 4 (1941) 321.

COLOMBIA: COMISARÍA DEL AMAZONAS, Río Miritiparaná, March 2, 1952, *R. E. Schultes et I. Cabrera 15728.*

Known hitherto only from the type collection from the Departmento de Loreto, Peru, this species is now registered from Amazonian Colombia. The bluish fruits are somewhat astringent and are chewed to "heal" bleeding gums. Tanimuka name = *kweé-ma-mĕ.* Yukuna name = *ko-me-noo-ma-rĕ* ("bird's spice").

Leandra rhodopogon *(DC.) Cogniaux* in Martius Fl. Bras. 14, pt. 4 (1886) 109.

COLOMBIA: COMISARÍA DEL VAUPÉS, Río Apaporis, Soratama, June 20, 1951, *R. E. Schultes et I. Cabrera 12727;* February 25, 1952, *15695;* August 17, 1952, *16951;* January 1952, *19614.* Río Piraparaná, September 1952, *R. E. Schultes et I. Cabrera 17121.* Río Vaupés, Mitú, *L. Uribe Uribe 2920; J. Cuatrecasas 6803.*

Miconia astrotricha *(DC.) Triana* in Trans. Linn. Soc. 28 (1871) 113.

COLOMBIA: COMISARÍA DEL AMAZONAS, Río Popeyaca, February 1952, *R. E. Schultes et I. Cabrera 15603.*

The present collection, which has been compared with the type in Munich, represents apparently the first time the species has turned up since the original Martius material from Amazonian Brazil.

Miconia filamentosa *Gleason* in Bull. Torr. Bot. Club 65 (1938) 579.

COLOMBIA: COMISARÍA DEL VAUPÉS, Río Apaporis, Río Popeyacá, June 10, 1952, *R. E. Schultes et I. Cabrera 16685;* Jinogojé, March 1952, *19825.*

The previously known range of this species included only Amazonian Brazil and Peru.

Miconia fissa *Gleason* in Bull. Torr. Bot. Club 59 (1932) 363.

COLOMBIA: COMISARÍA DEL AMAZONAS, Río Miritiparaná, May 8, 1952, *R. E. Schultes et I. Cabrera 16406.*

Miconia fissa was previously known only from the type collection by Holt and Blake from the Río Maturaca, Amazonian Brazil. The Yukuna Indian name is *hay-wa-lá,* and the orange fruit is employed as a diuretic.

Miconia marginata *Triana* in Trans. Linn. Soc. 28 (1871) 110.

COLOMBIA: COMISARÍA DEL VAUPÉS, Río Apaporis, September 1952, *R. E. Schultes et I. Cabrera 17053.* Río Piraparaná September 10, 1952, *R. E. Schultes et I. Cabrera 17367;* Río Ricapuyá, September 27, 1952, *R. E. Schultes et I. Cabrera 17634.*

Widespread in Amazonian Bolivia and Brazil and in Venezuela and British Guiana, *Miconia marginata* is now registered from Colombia.

Ossaea araneifera *Markgraf* in Notizbl. 13 (1937) 462.

COLOMBIA: COMISARÍA DEL VAUPÉS, Río Apaporis, Jirijirímo, July 5, 1951, *R. E. Schultes et I. Cabrera 12950.*

This species has been known only from the type collection from Loreto, Peru.

Ossaea cucullata *Gleason* in Bull. Torr. Bot. Club 58 (1931) 260.

BRAZIL: ESTADO DO AMAZONAS, Muquentaua, Rio Teffé, *R. L. Frôes 26299.* COLOMBIA: COMISARÍA DEL VAUPÉS, Río Apaporis, Soratama, July 17, 1951, *R. E. Schultes et I. Cabrera 13096;* August 4, 1951, *13349;* January 1952, *19626.* Río Kuduyarí, Cerro Yapobodá, April 1963, *R. E. Schultes et I. Cabrera 20031.*

Previously registered only from Loreto, Peru, this species is now known from Amazonia Brazil and Colombia.

MYRSINACEAE

Conomorpha citrifolia *Mez* in Pflanzenr. 4, Fam. 236 (1902) 256.

COLOMBIA: COMISARÍA DEL VAUPÉS, Río Piraparaná (tributary of Río Apaporis), Raudal Na-hoó-gaw-he, between lat. 0°15′ S, long. 70°30′W and lat. 0°25′N, long. 70°30′W. "Flowers whitish yellow. Small tree along bank. Bark rasped into chicha to give it a peppery taste. Puinave: *yoom-dá-ka.* Barasana: *gáw-hĕ-kĕ.*" September 1952, *R. E. Schultes et I. Cabrera 17593.*

Conomorpha citrifolia, like the recently described *C. lithophyta* R. E. Schult. of the Vaupés and *C. magnoliifolia* Mez in Dutch Guiana, is employed as a minor fish-poison. The Barasana Indians of the Río Piraparaná crush the leaves and strew them on the surface of still or very slowly moving water. They also have an interesting use of the bark which is rasped into fermented *chicha* (made of *Manihot esculenta* Crantz or any of a number of edible fruits) as a spice to give the beverage a rather peppery taste.

SOLANACEAE

Solanum platyphyllum *Humboldt et Bonpland* ex Dunal Sol. gen. aff. syn. (1816) 38.

COLOMBIA: COMISARÍA DEL PUTUMAYO, road between El Pepino and Mocoa, alt. about 700 m. "Bush 2 feet. Fl. purplish white. Fr.

ripens red with hairs. Lvs. with purplish cast underneath. Cult. Common name = *uvilla.*" July 28, 1960. *R. E. Schultes 22556.*

This is the second collection of *Solanum platyphyllum* which has come to light from the Colombian Amazon. The difference in altitude between the other collection, *Schultes 6642*, which was from Leticia at 100 m. and *Schultes 22556* at 700 m. is noteworthy. Both collections were taken from bushes cultivated for their edible berries.

BOTANICAL MUSEUM,
HARVARD UNIVERSITY

A DOUBLE-FLOWERED FORM OF DIAPENSIA LAPPONICA. — *Diapensia lapponica* L. is a common plant in the alpine area of the Presidential Range of New Hampshire where it has been observed by many botanists. There is no record, however, of any form occurring with more than 5 petals, the characteristic number.

This June, while conducting a flower walk in the vicinity of Mt. Monroe in the Presidentials, my attention was called by one of the group to an unusual flower. It was a Diapensia with numerous white petals and no stamens, a state that might be designated as "double-flowered". Diapensia grows in dense tussocks, all the plants of which are in close association. This tussock contained a number of flowers of which most were double-flowered, but 2 or 3 were normal. A note was made of the location and a check will be made next year to see if the condition persists. A specimen of the plant has been deposited in the Herbarium of the University of New Hampshire. — FREDERIC L. STEELE,

ST. MARY'S-IN-THE-MOUNTAINS, LITTLETON, N. H.

A NEW STATION FOR RHODODENDRON MAXIMUM IN NORTHERN VERMONT

H. W. VOGELMANN AND L. A. CHARETTE

The most northerly known station in Vermont for *Rhododendron maximum* L. has been found only 8 miles south of the Quebec border, not far from the village of Troy. The discovery was made in June 1957 by Dr. Charles G. Doll, Vermont State Geologist, while conducting field work in preparation for a new geological map of the state. Professor Doll guided the writers to the site on July 3, 1962 at which time a careful examination of the colony was made.

Located in the northwestern section of Troy township, ½ mile south of Troy village, the rhododendron colony is on a level moss-covered site about 200 feet from the southeastern bank of the Missisquoi River. The oval-shaped colony, covering an estimated ½ acre, is under an open stand of young trees of fir, yellow birch and red maple, with trunk diameters up to 10 inches. Surrounding this area is an older, denser second growth forest dominated by hemlock, fir, yellow birch, and red maple with an extensive cover of yew in the understory. The rhododendrons, toward the center of the colony, are dense and grow to heights of about 6 feet, while toward the edge of the colony they are lower and much sparser, finally becoming broken into small scattered clumps. Some of the latter grow under dense forest cover.

No flowers or flower buds were seen and there was no indication that the plants had flowered the previous year. A careful search failed to disclose any seedlings in the area and it seems unlikely that the colony had flowered in recent years.

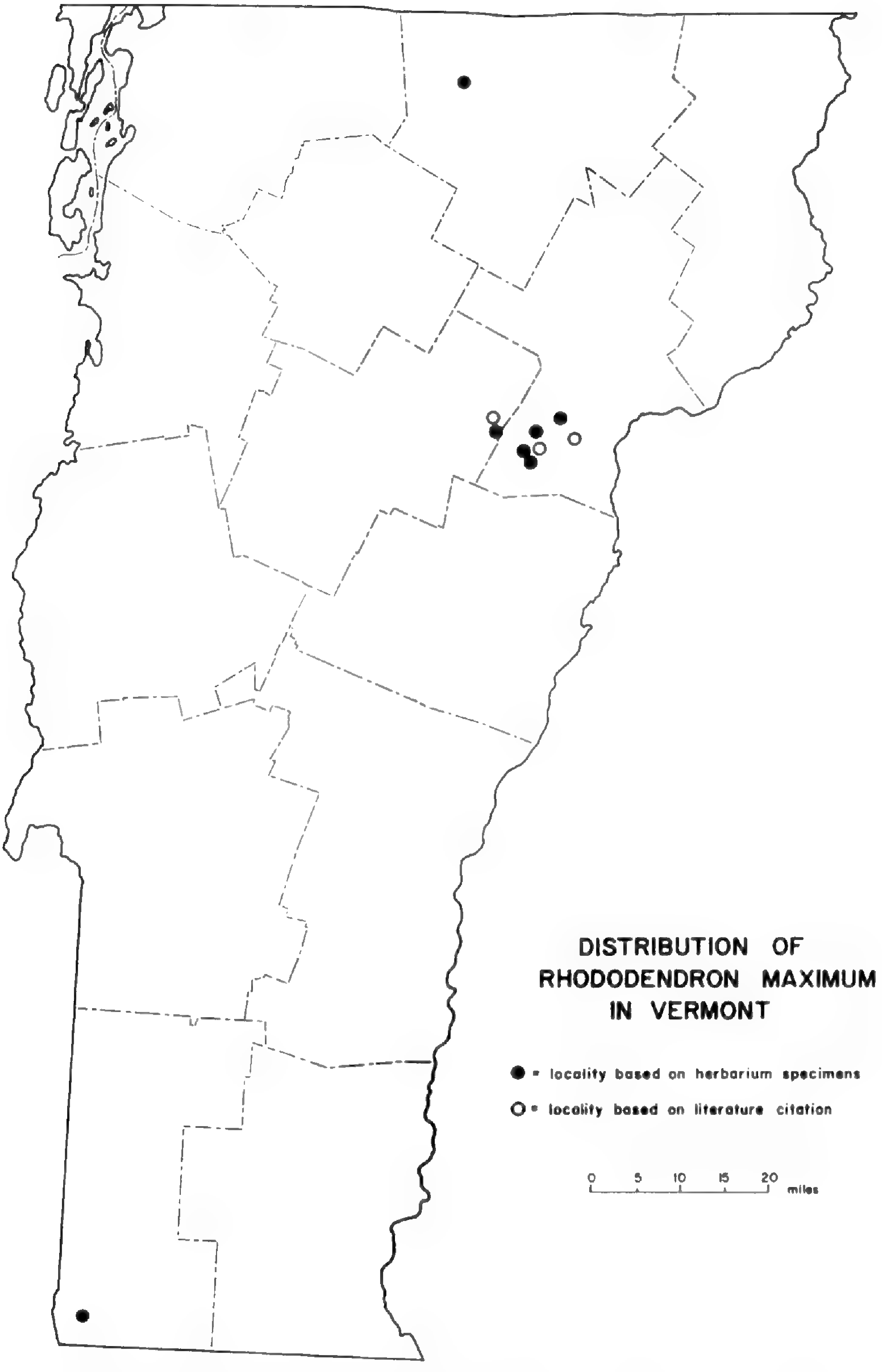
A striking feature of the rhododendrons is the appearance of many drooping, browned leaves toward the ends of some of the branches, giving one the impression that the plants are lacking sufficient water. The mossy cover beneath the colony appeared to be unusually dry for early summer. Dr. Doll indicated that in the summer of 1957 he had noted the same leaf condition as well as the absence of flowers and fruits. Toward the periphery of the main stand, the stems of dead rhododendrons are conspicuous and these appear to have once linked some of the smaller scattered colonies with the main colony. A similar condition apparently occurs in the outlying colony in Lexington, Maine where many dead plants are reportedly found near the edge of the stand (4, 8). The general aspect of the Vermont colony may be a further indication of the widespread deterioration of rhododendrons in northern and central New England (4). The dot map given by Iltis (7) shows the range of the species and clearly illustrates the disjunct distribution of colonies in the northern part of its range.

Growing among the rhododendrons is an assemblage of northern shrubs and herbs. *Nemopanthus mucronata* and *Viburnum cassinoides* are common along with seedlings of *Betula lutea* which grow in the mossy cover with an abundance of *Clintonia borealis* and *Coptis groenlandica.* Occasional in the shrubby layer are *Pyrus americana, Viburnum alnifolium* and *Vaccinium myrtilloides.* Associated herbs include *Osmunda cinnamomea, O. regalis,* var. *spectabilis, Dryopteris spinulosa, Cypripedium acaule, Cornus canadensis, Gaultheria hispidula, Maianthemum canadense, Trientalis borealis, Trillium undulatum, Dalibarda repens, Linnaea borealis* var. *americana* and *Carex intumescens.*

The Troy colony is 40 miles north of the nearest known rhododendron stations near Lanesboro and Peacham, Vermont, where several colonies grow along the borders of some of the ponds in the region. At a latitude of 44°53′ the new stand is almost as far north as the colony in Lexington, Maine, which is reported to be at about 45° north latitude. (8). The colony in Troy must be subjected to severe climatic stresses for the station is only 9 miles west of Newport, Vermont, which is noted for its cold winters, and in five of the last ten years has recorded temperatures of -30° F. or lower. In January 1957 the temperature dropped to -38° F. and a record low of -40° F. occurred in 1933.

A summary of the known Vermont stations of *Rhododendron maximum* which are supported by herbarium specimens is as follows:

ORLEANS COUNTY: Troy, *C. G. Doll, H. W. Vogelmann* and *L. A.*



Map. 1. Showing distribution of *Rhododendron maximum* colonies in Vermont.

Charette (No. 2451) July 3, 1962 (VT., NEBC, HNH). WASHINGTON COUNTY: Lanesboro, *Miss M. P. Skinner* (VT. NEBC); *J. G. Jack*, Aug. 16, 1901 (A). CALEDONIA COUNTY: Shores of Groton Pond, *J. A. Bates*, July 1897 (NEBC, HNH), *L. R. Jones*, July 4, 1898 (VT.); Shore of Long Pond, Ricker Station, *C. G. Pringle*, July 1879 (A); Groton, *W. H. Blanchard*, Oct. 7, 1911 (GH); Shore of Martin's Pond, Peacham, *F. Blanchard*, July 1881 (NHA); Peacham, *Alice F. Stevens*, July 26, 1892 (HNH), *F. Blanchard*, July 9, 1883 (A, HNH). BENNINGTON COUNTY: Pownal Center, *D. S. Carpenter*, June 28, 1922 (VT).

A station at Niggerhead Pond in Washington County is given in the 1900 edition of the Vermont Flora (2) and it is also reported at Harvey's Pond in West Barnet (1, 3). Knowlton (8) records it at Ricker and Levi Ponds in the Groton area.

These locations are plotted on Map 1 to show the distribution of *Rhodendron maximum* colonies in Vermont. When these localities are coupled with those given in recent issues of Rhodora for New Hampshire and Maine (5, 6) a fairly accurate distribution of the species in New England is obtained. — UNIVERSITY OF VERMONT, BURLINGTON.

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SIXTEENTH REPORT OF THE COMMITTEE ON PLANT DISTRIBUTION

The fifteenth report included the genus Carex of the Cyperaceae. The present report deals with the genera of the Cyperaceae other than Carex.

The data for these reports have been compiled chiefly from the material found in the herbarium of the New England Botanical Club, in the Gray Herbarium and in the herbarium of the Peabody Museum at Salem, Massachusetts.

Preliminary Lists of New England Plants — XLI

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

CYPERACEAE	Me.	N.H.	Vt.	Mass.	R.I.	Conn.
Bulbostylis capillaris (L.) C. B. Clarke	+	+	+	+	+	+
B. capillaris var. crebra Fern.	+	+	+	+	+	+
Cladium mariscoides (Muhl.) Torr.	+	+	+	+	+	+
Cyperus brevifolius (Rottb.) Hassk.						—
C. dentatus Torr.	+	+	+	+	+	+
C. diandrus Torr.	+	+	+	+	+	+
C. Engelmannii Steud.			+	+		
C. erythrorhyzos Muhl.				+	+	+
C. esculentus L.	+	+	+	+	+	+
C. ferruginescens Boeckl.			+			+
C. filicinus Vahl	+	+		+	+	+
C. filiculmis Vahl				+	+	+
C. filiculmis var. macilentus Fern.	+	+	+	+	+	+
*C. fuscus L.				+		
C. Grayii Torr.				+	+	+
C. Houghtonii Torr.	+	+	+	+		
C. inflexus Muhl.	+	+	+	+	+	+
C. odoratus L.				+	+	+
*C. ovularis (Michx.) Torr.				+		
C. polystachyos Rottb. var. texensis (Torr.) Fern.				+		
C. rivularis Kunth	+	+	+	+	+	+
C. strigosus L.	+	+	+	+	+	+
C. strigosus var. robustior Britt.				+		+
× C. Weatherbianus Fern. (=Dulichium arundinaceum × Rhynchospora capitellata)				+		

	Me.	N.H.	Vt.	Mass.	R.I.	Conn.
Dulichium arundinaceum (L.) Britt.	+	+	+	+	+	+
Eleocharis acicularis (L.) R. & S.	+	+	+	+	+	+
E. acicularis var. submersa (Hj. Nilss.) Svenson	+			+		
E. ambigens Fern.				—	—	
E. calva Torr.	+	+	+	+		+
E. diandra C. Wright	+	+	+	+		+
E. elliptica Kunth	+	+	+	+	+	+
E. Engelmanni Steud.	+			+	+	+
E. equisetoides (Ell.) Torr.				+	+	+
× E. fallax Weath.				+		
E. halophila Fern. & Brack.	+	+		+	+	+
E. intermedia (Muhl.) Schultes	+	+	+	+		+
E. melanocarpa Torr.				+	+	
E. microcarpa Torr. var. filiculmis Torr.						+
E. nitida Fern.		+				
E. obtusa (Willd.) Schultes	+	+	+	+	+	+
E. obtusa var. ellipsoidalis Fern.		+	+	+	+	
E. obtusa var. jejuna Fern.	+	+	+	+		+
E. obtusa var. Peasei Svenson	+	+				
E. olivacea Torr.	+	+	+	+	+	+
E. ovata (Roth) R. & S.	+	+	+	+		+
E. ovata var. Heuseri Uechtritz	+	+				
E. palustris (L.) R. & S.	+	+	+		+	+
E. palustris var. major Sonder	+	+	+	+	+	+
E. parvula (R. & S.) Link	+	+		+	+	+
E. pauciflora (Lightf.) Link var. Fernaldii Svenson	+	+	+			
E. quadrangulata (Michx.) R. & S. var. crassior Fern.				+		+
E. Robbinsii Oakes	+	+		+	+	+
E. rostellata Torr.	+			+	+	+
E. Smallii Britt.	+	+	+	+	+	+
E. tenuis (Willd.) Schultes	+	+		+	+	+
E. tricostata Torr.				+	+	
E. tuberculosa (Michx.) R. & S.		+		+	+	+
Eriophorum angustifolium Honckeny	+					
E. angustifolium var. majus Schultz	+			—		
E. gracile W. B. J. Koch	+	+	+	+	+	+
E. spissum Fern.	+	+	+	+	+	+
E. tenellum Nutt.	+	+	+	+	+	+
E. virginicum L.	+	+	+	+	+	+
E. viridi-carinatum (Engelm.) Fern.	+	+	+	+	+	+
Fimbristylis autumnalis (L.) R. & S.	+	+	+	+	+	+

	Me.	N.H.	Vt.	Mass.	R.I.	Conn.
F. autumnalis var. mucronulata (Michx.) Fern.				+	+	
Fuirena pumila Torr.				+	+	
Hemicarpha micrantha (Vahl) Pax	+	+		+	+	+
Psilocarya nitens (Vahl) Wood				+		
P. scirpoides Torr.				+	+	
Rhynchospora alba (L.) Vahl	+	+	+	+	+	+
R. capillacea Torr.	+	+	+	+		+
R. capitellata (Michx.) Vahl	+	+	+	+	+	+
R. fusca (L.) Ait. f.	+	+	+	+	+	+
R. inundata (Oakes) Fern.				+	+	
R. macrostachya Torr.	+			+	+	+
R. Torreyana Gray				+	+	
Scirpus acutus Muhl.	+	+	+	+		+
S. americanus Pers.	+	+	+	+	+	+
S. ancistrochaetus A. E. Schuyler			+			
S. atrocinctus Fern.	+	+	+	+	+	+
S. atrovirens Willd.	+	+	+	+	+	+
S. atrovirens var. georgianus (Harper) Fern.	+	+	+	+	+	+
S. cespitosus L. var. callosus Bigel.	+	+	+			
S. cespitosus var. delicatulus Fern.	+					
S. Clintonii Gray	+					
S. cyperinus (L.) Kunth	+	+	+	+	+	+
S. cyperinus var. pelius Fern.	+	+	+	+	+	
S. expansus Fern.	+	+	+	+	+	
S. fluviatilis (Torr.) Gray	+		+	+		
S. Hallii Gray				+		
S. heterochaetus Chase			+	+	+	
S. hudsonianus (Michx.) Fern.	+	+	+	+	+	+
S. lineatus Michx.	+	+	+	+		+
S. Longii Fern.				+		+
S. maritimus L. var. Fernaldii (Bickn.) Beetle	+	+		+	+	+
S. Olneyi Gray				+	+	+
S. paludosus Nels. var. atlanticus Fern.	+	+		+	+	+
S. Peckii Britt.	+	+	+	+	+	
S. pedicellatus Fern.	+	+	+	+	+	+
S. pedicellatus var. pullus Fern.	+	+	+	+		+
S. polyphyllus Vahl				+		+
S. Purshianus Fern.	+	+		+	+	+
S. robustus Pursh	+			+	+	+
S. rubricosus Fern.				+		
S. rubrotinctus Fern.	+	+	+	+		+
S. Smithii Gray	+	+	+	+	+	+

	Me.	N.H.	Vt.	Mass.	R.I.	Conn.
S. Steinmetzii Fern.	+					
S. subterminalis Torr.	+	+	+	+	+	+
S. Torreyi Olney	+	+	+	+	+	+
S. validus Vahl var. creber Fern.	+	+	+	+	+	+
S. verecundus Fern.			+	+	+	+
Scleria pauciflora Muhl. var. caroliniana (Willd.) Wood		—		+		+
S. reticularis Michx.				+	+	+
S. triglomerata Michx.				+		+
S. verticillata Muhl.						+

The Cyperaceae, other than Carex, were treated by Prof. M. L. Fernald in RHODORA X: 135-144, 1908. As in the case of Carex the number of specimens available for study has become very much larger since then and there has also been a considerable change in nomenclature in the intervening years. At the conclusion of his report Prof. Fernald included "Suggestions for Special Observation". Most of the range extensions that he predicted have proved to be correct, but many of the species from the southern United States have not as yet been reported from the New England area.

As in Carex the number of introduced species is insignificant. In fact there are only two, *Cyperus fuscus* and *C. ovularis.* The latter is native farther south but in New England it is known only as a casual waif on made land in Boston and has not been collected recently. In Prof. Fernald's report he cites this single station for *C. ovularis* and none for *C. fuscus.*

The geographical areas are in general the same as in the previous report.

I. GENERALLY DISTRIBUTED. — *Dulichium arundinaceum, Eleocharis acicularis, E. elliptica, E. obtusa, E. palustris* var. *major, Eriophorum spissum, E. tenellum, E. virginicum, Rhynchospora alba, R. capitellata, Scirpus acutus, S. atrocinctus, S. atrovirens* var. *georgianus, S. cyperinus* var. *pelius, S. rubrotinctus* and *S. validus* var. *creber.*

Eleocharis obtusa is poorly represented in northern Maine. *Scirpus acutus* is infrequent except for the Champlain Basin and the western Maine Coast. There are no stations for it in Rhode Island. *Scirpus atrocinctus* has not yet been reported from southern Rhode Island or southern Connecticut and has only one station in southeastern Massachusetts. *S. atrovirens* var. *georgianus* has not yet been recorded from Aroostook County, Maine. *Eriophorum spissum* has not been reported from southern Connecticut and Rhode Island and is rare in southeastern Massachusetts, due to the absence of cold bogs in these areas.

Ia. GENERAL, EXCEPT THE MAINE COAST EAST OF THE KENNEBEC RIVER. — None.

Ib. GENERAL, EXCEPT THE WASHINGTON COUNTY COAST. — *Cladium mariscoides*.

Ic. GENERAL, EXCEPT CAPE COD. — *Eriophorum viridi-carinatum, Scirpus atrovirens, S. pedicellatus* and *S. pedicellatus* var. *pullus*.

Scirpus atrovirens is infrequent. *S. pedicellatus* var. *pullus* has a distribution in New England similar to the species, but is much less frequent.

IIa. NORTHERN — NONE OR NOT MANY STATIONS SOUTH OF 43°. — *Eleocharis ovata* and var. *Heuseri, E. palustris, E. pauciflora* var. *Fernaldii, Eriophorum angustifolium, Scirpus cespitosus* var. *callosus* and *S. Clintonii*.

The interpretation of the characters separating *Eleocharis ovata* and var. *Heuseri* is so difficult in many specimens that it might have been better to have treated the two together; *E. ovata*, as currently interpreted, appears to be local in southern New England with a single station in Massachusetts and two in central Connecticut. *E. palustris* occurs doubtfully at two stations in southern New England. *Eriophorum angustifolium* and *Scirpus Clintonii* are confined to Maine only.

IIb. NORTHERN — NUMEROUS STATIONS SOUTH OF 43°. — *Scirpus hudsonianus*.

III. ARCTIC-ALPINE. — None.

IV. SOUTHERN — GENERAL SOUTH OF 45°. — *Bulbostylis capillaris* var. *crebra, Cyperus dentatus, Eleocharis Smallii, Rhynchospora fusca, Scirpus americanus, S. cyperinus* and *S. subterminalis*.

Scirpus americanus is more abundant near the coast. *S. subterminalis* has been reported from only three stations in Vermont, all in upland areas.

IVa. SOUTHERN — GENERAL SOUTH OF 45° BUT NOT ON MAINE COAST EAST OF THE KENNEBEC RIVER. — *Cyperus esculentus, C. filiculmis* var. *macilentus, C. rivularis, Fimbristylis autumnalis, Scirpus Purshianus* and *S. Smithii*.

The only Vermont station for *Fimbristylis autumnalis* is near the Connecticut River in the extreme southeastern corner of the state.

IVb. SOUTHERN — GENERAL SOUTH OF 45° BUT NOT IN WASHINGTON COUNTY. — *Cyperus diandrus, C. strigosus, Eleocharis olivacea* and *E. Robbinsii*.

Eleocharis Robbinsii in New England is restricted to an area within a hundred miles of the coast.

IVc. SOUTHERN — GENERAL SOUTH OF 45° BUT NOT ON CAPE COD. — *Eleocharis tenuis, Eriophorum gracile* and *Scirpus Torreyi.*

Eleocharis tenuis is frequent in Maine, and in New Hampshire occurs in the Merrimack River basin and eastward to the coast. It is occasional in eastern Massachusetts and has been collected at East Hartford and Wallingford, Connecticut.

IVd. SOUTHERN — GENERAL SOUTH OF 45° BUT NEITHER ON CAPE COD NOR IN WASHINGTON COUNTY. — *Bulbostylis capillaris, Cyperus inflexus, Eleocharis calva, E. diandra, E. obtusa* var. *ellipsoidalis* and var. *jejuna* and *Scirpus expansus.*

Cyperus inflexus is infrequent throughout New England east of the Connecticut River. *Eleocharis calva* is also infrequent east of the Connecticut River drainage area and is apparently absent from the coastal areas east of Connecticut. *E. diandra* is confined to the Kennebec, lower Merrimack, Thames and Connecticut River valleys. *E. obtusa* var. *ellipsoidalis* is frequent near the coast in eastern Massachusetts and southern Rhode Island.

V. CHIEFLY THE THREE SOUTHERN STATES. — *Hemicarpha micrantha.*

This species has a few stations in southeastern New Hampshire and adjacent southwestern Maine.

Va. CHIEFLY THE THREE SOUTHERN STATES BUT NOT IN WESTERN MASSACHUSETTS. — *Eleocharis Engelmanii, E. rostellata, Fimbristylis autumnalis* var. *mucronulata, Fuirena pumila, Rhynchospora macrostachya* and *Scleria reticularis.*

Eleocharis Engelmanni is very local but with a marked concentration in the Boston region. There is one outlying station at Falmouth, Cumberland County, Maine. *Eleocharis rostellata* has been reported in Massachusetts in the east only; there is a single station in Maine at Phippsburg, Sagadahoc County. In New England it is strictly maritime. *Fuirena pumila* is local except on central Cape Cod; it has not been reported from Connecticut. *Rhynchospora macrostachya* is restricted to southeastern Massachusetts, Rhode Island and Connecticut with two outlying stations at Falmouth, Maine and at Leverett, Franklin County, Massachusetts. *Scleria reticularis* is restricted to within twenty miles of tidewater except for an outlying station in the Connecticut River valley near Springfield, Massachusetts.

Vb. CHIEFLY THE THREE SOUTHERN STATES BUT NOT ON CAPE COD. — *Scirpus verecundus* and *Scleria triglomerata.*

Scirpus verecundus occurs at one station in southwestern Vermont. *Scleria triglomerata* is absent east of the Sudbury River valley and from all the southeastern counties in Massachusetts except Nantucket.

Vc. CHIEFLY THE THREE SOUTHERN STATES BUT NEITHER CAPE COD NOR WESTERN MASSACHUSETTS. — *Cyperus erythrorhyzos, C. filiculmis* and *Eleocharis tuberculosa.*

Cyperus erythrorhyzos is found chiefly in the lower Merrimack, upper Nashua, Sudbury, Charles, Taunton, Blackstone and lower Connecticut River valleys. *Eleocharis tuberculosa* has two New Hampshire stations at Madison and Tamworth, both in Carroll County.

VI. SOUTHWESTERN NEW ENGLAND CHIEFLY. — *Scirpus polyphyllus* occurs at two Massachusetts stations in the Connecticut and Deerfield River valleys and at numerous riparian stations in Connecticut from the Connecticut River valley westward.

VII. WESTERN NEW ENGLAND — CHIEFLY WEST OF THE CONNECTICUT VALLEY. — *Scirpus Peckii.*

VIIIa. COASTAL PLAIN PROPER. — *Cyperus polystachyus* var. *texensis, Eleocharis tricostata* and *Rhynchospora Torreyana.*

Cyperus polystachyus var. *texensis* occurs locally in specialized habitats on Cape Cod in southeastern Barnstable County and on Nantucket. *Eleocharis tricostata* is very local with one station on Nantucket and two in southern Rhode Island. *Rhynchospora Torreyana* is also local on Cape Cod in central Barnstable County, on Nantucket and in southern Rhode Island.

VIIIb. COASTAL PLAIN EXTENSIONS. — *Eleocharis melanocarpa* and *Rhynchospora inundata.*

Eleocharis melanocarpa is restricted to southeastern Massachusetts and Rhode Island. *Rhynchospora inundata* has three stations in Plymouth County, Massachusetts, one in Barnstable County on Cape Cod and one in Rhode Island.

IXa. CALCIPHILE. — *Rhynchospora capillacea* and *Scirpus cespitosus* var. *delicatulus.*

Rhynchospora capillacea is local with only 8 stations. *Scirpus cespitosus* var. *delicatulus* has a very restricted range; in New England it is confined to extreme northern Maine.

IXb. CALCICOLOUS — CHIEFLY WEST OF THE CONNECTICUT RIVER IN THE SOUTH; IF IN THE EAST, MOSTLY NORTH OF 45°. — *Eleocharis intermedia.*

Xa. MARITIME IN VICINITY OF COAST. — *Cyperus filicinus, C. Grayii, C. odoratus, Eleocharis halophila, E. parvula, Scirpus maritimus* var. *Fernaldii, S. Olneyi, S. paludosus* var. *atlanticus* and *S. robustus.*

Cyperus filicinus has not been collected in Maine east of the Kennebec River. *C. odoratus* does not appear north of Cape Ann, Essex County, Massachusetts. *Scirpus Olneyi* has not been found north of Cape Cod except for a station at Kents Island, Newburyport. *Eleocharis parvula, Scirpus maritimus* var. *Fernaldii* and *S. paludosus* var. *atlanticus* are common all along the New England Coast. *S. robustus* is confined to the three southern states except for one station at Falmouth, Maine.

Xb. MARITIME WITH INLAND STATIONS. — None.

XI. ESTUARINE. — None.

XII. MISCELLANEOUS. — *Cyperus brevifolius, C. Engelmannii, C.*

ferruginescens, C. Houghtonii, C. strigosus var. *robustior,* × *C. Weatherbianus, Eleocharis acicularis* var. *submersa, E. ambigens, E. equisetoides,* × *E. fallax, E. microcarpa* var. *filiculmis, E. nitida, E. obtusa* var. *Peasei, E. quadrangulata* var. *crassior, Eriophorum angustifolium* var. *majus, Psilocarya nitens, P. scirpoides, Scirpus ancistrochaetus, S. fluviatilis, S. Hallii, S. heterochaetus, S. lineatus, S. Longii, S. rubricosus, S. Steinmetzii, Scleria pauciflora* var. *caroliniana* and *S. verticillata.*

Cyperus brevifolius is a southern species which has been discovered at Greenwich, Connecticut and reported in Rhodora 51: 119-120, 1949. *C. Engelmannii* is found at Brattleboro, Vermont and at six stations in eastern Massachusetts. *C. ferruginescens* has one station in extreme southern Vermont and three in Connecticut, all along the Connecticut River. *C. Houghtonii* in New England occurs sparingly south of 45° but is not reported from Rhode Island and Connecticut. *C. strigosus* var. *robustior,* a variety of dubious validity, is seldom collected (six stations only!); as yet it has not been reported north of Boston. × *C. Weatherbianus* was described by Prof. Fernald (Rhodora 20: 189-191, 1918) as an intergeneric cross between *Cyperus dentatus* Torr. and *Rhynchospora capitellata* (Michx.) Vahl from a single tussock found by C. A. Weatherby at Dennis on Cape Cod in 1915. Mr. Marcel Raymond of the Montreal Botanical Garden has recently studied the type and is convinced that it should be treated as a chance hybrid between *Dulichium arundinaceum* (L.) Britt. and *Rhynchospora capitellata* (Michx.) Vahl. (See Rhodora 64: 349, 350, 1962). *Eleocharis acicularis* var. *submersa* seems to be indistinguishable from *f. longicaulis.* There are stations in Maine and Massachusetts. *E. ambigens* reaches its northeastern limit of range at Cuttyhunk, Massachusetts. The only other station in our area is at Block Island, Rhode Island where it was collected by Prof. Fernald in 1913. *E. equisetoides* is local at Wellesley, Massachusetts, Cumberland and West Greenwich, Rhode Island and Thompson, Connecticut. × *E. fallax* has been collected at Yarmouth, Massachusetts. *E. microcarpa* var. *filiculmis* is a southern variety which has one station in New England at Voluntown, Connecticut. *E. nitida* is represented by specimens from Colebrook and Columbia in Coös County, New Hampshire. *E. obtusa* var. *Peasei* has been collected at Fryeburg, Maine and Ossipee, New Hampshire. *E. quadrangulata* var. *crassior* has been found at Wellesley, Massachusetts and at Guilford and W. Guilford, Connecticut. *Eriophorum angustifolium* var. *majus* is, like the species, of northern distribution but is very local. It is represented by specimens from Matinicus and Oakland, Maine and is cited by Prof. Fernald in Gray's Manual, 8th ed., from Massachusetts. *Psilocarya nitens* occurs at Plymouth, Massachusetts, the only New England station yet discovered. *P. scirpoides* has been found at Brewster and Harwich on Cape Cod, Springfield, Massachusetts and East Providence, Rhode Island. *Scirpus ancistrochaetus*, a recently described species, has been reported from near Bellows Falls, Vermont (See Rhodora 64: 43-49, 1962). *S. fluviatilis* is local in river valleys near the coast south of 45°, but is frequent along the shores of Lake Champlain. *S. Hallii* has been found in New England only at Winter Pond, Winchester in eastern Massachusetts. *S. heterochaetus* is local in Massachusetts and Rhode Island but there are numerous stations on the shores of Lake Champlain. It has also been reported in the Connecticut River valley. *S. lineatus* has one station in central Maine, one in south central New Hampshire, two in the Champlain Valley in western Vermont and five in the Housatonic River valley in western Massachusetts and Connecticut. *S. Longii*, in New England a plant of fresh water river valleys, is local in Middlesex and Suffolk Counties in eastern Massachusetts; one station has been discovered at South Windsor in central Connecticut. *S. rubricosus* has five stations in eastern Massachusetts, three of them on Cape Cod. *S. Steinmetzii* is represented by specimens from Passadumkeag, Penobscot County, Maine only. *Scleria pauciflora* var. *caroliniana* occurs at Uxbridge, Massachusetts and Columbia, Hartford and Waterford, Connecticut. It is cited from southwestern New Hampshire by Prof. Fernald in Gray's Manual 8th ed. *S. verticillata* has one station in northwestern Connecticut at Salisbury.

R. C. Bean
A. F. Hill
R. J. Eaton

SCHEUCHZERIA IN WESTERN PENNSYLVANIA. — In September, 1961, while exploring a large sphagnum-cranberry bog, new to us, in Erie County, Pennsylvania, W. E. Buker and the writer found an old fruiting specimen of *Scheuchzeria palustris* L. var. *americana* Fern. We visited this bog again in early June, 1962, and saw another plant in fruit. Although we are familiar with many bogs here, this is our first and only record of this plant from the western part of the State. In our herbarium, we have specimens from Carbon, Monroe, and Sullivan counties, all in eastern Pennsylvania.

This species, of which ours in America is a variety, is widely distributed over the cooler regions of the Northern Hemisphere, growing in cold sphagnum bogs and on peaty shores. — L. K. HENRY, CURATOR OF PLANTS, CARNEGIE MUSEUM, PITTSBURGH, PA.

ANNOTATION OF NORTH AMERICAN POLYCARPAEA[1]

OLGA LAKELA

Polycarpaea nebulosa spec. nov. Annua herbacea erecta. Radix tenuis ad 25 cm. longa. Caulis 6-18 cm. altus corymbose ramosus pilosus vel glabrescens ad nodos incrassatus. Folia radicalia 8-12 mm. longa petiolata laminis oblongo-ovatis vel suborbicularibus; caulina 1.0-2.5 cm. longa linearia carnosula glabra subrevoluta mucronata; axillaria fasciculata similia breviora. Stipulae scariosae plus minusve bifidae. Inflorescentia dichotomo-cymosa decomposita. Bracteae florales scariosae. Flores 2.8-3.1 mm. longi perigynici. Hypanthium breve crateriforme. Sepala glabra scariosa nitida ovata vel lanceolata acuta. Petala ovata erosa vel integra sub anthesi incarnata cum staminum basibus connata. Filamenta subulata; antherae albae. Pistillum stipitatum; ovula plerumque 7; stigmata 3 subsessilia. Capsula trivalvis; semina reniforma pallide brunnea obscure transverse striata.

Erect annual herb. Taproot slender to 25 cm. long. Stem 6-18 cm. high, corymbosely branched, pilose or glabrate, becoming enlarged at nodes. Radical leaves 8-12 mm. long, petioled, blades oblong-ovate or suborbicular; cauline leaves 1-2.5 cm. long, linear, fleshy, glabrous, somewhat revolute, nerve excurrent. Fascicular leaves similar, shorter. Stipules scarious, more or less cleft. Inflorescence a compound dichasial cyme. Floral bracts scarious. Flowers 2.8-3.1 mm. long, perigynous. Hypanthium short, crater-like. Sepals glabrous, scarious, lustrous, ovate, or lanceolate, acute. Petals ovate, erose or entire, pink in anthesis, connate with stamen bases. Filaments subulate; anthers white. Pistil stiped; ovules usually 7; stigmas 3, nearly sessile. Capsule 3-valved; seeds reniform, pale brown, with obscure tranverse striae. (Name derived from L. *nebula,* mist for cloud-like luster of the flowers). TYPE: FLORIDA, Temple Terrace, adjoining Tampa. South-facing slope of sandhill west of 56th St., east of Overlook Drive. *O. Lakela 25565,* 7 Nov. 1962. Pl. 1280 & 1281. HOLOTYPE: (USF). ISOTYPES: GH, SMU, US, F).

ANNOTATION OF LIVING PLANT

Subsequent to the discovery of *Polycarpaea* in North America, the Florida plant has been studied in the greenhouse and in the field in large numbers. Ripe seeds found in capsules of a mature plant, coll. *24893A,* 26 Jan. 1962,

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[1] Contribution No. 2. Botanical Laboratories, University of South Florida.

Polycarpaea nebulosa sp. nov.

Hillsborough County

Sandhill east of Overlook Drive, northwest of intersection of 56th St. with Temple Terrace Highway. Plants growing in marginal area of unbroken ground, with few oaks, Eupatorium, Liatris & Helianthemum. Petals pink in life, fading to orange; stigma nearly sessile; seeds usually 7 or less. Temple Terrace.
O. Lakela 25564 [illegible] 7 Nov. 1962

Plate 1280. *Polycarpaea nebulosa.* Photograph of Holotype.

Plate 1281. *Polycarpaea nebulosa.* Enlarged portion of the inflorescence of Holotype.

were promptly planted in a greenhouse without artificial heat. Germination was evidenced on the 3rd of March. The spatulate cotyledons less than 1 mm. long and half as wide were more than tripled in size during the rosette development. They were fleshy, yellowish green and lustrous. The petioled radical leaves, 2-3(4) in number, 8-10 mm. long, with ovate, oblanceolate, or suborbicular blades, appeared singly. The blade appearing first became the largest. Fleshy in texture, and variegated with green and colorless tissue in pinnate fashion, they remained functional with tardily withering cotyledons through the growth of the lowest internodes. Flowering in April and May, the habit and floral structures of the plants compared well with those grown in a natural environment.

Meantime, the known sites of *Polycarpaea* were under close surveillance for signs of new growth. Summer rains were necessary to activate the heated sands. The first seedlings were located on the 7th of June. Prior study facilitated the identification of the tiny seedlings appearing in masses in the openings of vegetation on grassy terraces and on sandhills. The young plants of other species, e.g., *Diodia* and *Siphonychia,* were far beyond the seedling stages, thus eliminating confusion in the identification of *Polycarpaea.* Progressive germination rendered it possible to obtain various stages of growth in a single colony, as well as seeds with promise of germination (Fig. 1). Seedlings with complete rosettes, some already with withering leaves (no. *25136*) were collected on the 23rd of June (Pl. 1282).

During anthesis the stems become denuded of foliage, excepting the fascicular leaves that may remain on branches below the inflorescences (Pl. 1283). The cauline leaves are best seen before flowering (Pl. 1283). The fleshy tissues of a living leaf appear striped or mottled with green and white. This pattern of variegation as seen under the microscope is effected by the distribution of chlorophyll-containing tissues over slightly elevated veins and the colorless parenchyma within interstices of the reticulum. The colorless cells reveal an abundance of white crystalline inclusions. Stomata occur on both surfaces. The midnerve, visible only on the lower surface, becomes an excurrent tip. It is soft and pliable, hardly a "bristle" in the true sense of the term. On drying, the leaf becomes longitudinally ridged or wrinkled with slightly revolute margins.

FLORAL STRUCTURES

Specialization in the genus is manifested by reduction of chlorophyll in stipules, floral bracts, and sepals. Structurally these organs have become translucent and scarious with reduced vascular supply. In stipules the recognizable midvein is produced to a filament; in floral bracts it is less prominent; in sepals the vascular trace entering into the somewhat incrassate, usually colored basal area, becomes obsolescent toward the apex. Isolated spiral elements may be seen along the median line with thicker-walled parenchymatous

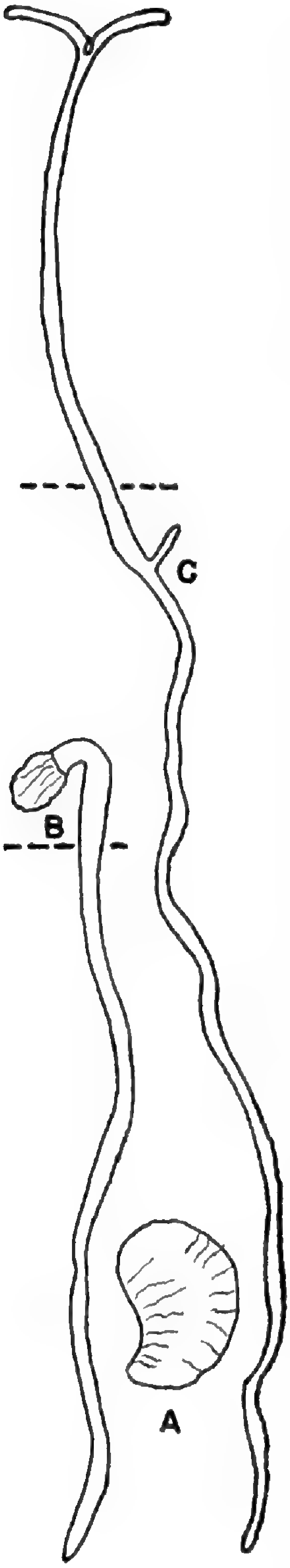

Fig. 1

Figure 1. *Polycarpaea nebulosa,* A, Seed, 0.5 mm. long. B, Seedling above the ground, 6 mm. long. C, Cotyledons and branch root, 12 mm. long.

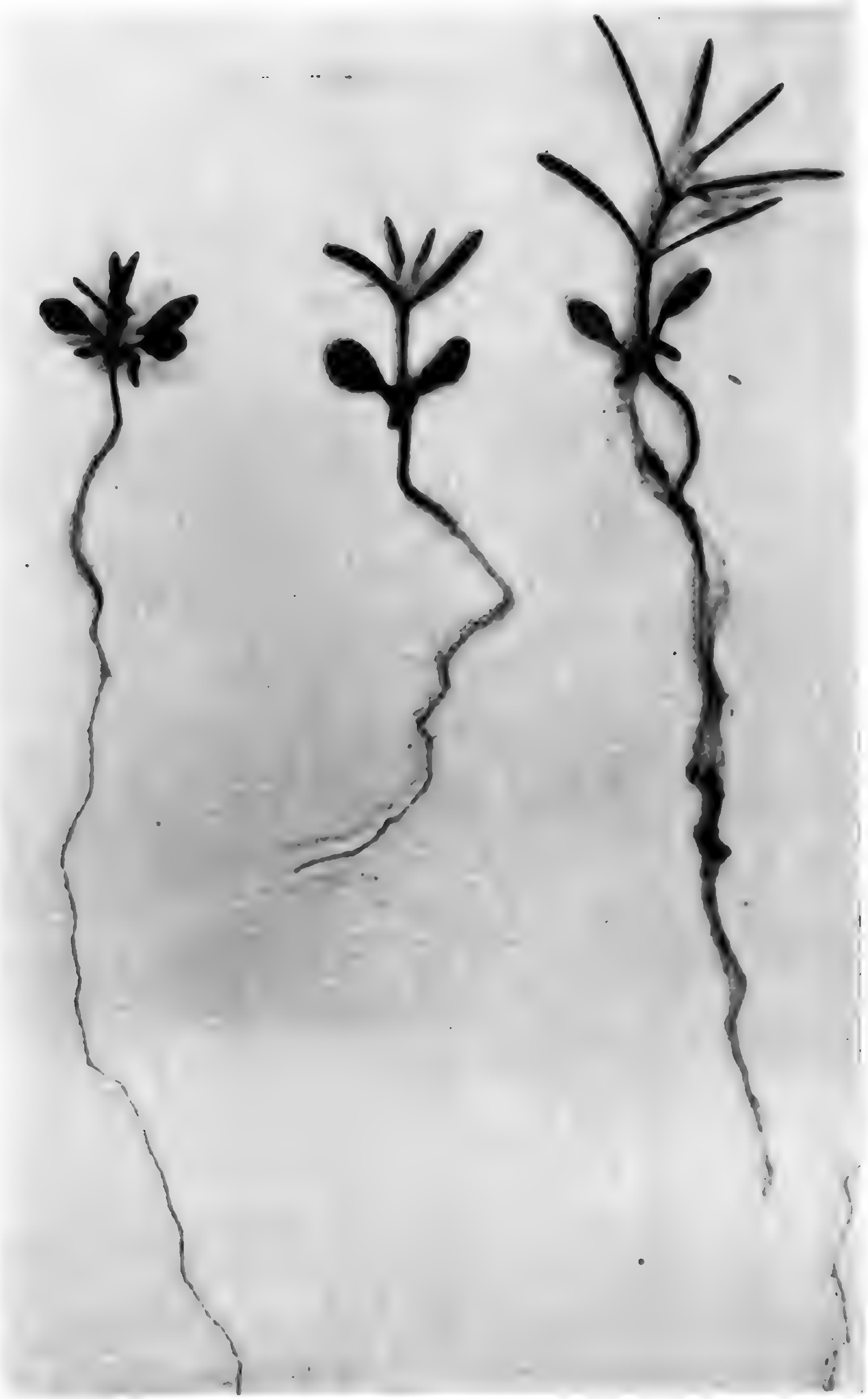

Plate 1282. *Polycarpaea nebulosa.* Seedlings with rosettes.

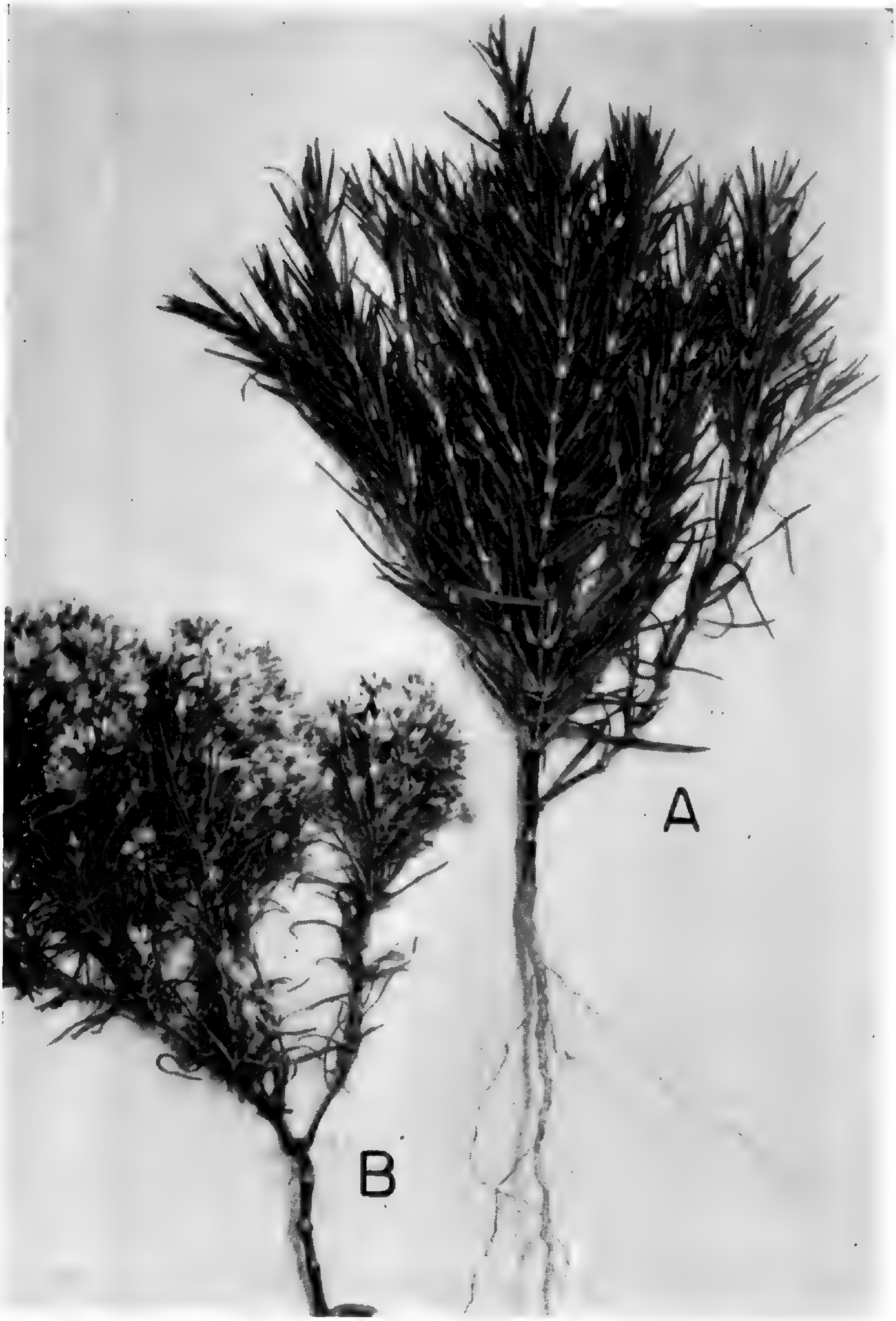

Plate 1283. *Polycarpaea nebulosa.* Appearance of plant A, preanthesis, B. anthesis.

cells. This remnant of the trace under a micro-projector casts a shadow which is more accented in Ceylon and South American plants than in those of Florida and Lucknow. Often the sepals along this line appear folded or conduplicate.

Allowing average variations, the small flowers, 2-3.5 mm. long, examined in representative specimens, show marked uniformity in structural pattern. Notwithstanding, differences are discernible. The Florida plant is similar to but not identical with South American and Old World plants passing under the epithet of *Polycarpaea corymbosa.*

Despite the limited availability of materials from the various regions of this amphigaean genus, it was deemed expedient to record diagrammatically characters of possible diagnostic value. Boiled, dissected flowers were mounted in water under a coverslip. Sepals, ovaries with ovules, or capsules with seeds, and tips of leaves, if available, were traced to the same scale under a micro-projector. The style measurements were estimated across the field of the microscope. The stigmas were included for added length to facilitate arriving at an approximate figure. (Fig. 2).

DISCUSSION

According to Martius (1872), styles in the genus vary greatly. In a large number of Florida plants studied, they have been found to be consistently short. The same cannot be reported for the Lucknow plant on the basis of a single available specimen with a few cymes in flower and without mature capsules. In habit the plant is lax, denuded of foliage at base, with spreading, linear, cauline leaves. Exchange specimens from the National Botanic Gardens, Lucknow, received at Tampa, 31 Oct. 1962, consist of a number of plants in preanthesis and seedlings; their habit is similar to the cited specimen. The radical leaves in seedlings compare well with those of the Florida seedlings. However, the lowest cauline leaves are somewhat wider. The long styles and lanceolate, attenuate sepals are in common with Ceylon and South American plants. Vegetatively they are

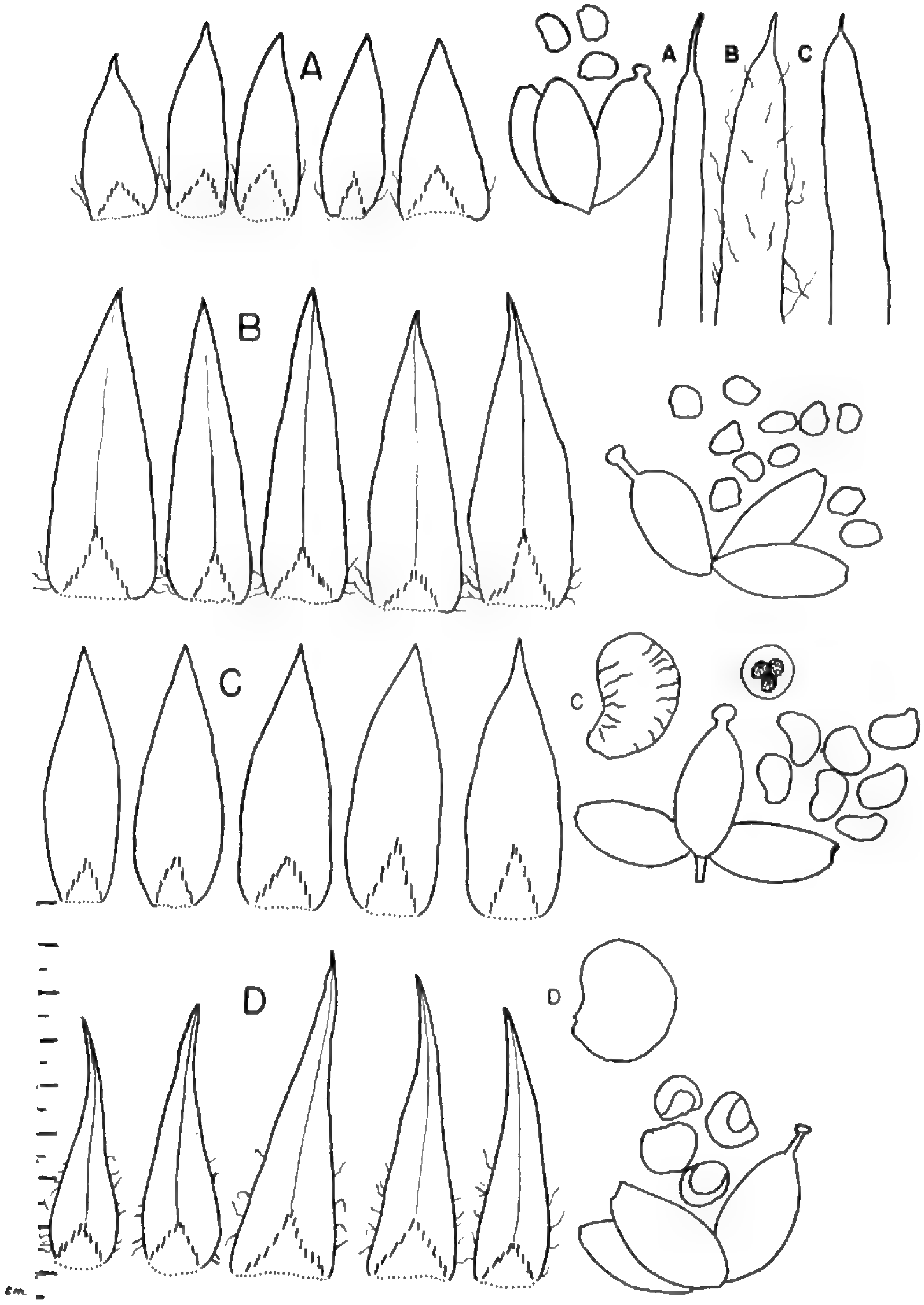

Fig. 2. Taxonomic characters of Polycarpeae. A. Sepals essentially ovate-lanceolate or lanceolate, acute or attenuate, glabrous or rarely ciliolate at base; style with stigmas 0.12 mm. long; ovules 11; excurrent vein-tip less than 1 mm. long. Coll. *Omar Shankar 12982*, 20-9-

unlike. The cited Ceylon collection consists of ten plants in flower of which nine are strict, and mostly with persistent radical leaves. The cauline leaves at the lowest nodes are broadly linear or oblanceolate, 2-3.5 mm. wide, in sharp contrast to the narrower and shorter upper cauline leaves. Further study of the Lucknow and Ceylon material is recommended, especially since fruiting plants have not been seen. In the South American taxon, *P. corymbosa,* var. *brasiliensis,* the cauline leaves throughout are narrowly linear or subulate, of firm texture, with strongly revolute margin and terminal seta 2-3 mm. long. The stipules are deeply cleft with prolonged filaments. The mature seed is dark brown, smooth, and shiny.

In conclusion, *P. nebulosa* is distinguished by compact habit, reddish nodes, internodes and undersurfaces of leaves. The cauline leaves throughout, are narrowly linear. The ovate acute sepals are dorsally rounded. The petals are pink in contrast to the white and sordid yellow petals recorded for *P. corymbosa.* Mature seeds, comparable only with those of a Paraguayan plant, are of even light buff when fully cutinized, and the groove on the dorsal side disappears on soaking.

A preliminary study of microsporogenesis in *P. nebulosa* indicates that the chromosome number is probably $n = 3$. Further investigation is necessary before this number can be confirmed (unpubl. Long, R. W., Associate Professor, University of South Florida.)

DISTRIBUTION

The present known distribution of *Polycarpaea* in Florida

56, Lucknow, India. (USF). B. Sepals lanceolate, attenuate, often ciliolate below with median shadow line; style with stigmas 0.24 mm. long; ovules 11-13; excurrent vein tip 1 mm. long or less. Coll. *George R. Cooley,* 14-1-57. Dambulla, Ceylon. (USF). C. Sepals ovate, acute; style with stigmas 0.13 mm. long; seeds usually 7 (8), c. mature seed actual size 0.5 mm. 1.; excurrent vein tip 1 mm. long or less. Coll. *Lakela 24779,* 18-10-61. (USF). D. Sepals lanceolate, attenuate, pilose, with median shadow line; style with stigmas 0.26 mm. long; d. mature seed actual size 0.5 mm. long; ovules 6. Coll. *E. Hassler 9808,* 1907-08, Paraguay, S. A. (US).

is restricted to northeast Tampa and the western border of adjoining Temple Terrace. It occurs sporadically in an area approximating 12 square miles. It flowers from August to November.

The question of *Polycarpaea* occuring in other parts of North America was aroused by a record from Mexico, listed in *Index Kewensis.* In reply to an inquiry, Dr. R. Llamas, Director, Instituto de Biologia, Ciudad Universitaria, in a communique referred to the "note of Hemsley (*Biologia Centrali Americana* Vol. I, p. 77) where he says: . . . The following is probably not a true *Polycarpaea* (*P. cuspidata* Ehrenb. Real del Monte)." Further, Dr. Llamas notes that the climate of Real del Monte, "is . . . a cold one: 2781 metres above sea level, with mean temperature in summer of 14.5 degrees Centigrade, which drops to from 2 to 10 degrees below zero Centigrade. For these reasons we are inclined to believe in the nonexistence of this species or, at least it has not been collected up to the present time." Patently, the climate is unfavorable for survival of a tropical plant.

The genus embraces a global distribution in the warm parts of both hemispheres. On the northern limit of the range approximating the same parallel, North America fills in the gap between the Canary Islands, China and Lucknow.

Acknowledgements

The author wishes to extend thanks to Dr. Lloyd H. Shinners for the Latin description and Miss Martha Gillon for painstaking aid with illustrations and the manuscript.

THE UNIVERSITY OF SOUTH FLORIDA,
TAMPA, FLORIDA.

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PROTANDRY IN TWO SPECIES OF STREPTANTHUS (CRUCIFERAE)

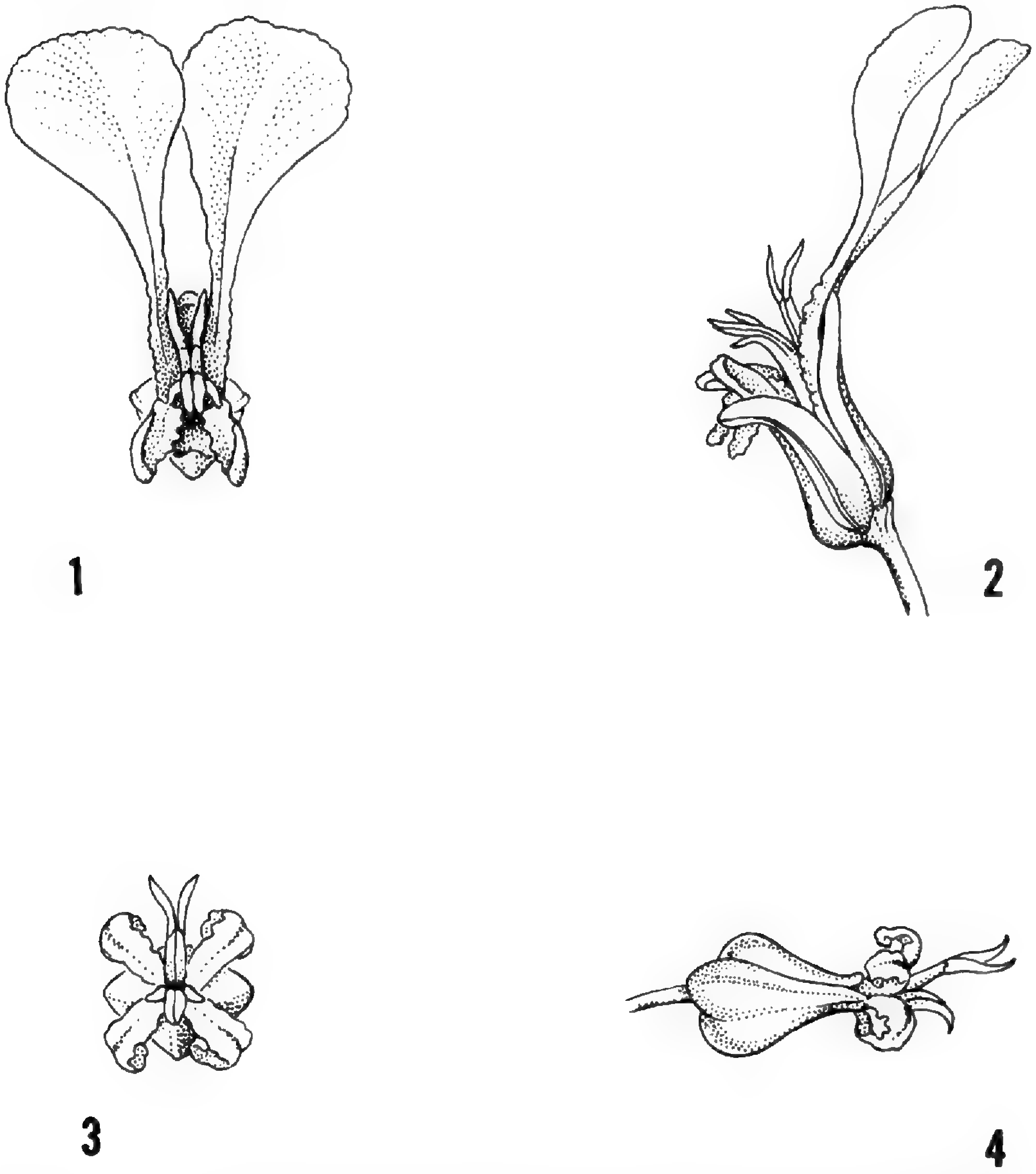
REED C. ROLLINS

The widespread presence of self-incompatibility as an outbreeding mechanism in the Cruciferae has been emphasized particularly by Bateman (1955a). Of the eleven tribes reported upon, only the *Streptantheae,* in which but a single species of *Caulanthus* had been investigated, showed no self-incompatibility. During the last year, we have had two species of *Streptanthus, S. cutleri* Cory and *S. carinatus* Wright, in greenhouse cultures. These were grown from seed collected in western Texas. Isolation tests on both species show they are not only self-incompatible but that the flowers are protandrous as well. The *Streptantheae* may now be added to the list of tribes showing self-incompatibility.

In his major paper, Bateman (l.c., p. 63) made the statement that there is no protandry, no protogyny and no dioecy in the Cruciferae. A later short note (Bateman, 1955b) acknowledged the presence of dioecy in *Lepidium sisymbroides* Hook. as an exception to the rule. Now, we bring to the attention of botanists an exception to the generally accepted idea that there is no protandry in the Cruciferae. At the same time, one of the most striking cases of zygomorphy in this family, where actinomorphy characterizes the flowers of nearly all species, is emphasized.

Both *Streptanthus cutleri* and *S. carinatus* have greatly elongated racemose inflorescences on which it is usual for a single flower to mature at a time. There are successively maturing flowers from base to apex of the inflorescence. These are usually spaced about 2 cm. apart at the time of full anthesis. In each flower, the anthers mature before the stigma and, as shown in figs. 1-4, the stamens project slightly. At the same time, they occupy the area at the center of the flower and effectively cover the stigma which remains unexpanded and situated toward the base of the flower until well after the pollen has been shed. At the stage of anther maturity, the outer floral parts tightly close the flower entrance. Following anther maturation and the shedding of pollen, the ovary elongates, the stigma expands and the floral parts move to an open stance. The stigma becomes much enlarged and is brought by the elongating ovary and style to a central position below the entrance of the flower. The primary flow of nectar from the nectaries located at the base of the filaments and near the point of insertion of the petals coincides with stigma maturation rather than anther maturity. This is significant not only because it correlates with the opportunity of flower entry by insects and the receptivity of the stigma to pollen but because it actually avoids the time of anther maturation as well. The question as to what it is about the flowers in the closed condition, where nectar is not available, that attracts appropriate insects for pollen pick-up, is a pertinent one. We do not have a definite answer but we did notice that flower odor seemed to be at its peak during the period of anther maturity and pollen shedding. Odor, together with flower shape and perhaps color, may fulfill the requirements for insect attraction. On the other hand, it may be that the insects pollinating these flowers do not distinguish between the open and closed condition. If so, they would move from flower to flower indiscriminately, sometimes being rewarded by available nectar and sometimes not. In any case, the timing of pollen pick-up by the insect is effectively separated from pollen deposit not only by protandry but by several correlated reinforcing mechanisms in addition. The situation is approximately the same in *Streptanthus cutleri* and *S. carinatus*, although the flower form in these two species is radically different because of the differences in petal development. The petal color is also different. The petals of *S. cutleri* are light to reddish purple while those of *S. carinatus* are brownish white with the veins prominently purple. In both species the calyx is a deep blackish purple. Undoubtedly different insects pollinate these two species of *Streptanthus*. However, we have not observed insect visitation to the flowers of either species in its native habitat. Both species occur wholly in extreme western Texas.

Two levels of zygomorphy are shown by *Streptanthus carinatus* and *S. cutleri*. In the former, the stamen whorls



Figs. 1-4. Flowers of *Streptanthus*, × 2. Fig. 1 & 2, face and side view respectively of *S. cutleri*. Fig. 3 & 4, face and side view respectively of *S. carinatus*. Drawings by Dorothy H. Marsh.

are strongly zygomorphic but the other floral parts show little or no zygomorphy. The situation is readily seen by reference to fig. 3 and 4. The filaments of the paired stamens, above and below, are of different lengths and the usual radial symmetry of the androecium present in most crucifer flowers is thereby considerably changed. A further change is seen in the tendency of the two single stamens to become associated with the lower paired stamens into a grouping of four with the anthers at about the same level of exsertion from the flower. Recurved petals further emphasize the prominence of the anther position. The androecium of *S. cutleri* is quite similar to that of *S. carinatus*, but the upper stamen pair is less exserted and the tendency of the single stamens "to platform" with the lower paired stamens is perhaps more strongly developed.

A strong zygomorphy is present in the corollas of *Streptanthus cutleri*. Here, the blades of the two lower petals have virtually been lost and the two upper bladed petals have become strictly upright. There is some variability between different plants as to the amount of blade present on the lower petals. This ranges from no blade at all, as shown in fig. 1 and 2, to a distinct asymmetrical blade of considerably smaller size than that present on the upper petals. The calyx also shows a noticeable but not highly developed zygomorphy in this species. The lower sepal is more pouched toward its base than any of the other three. This is shown in fig. 2.

In summary, it may be stated that *Streptanthus cutleri* and *S. carinatus* are protandrous and self-incompatible. These phenomena promote out-crossing between different plants of a given population. Protandry and self-incompatibility reinforce each other and thereby probably produce a nearly foolproof system of out-crossing. Several facets of flower behavior strengthen the separation of pollen pick-up and pollen deposit in a particular flower provided by the maturation sequence characteristic of protandry. These are (1) flower closure, preventing insect penetration and consequent self-pollination during anther dehiscence, (2) flower opening during the period of stigma receptivity, (3) nectar flow timed to coincide with stigma maturation and flower opening. — GRAY HERBARIUM, HARVARD UNIVERSITY.

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VIOLA PALUSTRIS L. IN ARIZONA. — This past spring there were sent to me specimens of a species of violet previously unreported for Arizona. Kearney and Peebles (1960) listed nine species for the state which are named below.

Viola palustris L. June 3, 1962. Collector V. W. Rhoton. Lake Number One (U. S. Forest Service name) on Heber-Payson Highway, about 25 miles from Heber, about ¼ mile from edge of Mogollon rim. Elevation about 7200′. Coconino County, Arizona. Abundant in wet soil in a strip about 25′ x 500′ around the southwestern edge of the lake. Specimens of this collection are deposited in the herbaria of Arizona State College, Arizona State University and of Mr. V. W. Rhoton of Lakeside, Arizona.

This is the white-flowered form which is apparently more common in the southern Rocky Mountains than the typical blue-flowered plant. The nearest locations to the above that I am aware of are in the high mountain passes north of Durango, Colorado.

Only two species of violet are commonly found in the mountains of Arizona. These are *V. canadensis* L. and *V. nephrophylla* Greene, which are occasional in pine and douglas fir forests in northern, northeastern, and southeastern Arizona. *Viola Rafinesquii* Greene, *V. pedatifida* G. Don, *V. aurea* Kellogg, and *V. nuttallii* Pursh occur very rarely in coniferous forests in northern and northeastern Arizona. *Viola charlestonensis* Baker & Clausen has been reported from a single location. *Viola umbraticola* H. B. K. is a form of *V. nephrophylla* that I have been unable to separate and therefore consider synonymous. The number of species in the state remains therefore at nine. — NORMAN H. RUSSELL, DEPARTMENT OF BOTANY, ARIZONA STATE UNIVERSITY, TEMPE, ARIZONA.

STUDIES IN LINUM: L. IMBRICATUM AND L. HUDSONIOIDES[1]

C. Marvin Rogers

On the basis of two or three seemingly minor features Planchon (London Jour. Bot. 7: 185-186. 1848) distinguished two closely related species of flax of Texas, *Linum multicaule* Hook. (=L. *imbricatum* [Raf.] Shinners) and the new *L. hudsonioides* Planchon. Later Asa Gray (Pl. Lindheim., Boston Jour. Nat. Hist. 6: 155-156. 1850) somewhat hesitantly maintained both, but subsequently (Pl. Wright., Smithson. Contr. Knowl. 3: 27. 1852) decided that the two were not separable. Since that time they have been treated as a single species. This species has been readily distinguished from other flaxes with united styles by the numerous, small, closely appressed, imbricated leaves and the sepals with broadly scarious, nonglandular margins.

An examination of the rather plentiful herbarium material reveals two clear-cut populations which, though very much alike in habit, are easily separated by a number of characteristics and it is evident that *L. hudsonioides* should properly be recognized. The following table lists the more obvious

TABLE 1. A comparison of *L. imbricatum* and *L. hudsonioides*.

L. imbricatum	*L. hudsonioides*
Pedicels and upper part of the stem hirsute	Pedicels and upper part of the stem hirsutulous
Upper leaves ciliate-margined	Upper leaves not ciliate-margined
Lower, longer pedicels (2-) 4-6 (-11) mm averaging about 5 mm long[2]	Lower, longer pedicels (3-) 8-13 (-15) mm averaging about 10 mm long
Outer sepals, like the inner, prominently toothed	Outer sepals entire or nearly so
Cartilaginous portion of false septum conspicuously broadened below	Cartilaginous portion of false septum uniformly narrow or absent throughout

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[1] Contribution No. 94 from the Department of Biology, Wayne State University.

[2] Dimensions, when based on 25 or more measurements, are shown in the following way: (2-) 4-6 (-11) mm long indicates a total range of 2-11 mm, with approximately 60% of the individuals being 4-6 mm long.

Hyaline portion of false septum appressed pilose along the inner margin, otherwise essentially glabrous	Hyaline portion of false septum conspicuously tomentose near the summit
Seeds biconvex	Seeds three angled
Unopened anthers 0.6-1.2 mm averaging less than 0.9 mm long	Unopened anthers 1-1.6 mm averaging more than 1.2 mm long

of these features, some of which are shown in the accompanying illustrations (Figs. 1-9).

Pedicel length and other more subtle differences in leafiness of the upper part of the stem, divergence of the branches and stature enable one to recognize perhaps nine of ten individuals without resorting to the other characters listed. Though probably not the most significant difference, the type of pubescence is perhaps the most easily observed and once the two taxa have been compared for this feature, specimens may be readily sorted on the basis of pubescence alone, since there appears to be virtually complete correlation between this and the other features.

There is very little evidence of hybridization between the two species (*Letterman,* July 1880, Denison, Texas (MO) and perhaps *Tharp,* Apr. 22, 1931, Bastrop, Texas (TEX) can be interpreted as being intermediate) and, as shown in Fig. 10, they occupy nearly distinct geographical ranges.

The species are clearly related to *L. rigidum,* which they resemble rather closely in the annual habit, shape and mode of dehiscence of the fruit, development of complete false septa, union of styles and pollen morphology.

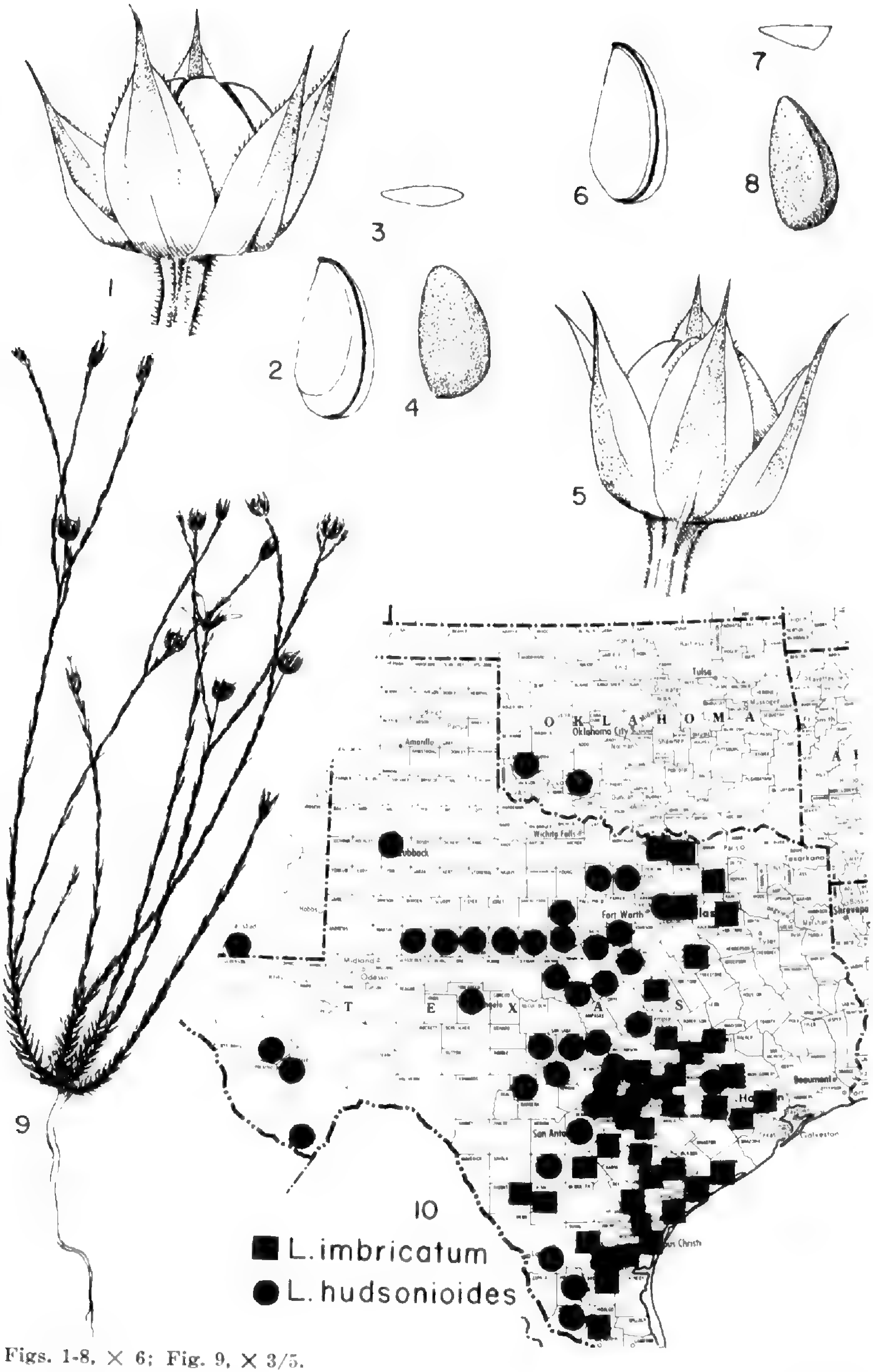
Linum imbricatum (Raf.) Shinners, Field & Lab. 25: 32. 1957. Fig. 1-4.

Nezera (or *Linum*) *imbricata* Raf. New Fl. and Bot. N. Amer. 4: 66. (1836) 1838.

Linum multicaule Hook. in T. & G. Fl. N. Amer. 1: 678. 1840.

Cathartolinum multicaule (Hook.) Small, N. Amer. Fl. 25: 84. 1907.

Low annual herb (6-) 11-20 (-27) cm tall, from a slender tap root, branched at the base, sometimes divaricately so in plants along the Gulf shore; stems spreading-ascending or erect, terete or nearly so at the base, strongly striate above, glabrous below, conspicuously short-hirsute with stout-based hairs above; leaves narrow, opposite near the base, alternate above, the larger (5-) 6-8 (-9) mm long, (0.5-) 0.7-0.9 (-1.2) mm wide, strongly imbricate, the lower spreading-



Figs. 1-8, × 6; Fig. 9, × 3/5.

Figs. 1-4. *Linum imbricatum*. Fig. 1. Fruit. Fig. 2. Carpel. Fig. 3. Cross-section of seed. Fig. 4. Seed.

Figs. 5-9. *Linum hudsonioides*. Fig. 5. Fruit. Fig. 6. Carpel. Fig. 7. Cross-section of seed. Fig. 8. Seed. Fig. 9. Habit

Fig. 10. Distribution of *L. imbricatum* and *L. hudsonioides*. Not shown are two collections of *L. hudsonioides* from Saline and Sedgwick Counties, Kansas.

ascending, the cauline rather strongly appressed, with conspicuous cartilaginous-based midribs, short-awned, the upper ciliate-margined; stipular glands none; inflorescence few-flowered, the lower, longer pedicels (2-) 4-6 (-11) mm long, the upper mostly hidden by the subtending leaves; sepals 5, persistent, usually with a few stiff hairs along the midrib, ovate, (4.2-) 4.6-5.5 (-6.1) mm long, with broad, commonly purplish, scarious margins, prominently toothed above the middle, the median herbaceous portion extended into an awn; petals 5, fugacious, yellow, with or without a darker base, obovate, 6.5-8 mm long, pilose at the base inside; stamen tube short; staminodia none; stamens 5; filaments about 5 mm long; anthers elliptic, 0.6-1.2 mm long before dehiscence; fruit pale, completely 10-celled, broadly ovate, 2.6-3 mm high, 2.9-3.3 mm in diameter, splitting freely at the false septa into 5 parts; true septa cartilaginous; false septa appressed pilose along the inner margin, otherwise essentially glabrous, mostly hyaline, but with a cartilaginous portion along the ovary wall, this cartilaginous strip conspicuously broader toward the base of the carpel; styles 5, 2-4.3 mm long, united to within 0.3-0.8 mm of the stigmas; stigmas capitate; seeds 10, flattened, ovate, 2-2.6 mm long, 1.1-1.5 mm wide, reddish brown.

In predominantly sandy soil in the Blackland and Coastal Prairies throughout east central Texas.

Type: San Felipe (Austin County), Texas, *Drummond 37*, Coll. 3. Though the specimen, received from Torrey, from which Rafinesque drew his description of *Nezera imbricata*, is probably not extant, there is little question but that it was one of the several plants distributed under this number. A sheet from the Torrey herbarium (NY) was almost certainly erroneously labelled "II, 47", accounting for some confusion as to the correct collection number. The original citation of Hooker's *L. multicaule* (in T. & G., Fl. of N. Amer. 1: 205. 1838, as *L. selaginoides* Lam.) was Collection 2, 47 (37?), later (T. & G. *op. cit.*: 678. 1840) changed to Collection 2, 37, but the specimen in the Hooker herbarium (K), upon which the name was based is Collection 3, 37. Other similar specimens, here considered isotypes, have been seen at GH and NY.

About 100 collections were examined of which the following are representative.[3]

TEXAS: ARANSAS: *Whitehouse 18163* (SMU); ATASCOSA: *Schulz 81* (US); BASTROP: *Barkley et al. 7037* (OKLA, TEX); BEE: *Shinners 9889* (SMU); BRAZOS: *Parks*, May 1, 1947 (OKLA, TEX); BROOKS: *Cory 55231* (SMU, US); BURLESON: *Fisher 31* (F); CALDWELL: *McBoyce*, 1931 (TEX); CALHOUN: *Tharp*, May 22, 1930 (TEX); COOKE: *Shinners*

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[3] Specimens are cited alphabetically by state and then county and only one collection per county is given. For the eleven herbaria from which material was borrowed, the usual abbreviations are given. The assistance of the respective curators is gratefully acknowledged.

12410 (SMU); Dallas: *Reverchon,* May, 1875 (GH, NY); De Witt: *Riedel,* Mar 15, 1942 (TEX); Dimmit: *Lundell 13603* (US); Duval: *Croft 101* (NY); Fayette: *Johnston & McCart 5167* (TEX); Fort Bend: *Bray 106* (US); Goliad: *Williams 41* (TEX); Gonzales: *Tharp,* May 21, 1936 (MICH); Grayson: *Letterman,* Jul, 1880 (MO); Harris: *Tharp 2293* (TEX); Hays: *Baker 35* (TEX); Hidalgo: *Runyon 1703* (US); Hunt: *Shinners 12245* (SMU); Jim Wells: *Drushel 6504* (MO); Kleberg: *Reed 54* (NY); La Salle: *Reverchon,* Apr 29, 1905 (OKL); Lee: *Cory 55761* (SMU); Matagorda: *Palmer 9674* (MO, US); McLennan: *Smith 426* (TEX); Milam: *Fisher 3151* (US); Navarro: *Joor,* June 8, 1880 (MO, US); Nueces: *Heller 1389* (F, MICH, MO, NY, OKL, SMU, US); San Patricio: *Williges 380* (SMU); Travis: *Rehm,* May 1, 1935 (TEX p.p.); Van Zandt: *Van Fleet 1217* (SMU); Victoria: *Eggert,* Apr 10, 1900 (MO); Waller: *Hall 64* (F p.p., GH, MO, NY, US); Wilson: *Parks & Cory* 7779 (TAES).

Linum hudsonioides Planchon, London Jour. Bot. **7**: 186. 1848. Fig. 5-9.

Annual herb with a slender taproot, closely resembling *L. imbricatum* in habit, (5-) 11-23 (-30) cm tall; stems scabrous or hirsutulous on the angles above, otherwise glabrous, branching from the base, ascending to erect, nearly terete below, prominently striate above; leaves narrow, opposite near the base, alternate above, the larger (5-) 6-8.5 (-10) mm long, (0.5-) 0.7-0.9 (-1.1) mm wide, imbricated throughout, the lower spreading-ascending, the cauline closely appressed, the lower sharp-pointed, the upper with a short slender terminal awn, all entire, the uppermost with a narrow scarious margin; stipular glands none; inflorescence few-flowered, the lower, longer fruiting pedicels (3-) 8-13 (-15) mm long, all usually conspicuously exserted beyond the subtending leaves; sepals 5, persistent, the outer lanceolate-ovate, (4.5-) 5.5-6.2 (-7.2) mm long, with a very broad, scarious, entire or sparsely delicately toothed, or in age somewhat lacerate, margin, the slender herbaceous median portion extending into a conspicuous awn, the inner sepals similar, but more prominently toothed; petals 5, fugacious, obovate, yellow, with or without a darker basal portion, 8-12 mm long, pilose at the base inside; stamen tube short; staminodia none; stamens 5, filaments about 5 mm long; anthers elliptic, 1-1.6 mm long before dehiscence; fruit pale, completely 10-celled, broadly ovate, 2.7-3.5 mm long, 2.8-3.6 mm in diameter, splitting freely at the false septa into 5 parts; true septa cartilaginous; false septa tomentose near the summit, entirely hyaline, or with a uniformly very narrow outer cartilaginous portion; styles 5, 2.7-6.3 mm long, united to within 0.3-1.1 mm of the stigmas; stigmas capitate; seeds 10, ovate, 2-2.7 mm long, 1-1.2 mm wide, wedge-shaped in cross-section, reddish brown.

In sandy or gravelly, granitic or occasionally calcareous soil, principally in the eastern Plains Country and the Edwards Plateau areas of Texas, with outlying stations in Trans-Pecos Texas and southeastern New Mexico and in the Wichita Mts. of Oklahoma. Two additional collections, perhaps questionable, have come from central Kansas.

Type: Entre Bejar y el rio de la Trinidad, *Berlandier 385*, May, 1828 (K, not seen). Possible isotype, a poor specimen, at GH (dated Mar 20, 1828).

About 100 collections were examined of which the following are representative.

KANSAS: Saline: *Letterman,* Aug 24, 1884 (US); Sedgwick: *Sears,* Jun 9, 1928 (OKL); NEW MEXICO: Eddy: *Ripley & Barneby 2593* (NY); OKLAHOMA: Comanche: *Orr 313* (SMU); Greer: *Waterfall 7246* (OKL, OKLA); TEXAS: Bastrop: *Thorp,* Apr 22, 1931 (TEX); Bell: *Wolff 2897* (TAES); Bexar: *Schulz 44* (US); Bosque: *Van Fleet 52* (SMU); Brewster: *Mueller 8056* (TEX); Brown: *Reverchon 1294* (MO); Burnet: *Barkley & Rowell 62* (TEX); Callahan: *Letterman,* Aug 10, 1882 (MO, NY, US); Comal: *Pennell 5457* (NY); Dallas: *Reverchon 109* (US p.p); Eastland: *Tharp,* Apr, 1937 (NY); Erath: *Gough,* May 16, 1921 (TEX); Frio: *Higdon 53-139* (TEX p.p.); Gillespie: *Barkley et al. 47253* (TEX); Hamilton: *Reverchon,* Apr, 1882 (GH); Hays: *Stanfield,* Apr 1, 1897 (NY); Hood: *Eggert,* May 6, 1900 (MO); Howard: *Parks & Cory 12520* (TAES); Jack: *Shinners 12347* (SMU); Jeff Davis: *Girard,* Ft. Davis (GH); Jim Hogg: *Tharp,* Jun 15, 1928 (TEX); Kerr: *May 555* (SMU); Llano: *McCart 5673* (SMU); Lubbock (or Lamb): *Tharp 6309* (TEX); Mason: *Shinners 26296* (SMU); Mills: *McWhorter,* Apr 17 (TEX); Mitchell: *Pohl 5106* (SMU); Nolan: *Palmer 12469* (MO, US); Starr: *Clover 1097* (NY); Stephens: *Deaton,* Jun 15, 1931 (GH, MICH, TEX); Taylor: *Tolstead 7038* (MICH, NY, SMU, TEX); Tom Green: *Tweedy 110* (US); Travis: *Birge 999* (TEX); Waller: *Hall 64* (F p.p.); Webb: *Salazar et al. 10* (OKLA); Wise: *Shinners 26105* (SMU).

NOTES ON THE FERN GENUS ERIOSORUS

ALICE F. TRYON

Eriosorus Fée was taken up by Copeland (Genera Filicum, Chronica Botanica, Waltham, Mass. 1947) for the older, much used name, *Gymnogramma*. Several of the species are transfered with the explanation, "both *Gymnogramma* and *Neurogramma* have the same type species as *Gymnopteris* and are thus synonyms". *Gymnogramma* is a synonym of *Gymnopteris* but it must pass from botanical usage more precisely because it is superfluous (Internat. Code Bot. Nomencl., Montreal 1961, Art. 63). *Gymnogramma* Desvaux (Ges. Naturf. Freunde Berlin Mag. 5: 304. 1811) included *Acrostichum rufum* L. (*Gymnogramma rufum* (L.) Desv.). However, Bernhardi had previously based *Gymnopteris* (Jour. Bot. Schrader 1: 297. 1799) on *Acrostichum rufum* L.; thus Desvaux's name is illegitimate because it included the type of Bernhardi's earlier name. Since *Gymnogramma* is superfluous its type is the same as that of *Gymnopteris* (Art. 7, note 4).

Kuhn (Fests. 50 Jub. Reals Berl. (Chaetop.) 1882) proposed the name *Psilogramme* for these species and he was followed by Underwood (The genus *Gymnogramma* of the Synopsis Filicum, Bull. Torrey Club 29: 617-634. 1902) and Maxon (North American species of *Psilogramme*, Bull. Torrey Club 42: 79-86. 1915) neither of whom referred to the earlier name, *Eriosorus*.

Copeland considers *Eriosorus* a "very natural genus of about 35 species, all tropical American, mostly Andean" but includes only a partial list of 14 species. The following new combinations and new species are added to these. These new names are published here for use in a treatment of the genus in Peru in which the species are illustrated.

Eriosorus Orbignyanus (Kuhn) comb. nov.

Gymnogramma Orbignyana Mett. ex Kuhn, Linnaea 36: 70. 1869.

Eriosorus Lechleri (Kuhn) comb. nov.

Gymnogramma Lechleri Mett. ex Kuhn, Linnaea 36: 71. 1869.

Eriosorus rufescens (Fée) comb. nov.

Gymnogramma rufescens Fée, Gen. Fil. 181, to. 19C, f. 3. 1852.

Eriosorus Stuebelii (Hieron.) comb. nov.

Gymnogramma Stuebelii Hieron. Hedwigia 48: 219, t. 9, f. 5. 1909.

Eriosorus accrescens A. F. Tryon, sp. nov.

Rhizoma ignotum, folia subscandentia (vel pendentia ?), laminae elongato-lanceolatae vel elongato-ovatae, bipinnato-pinnatifidae vel tripinnatae, apex indeterminatus gemma tomentosa fulva vel straminea, rhachis modice flexuosa, pinnae deltoideae subcoriaceae petiolulatae, pinnulae deltoideae vel ovatae adaxialiter et abaxialiter fulvo-sericeae, nervis marginem attnigentes ad terminos flabellatis, sporae obscure fuscae.

TYPUS: PERU, DEPT. CUZCO, PROV. URUBAMBA, Puyupata — "Yuncapata", *C. Vargas* 2921 (US); PARATYPI: DEPT. CUZCO, Huadquiña, *Bües* 992 (US), Valle de Lares, Montaña de Colca, *Bües* 1925 (US), Altura de Chaco, *Bües* 2135 (US).

Petiole probably shorter than the lamina (specimens incomplete), atropurpureus, terete, plane or slightly channeled on the upper surface near the apex, slender, less than 1/2 the diameter of the rachis, pubescent with tan, patent trichomes. Lamina 15-30 cm. long, 8-15 cm. wide. Rachis castaneus becoming lighter colored toward the apex, terete, plane or channeled on the upper surface, tomentose, the trichomes tan, acuminate. Pinnae stalks ca. 1.0 cm. long. Ultimate segments bluntly lobed to crenulate, somewhat more densely pubescent on the lower surface along the veins, the trichomes tan, multiseriate with acuminate apex. Margin with a border of clear, linear cells. Spores triangular-globose, the equatorial wing broad, sometimes lobed, the 3 angles slightly protruding, the proximal face with ridges or papillae adjacent to the commissural ridges, the distal face with 3 contiguous ridges forming a triangle.

These specimens from Cuzco, although incomplete, are quite distinct from other species in having leaves with a large, tan, tomentose apical bud and stalked pinnae with soft, tan pubescence. They most closely resemble *E. aureonitens*, especially in the form of the bud, but in that species the leaves are more slender and densely covered with a bright, rust colored tomentum. Several other species also have sustained growth from the leaf apex but have smaller buds. The habit of the leaves is difficult to determine from the specimens but is either somewhat climbing or hanging, for the very slender petiole could not support the lamina.

All of the specimens are from the Urubamba valley, north of Cuzco, from 3000-3350 m.

GRAY HERBARIUM, HARVARD UNIVERSITY.

CONTRIBUTIONS TO AN ILLINOIS FLORA I. THE GENUS PHYSOSTEGIA

ROBERT H. MOHLENBROCK

Linnaeus' (1753) *Dracocephalum* included species now known to belong to more than one genus. Two groups of Illinois plants belong here. One usually has been called *Dracocephalum*, the other *Physostegia*. Nearly a score of years ago, there was considerable effort on the part of some botanists to consider Linnaeus' *Dracocephalum virginianum* the type for the genus. This would have caused all Physostegias to be placed in *Dracocephalum*, and would have required the other Dracocephalums to be known by Adanson's revived name *Moldavica*. Gleason (1952) has followed this plan.

Fortunately, to avoid confusion, *Dracocephalum*, based on *D. moldavica* L., has been conserved under provisions of Article 14 of the International Code of Botanical Nomenclature (1961) so that *Physostegia* may still be retained for American species generally known by that name in the past.

Jones (1945, 1950) and Jones, Fuller, *et al.* (1955) consistently have recognized only two species in Illinois. They list *Physostegia speciosa* and *P. virginiana*. They relegate *P. angustifolia* to synonymy under *P. virginiana*. This writer during this study has found sufficient evidence to justify the maintenance of Fernald's *P. angustifolia* as a distinct species. Neither *P. intermedia* nor *P. parviflora* is treated in Illinois by Jones (1945, 1950) and Jones, Fuller, *et al.* (1955), although Gleason (1952) attributes the former to Illinois and Fernald (1950) the latter. Both species were found to be present in Illinois in this study.

Physostegia, because of its exserted stamens, of which the upper pair is shorter than the lower, generally is classified in tribe Stachydeae of the subfamily Stachydoideae. The genus is phylogenetically close to the monotypic *Synandra*, but this latter genus possesses one nearly suppressed calyx lobe and anthers which are brought into contact due to incurving of the filaments. The name *Synandra* refers to the "united anthers."

Various authors have accorded different treatments to the genus. Fernald (1950) recognizes 7 species and 2 varieties over the same area for which Gleason (1952) lists merely 5 species. Further confusion has been brought about by the transfer of species to the genus *Dracocephalum.*

The most valid characters to be used in distinguishing species are leaf size and shape, leaf margin, bracteal development, and calyx structure. Less important characters are corolla size and color and length and arrangement of the inflorescence.

LEAF SIZE AND SHAPE. Although size and shape of leaves are generally unreliable diagnostic characters, they seem to stand up well in the separation of the species of *Physostegia.* Size is particularly important in the segregation of *P. angustifolia,* for it is the only species which always has all its leaves 1 cm. broad or less. Shape is invaluable in distinguishing *P. parviflora,* for it is the only species with the uppermost leaves rounded at the base. Neither leaf length nor leaf apex offers any reliable characters.

LEAF MARGIN. *Physostegia virginiana, P. speciosa,* and *P. angustifolia* have coarsely serrate margins in which the teeth are frequently incurved-acerose. The teeth of *P. parviflora* are generally small and not acerose, while the margin of *P. intermedia* is repand or undulate. Some deviation from these general patterns exists, but for the most part the character of the leaf margin is useful.

BRACTEAL DEVELOPMENT. Perhaps the most conspicuous difference among the species of *Physostegia* is bracteal development. In *P. speciosa* and *P. parviflora* there is a gradual transition from the larger lower cauline leaves to the upper cauline and bracteal leaves; in the other species, there is an abrupt demarcation in size between the lower and upper leaves. The bracteal leaves may be reduced without reduction in size of teeth and thereby appear pectinate. In *P. virginiana,* the bracts may be entire.

CALYX STRUCTURE. Several characters of the calyx may be useful in distinguishing the species. The calyx is always densely glandular in *P. virginiana,* eglandular in the others.

It ranges in length from 3-6 mm. in *P. intermedia* to 5-10 mm. in *P. virginiana*. Considerable overlapping of calyx lengths occurs, however. The relative lengths of the calyx teeth and tube are significant. The teeth are nearly one-half as long as the tube in *P. intermedia*, one-third as long in *P. virginiana* and *P. parviflora*, and two-fifths as long in *P. speciosa* and *P. angustifolia*.

COROLLA SIZE AND COLOR. The corolla is usually 2-3 cm. long in *P. virginiana* and *P. angustifolia* and only slightly smaller in *P. speciosa;* in *P. parviflora* and *P. intermedia*, the size range is 1.0-1.7 cm. long. Color of the corolla varies from all shades of purple to nearly white.

INFLORESCENCE. The inflorescence ranges in length from 5-35 cm.; it is shortest in *P. intermedia*. The spikes may be slender and interrupted *(P. intermedia* and *P. angustifolia)* or more robust and continuous in the other species; they may be stiffly erect or arched-ascending.

ECOLOGY AND DISTRIBUTION OF THE SPECIES

The species of *Physostegia* in Illinois occur in moist open areas. Collectors usually refer to these habitats as swales or low prairies. *Physostegia virginiana* seems to show a somewhat wider tolerance in the moisture requirement.

The five Illinois species of *Physostegia* exhibit three general distribution patterns. *Physostegia virginiana* and *P. speciosa* are eastern species generally ranging from New England to the Dakotas; *P. virginiana* extends south to the Gulf of Mexico, while *P. speciosa* reaches only Missouri, Tennessee, and the Carolinas. *Physostegia angustifolia* and *P. intermedia* are midwestern, occupying an area roughly bounded by Kentucky, Kansas, Mississippi, and Texas. *Physostegia parviflora* is northwestern, ranging from Minnesota and Indiana to the Pacific Ocean.

In Illinois, *Physostegia virginiana* and *P. speciosa* are locally abundant throughout the state. *Physostegia angustifolia* is fairly common, but thus far confined to the northern three-fourths of Illinois. Our most southern records are from St. Clair and Marion Counties. *Physostegia parviflora* and *P. intermedia* are rare, the former known from Adams County, the latter from Lake and Lee Counties.

The distributional data recorded in the paper are the results of study of all material in the following herbaria: University of Illinois, Illinois Natural History Survey, Illinois State Museum, Missouri Botanical Garden, Southern Illinois University.

SYSTEMATIC TREATMENT

Physostegia Benth. Lab. Gen. & Sp. 504. 1834.

Dracocephalum L. Sp. Pl. 594. 1753, pro parte, non nom. conserv.

Rather stiffly erect, branched or unbranched, perennials with glabrous stems and leaves; leaves alternate, simple, serrate, dentate, undulate, or rarely nearly entire, usually becoming reduced near the inflorescence; inflorescence terminal, spicate, simple or compound; flowers large, showy, purplish to whitish; bracts small, each bearing one flower; calyx campanulate or tubular, regular, pubescent, 10-nerved, slightly enlarging in fruit, the lobes deltoid; corolla tubular, bilabiate, with a dilated throat, the upper lip erect, emarginate to entire, the lower lip spreading, 3-lobed; stamens 4, the lower pair longer and ascending under the upper lip of the corolla; nutlets smooth.

Key to the Illinois Species of *Physostegia*

1. Leaves more or less undulate .... 1. *P. intermedia*
1. Leaves definitely serrate.
    2. Leaves (at least the upper) broadly rounded at base, the teeth rarely more than 1 mm. long; corolla rarely longer than 1.5 cm. .... 2. *P. parviflora*
    2. Leaves cuneate or subcuneate at base, the teeth regularly more than 1 mm. long; corolla 1.5-3.0 cm. long.
        3. Upper leaves abruptly reduced in size; spike appearing pedunculate.
            4. Broadest leaves never exceeding a width of 1 cm.; flowers remote .... 3. *P. angustifolia*
            4. At least some of the leaves over 1 cm. broad; some of the flowers overlapping .... 4. *P. virginiana*
        3. Upper leaves gradually reduced in size; spike appearing sessile .... 5. *P. speciosa*

1. *Physostegia intermedia* (Nutt.) Engelm. & Gray, in Boston Journ. Nat. Hist. 5:257. 1845.

Dracocephalum intermedium Nutt. in Trans. Am. Philos. Soc. 5:187. 1837.

Slender upright perennial to 1 m. tall; leaves sessile, subcoriaceous, lanceolate to linear-lanceolate, acute at apex, cuneate at base, with low teeth or undulate along the margins, the lower leaves 1.0-1.2 cm. broad, the upper much reduced; inflorescence spicate, terminal and occasionally lateral, slender, interrupted, to nearly 30 cm. long; calyx campanulate, 3.5-5.0 mm. long, the lobes at least one-third as long as the tube; corolla 1.2-1.7 cm. long, purplish to rarely white. Range. — Kentucky to Kansas south to Texas and Alabama. Habitat. — Low prairies.

This is our only species with an undulate leaf margin. The drastic reduction in size of the upper leaves recalls *P. virginiana* and *P. angustifolia.*

Fernald (1950) records this species from Illinois, while Gleason (1952) states "reported from Ill." Jones, Fuller, *et al.* (1955) regard these references as errors for *P. virginiana,* but consider that the real *P. intermedia* does not occur in Illinois. A single station for this species in Illinois is the edge of Willow Slough in Adams County.

2. *Physostegia parviflora* Nutt. ex Benth. in DC. Prod. 12:454. 1825.
Dracocephalum nuttallii Britt. Ill. Fl. ed. 2. 3:117. 1913.

Erect perennial to a little less than 1 m. tall; leaves sessile, subcoriaceous, broadly lanceolate, acute to acuminate at apex, the upper broadly rounded at base, serrate, the lower 1.5-2.0 cm. broad, the upper gradually reduced; inflorescence spicate, terminal and occasionally lateral, rather thick, densely flowered, to 15 cm. long; calyx campanulate, 4-7 mm. long, the lobes about one-third as long as the tube; corolla 1.0-1.5 cm. long, purplish to whitish. Range. — Minnesota to British Columbia south to Oregon and Illinois. Habitat. — Low prairies.

The broadly rounded bases of the upper leaves are unique among the Illinois species of *Physostegia.* The corolla is the shortest in the genus. The gradual reduction in size of leaves from base to summit of stem is similar to the condition in *P. speciosa.*

Fernald (1950) attributes this species to Illinois, although Gleason (1952), Jones (1945, 1950), and Jones, Fuller, *et al.* (1955) do not record it. Authentic specimens of *P. parviflora* in Illinois herbaria are from Lake and Lee counties.

3. *Physostegia angustifolia* Fern. in Rhodora 45:462. 1943.

Rather robust erect perennial to nearly 1 m. tall; leaves sessile, subcoriaceous, narrowly lanceolate, acute to acuminate at apex, cuneate at base, serrate, the broadest about 1 cm. wide, the upper abruptly reduced in size; inflorescence spicate, slender, usually solitary, occasionally with lateral branches, remotely flowered, to about 30 cm. long; calyx tubular-campanulate, 4-8 mm. long, the teeth about two-fifths as long as the tube; corolla 2.5-3.0 cm. long, purplish to whitish. Range. — Tennessee to Illinois south to Texas and Mississippi. Habitat. — Low prairies. Fernald (1943) has discussed the naming of this species.

While the general aspect of the plant indicates its relationship with *P. virginiana,* the consistently narrow leaves and the very interrupted inflorescence are sufficient reasons for maintaining this as a distinct species.

The distribution of this species is local throughout the state, except for the southern counties where it is apparently absent.

Distribution. — Calhoun, Cass, Cook, Ford, Greene, Hancock, Henderson, Iroquois, LaSalle, Livingston, McLean, Madison, Marion, Mason, Morgan, Moultrie, Piatt, Pike, Shelby, Tazewell, Vermilion, Wabash, Will.

4. *Physostegia virginiana* (L.) Benth. Lab. Gen. & Sp. 504. 1834.
Dracocephalum virginianum L. Sp. Pl. 594. 1753.
Physostegia virginiana f. *candida* Benke, in Am. Midl. Nat. 16:423. 1935.

Rather stout perennial to about 1 m. tall; leaves sessile, subcoriaceous, lanceolate, acute at apex, cuneate at base, sharply serrate, the teeth upwardly curved, the lower leaves 1.2-2.2 cm. wide, the upper abruptly reduced, usually entire; inflorescence spicate, usually branched, rather thick, continuous, to 20 cm. long; calyx short-tubular, glandular and puberulent, 5-10 mm. long, the teeth about one-third as long as the tube; corolla 2.2-3.0 cm. long, purple to white. Range. — Maine to Oklahoma south to Texas and Alabama. Habitat. — Low ground, particularly prairies.

Opinion varies concerning the specific limitation of this species. Most botanists segregate *P. speciosa* as a separate species, although Fernald (1950) chooses to consider the latter as a variety.

The chief diagnostic characters for *P. virginiana* are the greatly reduced and usually entire upper leaves and the large and glandular calyx. White-flowered forms have been called f. *candida.*

This species has a general distribution throughout Illinois.

Distribution. — Champaign, Christian, Cook, DeKalb, DuPage, Hancock, Henderson, Henry, Iroquois, Jackson, Jersey, Johnson, Kankakee, Lawrence, Lee, Livingston, Macon, Marion, Mason, Monroe, Pope, Randolph, Richland, St. Clair, Saline, Stark, Union, Vermilion.

5. *Physostegia speciosa* (Sweet) Sweet, Hort. Brit., ed. 2, 406. 1830.
Dracocephalum speciosum Sweet, Brit. Fl. Gard. pl. 93. 1825.
Physostegia formosior Lunell, in Bull. Leeds Herb. 2:7. 1908.
Dracocephalum formosius (Lunell) Rydb. in Brittonia 1:95. 1931.

Robust upright perennial to nearly 1 m. tall; leaves sessile, subcoriaceous, lanceolate to oblanceolate, acute at apex, cuneate at base, sharply serrate, the lower leaves 2-3 cm. broad, the upper only gradually reduced; inflorescence spicate, rather stout, terminal and usually lateral, continuous, 15-25 cm. long; calyx campanulate, 4.5-7.0 cm.

long, the lobes about two-fifths as long as the tube, eglandular; corolla 1.5-3.0 cm. long, purplish to rarely white.

Although this species is similar to *P. virginiana,* it may be distinguished by its eglandular calyx and its gradually reduced bracteal leaves. The flowers are generally slightly smaller in *P. speciosa.* Range. — Maine to North Dakota south to Nebraska and North Carolina. Habitat. — Low prairies.

Distribution. — Adams, Boone, Brown, Champaign, Cook, DeWitt, Greene, Henry, Jackson, Jersey, JoDaviess, Kankakee, Lake, LaSalle, Lawrence, Lee, McHenry, Macon, Marshall, Mason, Ogle, Peoria, Piatt, Pike, Putnam, Rock Island, Sangamon, Tazewell, Union, Vermilion, Wabash, Warren, Winnebago, Woodford.

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THE INTEGRADATION OF SENECIO PLATTENSIS AND SENECIO PAUPERCULUS IN WISCONSIN[1]

T. M. BARKLEY

Dr. Hugh Iltis of the University of Wisconsin recently invited me to contribute *Senecio* to his *Flora of Wisconsin* project. Preparation of the treatment has focused attention on the intergradation of *S. plattensis* Nutt. with *S. pauperculus* Michx. var. *pauperculus,* (hereafter referred to as *S. pauperculus*) and the related difficulty in delimiting the two taxa. The problem of species delimitation in *Senecio* is treated generally in my revision of *S. aureus* L. and allied species (in press). This paper, however, will serve to discuss a specific instance and its taxonomic implications.

Senecio plattensis and *S. pauperculus* are fairly distinct taxa, each with its own range and ecological requirements. However, where the ranges and habitats overlap, the two taxa intergrade morphologically. The greatest extent of intergradation is in the upper Mississippi Valley from northern Missouri through eastern Iowa to Wisconsin and Minnesota.

Typical *S. plattensis* is distinguished by its persistent pubescence, its single-stemmed growth habit, its short erect caudex, its well developed pinnatifid lower cauline leaves, and its relatively compact inflorescence. It is fundamentally a plant of the prairies and plains of central North America. It also occurs in relict prairie areas in localities disjunct from the main distribution.

Biologically typical *S. pauperculus* is distinguished by being glabrous or nearly so at maturity, by its frequent production of several loosely clustered stems, its short but often horizontal, branching caudex, its reduced cauline leaves and its generally loose inflorescence. It grows primarily in boreal woodlands, meadows, and open areas in woodland associations.

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[1] Supported in part by a grant from the Kansas State University Bureau of General Research.

Each taxon is further distinguished by a series of more or less intangible features which collectively give it a characteristic gross aspect.

In Wisconsin, typical *S. plattensis* is most abundant in the southwestern half of the state, i.e., in the areas primarily of gray-brown podzol soils. *S. pauperculus* occurs throughout the state, but it is most abundant and "most typical" in the northern half, in the areas of true podzol soils, (cf. soil map in U. S. Dept. Agr. Yearbook, 1938).

Populations occur throughout Wisconsin which are more or less intermediate between *S. plattensis* and *S. pauperculus.* These intermediate populations are most frequent in and near northern Washburn county in northwestern Wisconsin, and in Dane, Iowa, Green, and Rock counties at the southern edge of the state. The intermediates commonly resemble either *S. plattensis* or *S. pauperculus* rather closely, but they have conspicuous tendencies toward the other taxon. Two frequent "intermediates" in Wisconsin are: (a) otherwise typical *S. pauperculus*, but with light, persistent tomentum, and (b) fairly typical *S. plattensis* but with strongly reduced cauline leaves and a branching caudex. Plants which are exactly midway between the two taxa are rather uncommon.

In North America the genus *Senecio* appears to be composed of numerous more or less discrete taxa which have broad but definite natural ranges. These intergrade morphologically with related taxa wherever their ranges and habitats overlap. It is one thing to recognize the biological patterns within the genus, but quite another to reflect these patterns in the taxonomic system. If there were no senecios other than *S. plattensis* and *S. pauperculus*, the taxonomic treatment could be simple; the two entities could be recognized as infraspecific taxa of one species. However, in other localities, both *S. plattensis* and *S. pauperculus* intergrade just as completely with other taxa as they do with each other in the upper Mississippi Valley. *S. plattensis*, for example, intergrades with both *S. obovatus* Muhl. ex Willd. and *S. tomentosus* Michx., while *S. pauperculus* intergrades with *S. streptanthifolius* Greene and *S. smallii* Britt.

Combining *S. plattensis* and *S. pauperculus* into a single species could not stop there; it would be necessary to include *S. obovatus, S. tomentosus, S. smallii,* and *S. streptanthifolius,* plus the other taxa with which these in turn intergrade. Continued combining of all the entities which intergrade through *S. streptanthifolius* would be an almost limitless process, eventually taking much of what is included in Rydberg's sections *Aurei, Lobati,* and *Tomentosi.* The one resulting species would contain so many and such diverse entities, and would encompass so much variation as to be ridiculous. Therefore, *S. plattensis* and *S. pauperculus* are recognized as separate species.

The necessity for maintaining these entities as species becomes apparent only when all of the related senecios are considered. This is of small consolation to the floristic botanist working in the upper Mississippi Valley area, and one can sympathize with Davidson, who reduced *S. plattensis* to *S. pauperculus* in his flora of southeastern Iowa (1959). — DEPARTMENT OF BOTANY, KANSAS STATE UNIVERSITY, MANHATTAN, KANSAS.

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THE GEOGRAPHIC LOCATION OF GORGONIDIUM (ARACEAE)

DAN H. NICOLSON[1]

The type-species of the monotypic genus *Gorgonidium, G. mirabile* Schott, until just recently was believed to have been collected by Gaudichaud in the Papuan area, but has now been found to have been collected by d'Orbigny in Bolivia.

The type-material of *G. mirabile* (Schott, 1864) was cited as being from "Carari, Sualica (?)", the query reflecting Schott's uncertainty as to the locality. Schott credited the collection to Gaudichaud and cited the field description, "Arum à fleur violette." The type was stated to be at Leiden.

At Leiden, the holotype was found, with the following information which Schott had not reported. The specimen is labelled as being from "Herb. Gaudichaud" (which does not mean that it was collected by Gaudichaud). A collection number, 484, appears on the label that bears the field description.

Engler (1920), the last monographer of the *Araceae,* reported, without any explanation, that this "Gaudichaud" collection was from "Monsungebiet. — Papuasische Provinz: Insel Carari im Mare sualicum." There is a Cavili Island in the Sulu Sea, but that is between the Philippine Islands and Borneo, not in the Papuan area, and there is no evidence that Gaudichaud visited it. Members of several institutions (Leiden, Kew, British Museum) agreed that something was wrong with this locality.

The solution of the type-locality problem came when the present author noted that an isotype of *Spathantheum orbignyanum* Schott (1859) at Leiden had a field label saying "Arum alique verte de Cavari, Sicalica," in handwriting

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[1] This problem was investigated while the author held an inermediate graduate fellowship, No. 21024, from the U.S. National Science Foundation.

The author wishes to thank Drs. A. Lourteig (Paris), H. Sleumer (Leiden), R. Foster (Harvard) and W. Dress (Cornell) who contributed much of their personal time and enthusiasm to this problem.

identical with that on the field label of the *G. mirabile* holotype. The collector's name, d'Orbigny, which was the basis of the specific epithet, was not to be found on the specimen, although it, too, was noted as being from "Herb. Gaudichaud."

Dr. Alicia Lourteig, of the Paris Museum of Natural History, kindly investigated the "Gaudichaud" and d'Orbigny herbaria at Paris. She reported that there is not, and never has been, an officially recognized Gaudichaud herbarium, and that the materials so labelled at Leiden probably only record that they were received from Gaudichaud. However, the d'Orbigny herbarium, never before investigated for its isotypes of *Araceae,* produced isotypes of both *S. orbignyanum* (holotype at Geneva) and *G. mirabile* (holotype at Leiden) and yielded the following complete information from the original field labels, written in the hand of d'Orbigny.

G. mirabile — Cavari, Sicasica Prov., Bolivia — d'Orbigny 484 —Arum à fleur violette.

S. orbignyanum — Cavari, Sicasica Prov., Bolivia — d'Orbigny 485 — Arum à tige verte.

In the early days of the Rijksherbarium (Leiden) and in other herbaria, there was a good deal of label-copying and sometimes the original labels were discarded. For instance, the same handwriting on the field labels of the Leiden types of *G. mirabile* and *S. orbignyanum* may be seen on the holotype of *Xenophya branceaefolia* Schott, which was collected by Zippel in New Guinea. However, in the case of the latter, the original field labels are present.

The change from "Sicasica" to "Sualica" in handwriting can best be seen in two steps. First, changing it "ic" to "u" happens when the dot over the "i" is omitted and the top of the "c" is not rounded. Second, "sica" to "lica" is explicable in terms of the old-style internal "s" that looked more like an uncrossed "f". This internal "s" can easily be misread as an "l" in handwriting. A copying clerk, unfamiliar with the place-names, might easily have read "Sualica" (viz. *Gorgonidium*) or "Sicalica" (viz. *Spathantheum*) where "Sicasica" was originally written.

It is probable that d'Orbigny gave some of his duplicates to Gaudichaud, who, in turn, gave them to Leiden. The original d'Orbigny field labels (Paris) do not bear the collector's name. In the absence of this, they were recorded at Leiden as being from "Herb. Gaudichaud". Both Scott and Engler, not knowing of the original duplicates at Paris, incorrectly interpreted this to mean that Gaudichaud had collected the holotype of *G. mirabile.*

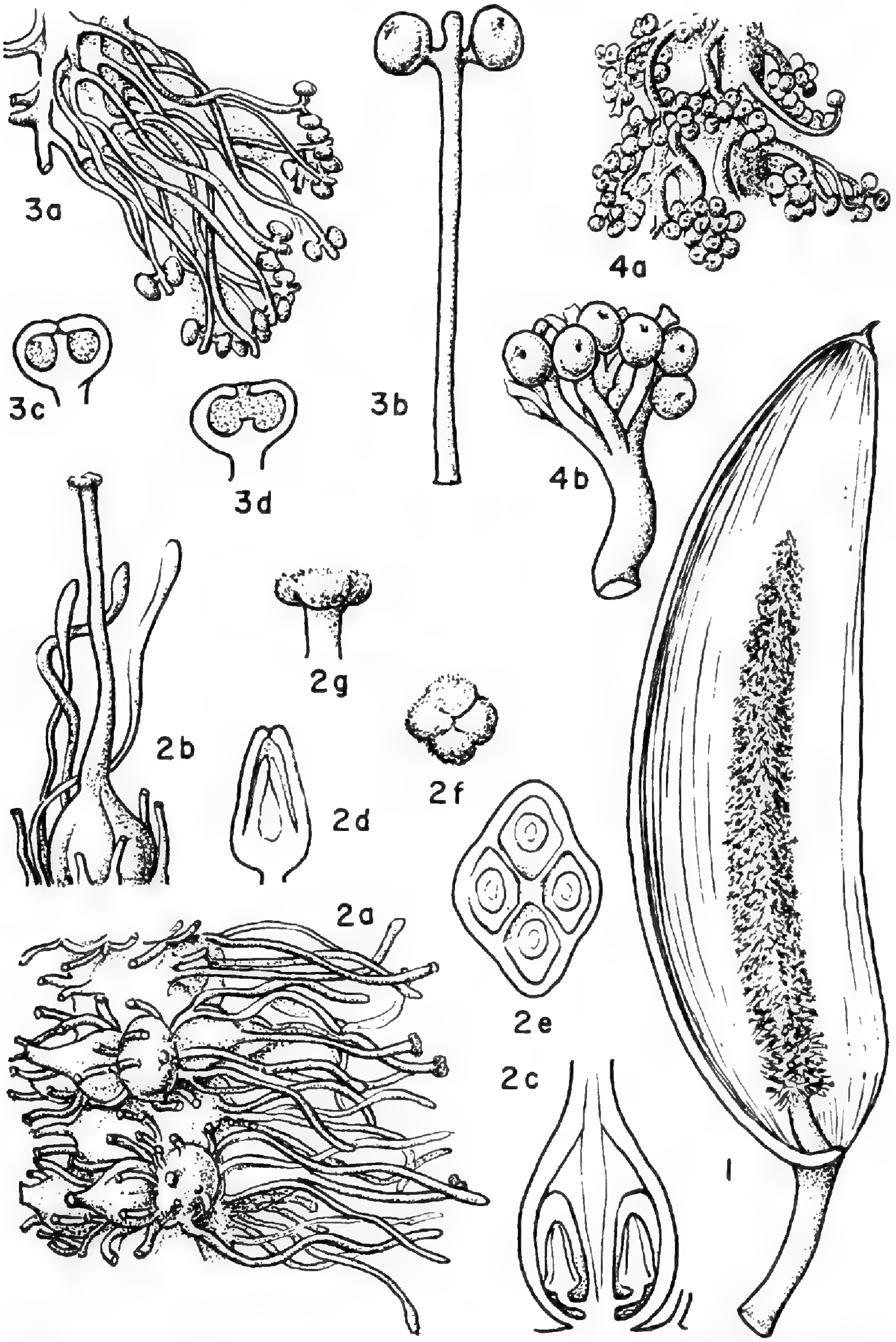
Schott (died 1865) had 3282 color and black and white drawings of *Araceae* prepared, for which he himself paid. This set of drawings (of which less than 200 have been published) is deposited at the Natural History Museum, Vienna. The unpublished folio drawing numbered "Icon. Herb. Palat. Vindob./Schott Aroideae Nr. 1990" was drawn by Nickelli from the Leiden holotype of *Gorgonidium mirabile.*

Engler (1920, Pl. 2, fig. F-H) illustrates a pistillate flower, a stamen, and a staminate flower. Figure F is copied from the Schottian drawing. Figures G and H are highly stylized, but were undoubtedly based on the Schottian drawing, rather than on the holotype.

The illustration published here includes fourteen figures which were copied by Miss Mitsu Nakayama from photographs of Schott's Nr. 1990, which contains twenty-seven figures. The author wishes to thank Prof. Dr. K. H. Rechinger, Director of the Natural History Museum in Vienna for permission to publish these figures.

The following description of *Gorgonidium mirabile* is synthesized from the original description (Schott, 1864), Engler's description (1920), and photographs (taken by the author) of the holotype at Leiden and the Schottian drawing Nr. 1990 at Vienna.

Leaf unknown. Peduncle incomplete. Spathe purple, about 20 cm. long and 5 cm. wide, open almost to the base. Spadix purple, approximately 14 cm. long; stipe 1.7 cm. long, pistillate portion 1.8 cm. long, and staminate portion 11.5 cm. long. Pistillate flowers more or less whorled, each surrounded by 6-8 irregularly arranged staminodia; ovary 4-locular, locules 1-ovular; ovule orthotropous; style filiform; stigma 4-lobed. Staminate flowers contiguous with the pistillate, with 6-8 stamens; lower flowers with free stamens, often irregularly ar-



Figs. 1-4b *Gorgonidium mirabile* Schott. 1. Inflorescence with one half of the spathe removed. 2. Details from lower (pistillate) portion of the inflorescence: 2a. Several pistillate flowers and their staminodia; 2b. Single pistillate flower and its staminodia: 2c. Longitudinal section of pistil; 2d. Longitudinal section of an ovule; 2e. Cross-

ranged; upper flowers with stamens more or less connate by their filaments; stamens with long filaments, much longer than the spheroidal anthers, these paired, stipitate below the free end of the connective, and dehiscent by a terminal pore.

SUMMARY

The type-specimen of the type-species of *Gorgonidium* Schott has hitherto been considered as having been collected by Gaudichaud in the Papuan area. In fact, however, it was collected by d'Orbigny in Bolivia. The error developed from the omission of d'Orbigny's name on the field labels, the distribution of duplicates by Gaudichaud, and a clerk's miscopying of "Sicasica" (a province of Bolivia) as "Sualica", which was thought to be a sea in the Papuan area. The solution was found by a study of previously unrecognized isotypes of *Spathantheum orbignyanum* Schott and *Gorgonidium mirabile* Schott in the Paris Museum of Natural History. — L. H. BAILEY HORTORIUM, CORNELL UNIVERSITY.

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————. 1864. *Gorgonidium mirabile* Schott in Ann. Mus. Bot. Lugd.-Bat. **1**: 282.

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section of the ovary; 2f. Top view of stigma; 2g. Side view of stigma. 3. Details from central (staminate) portion of inflorescence. 3a. Several staminate flowers; 3b. Single stamen; 3c. Longitudinal section of immature anther; 3d. Longitudinal section of anther at anthesis. 4. Details from upper (staminate) portion of inflorescence: 4a. Several staminate flowers; 4b. Single staminate flower.

NEW PLANTS IN OLD PLACES

FRANK C. SEYMOUR

Justification for this title lies in the fact that the plants listed in this article are mostly new, so far as our knowledge goes, to the localities in which they were collected. Old places refers to the fact that their localities are mostly areas which have been extensively botanized previously.

Historically, Bristol County, Massachusetts, from which most of the records come is one of the earliest regions in America to be settled by white men. Botanically, while not one of the earliest areas to be explored, it has been the scene of collecting activity for nearly a century, at least. The earliest collectors in this county, so far as has been ascertained, are George Mackie who collected in 1872 in New Bedford, and S. M. Holman who collected in 1880 in Attleboro. A few specimens from each of these are in the Herbarium of the New England Botanical Club. The earliest botanist who collected a considerable number of specimens was Carl Blomberg. His specimens (NEBC) are from Easton and range in date from 1890 to 1902.

Much better known as a botanist is Eliphalet Williams Hervey, who appears to have begun collecting at about the date when Blomberg's collecting ceased. Although many of his specimens in the Club Herbarium are not dated, from those which are dated, we learn that he collected in New Bedford and vicinity during the years 1899 to 1916. His "Flora of New Bedford" (the 3rd edition, revised, published in 1911) seems to have marked the climax of his botanical investigations in Bristol County.

Other botanists whose specimens are in the Herbarium of the Club include S. N. F. Sanford. His specimens are from various towns in this County during the years 1903 to 1929 and probably later. Many others, — outstandingly F. F. Forbes, F. W. Hunnewell and C. H. Knowlton, — have contributed extensively to our knowledge of this fruitful region.

In spite of so much botanical activity, Dighton seems to have been almost entirely overlooked, perhaps because it is on the other side of Taunton River from New Bedford. Not many bridges cross that river. During the present writer's eight years of residence in Dighton, his botanical eye picked up a few plants which seem worthy of note.

Of the 47 species listed below, 40 are from Bristol County, Massachusetts. 6 of the 40 have been reported before but are mentioned for reasons given below. It is surprising that of the 34 believed not to have been reported before, only 20 are introduced while as many as 14 are native. Thus only 59% were probably not there in Hervey's day. Of the 20 introduced species not previously reported, 6 or 30% are introduced from elsewhere in America while 14 or 70% are introduced from Europe or Asia. The list below is divided into groups to represent these aspects. Usually the number of the collection is cited so that in the future the identification may be verified or, if necessary, corrected.

Many of the specimens here mentioned are to be found in the herbarium of the New England Botanical Club and in the writer's private herbarium. Some are also in the herbarium of Southern Methodist University. The writer wishes to thank Dr. Reed C. Rollins, Director of the Gray Herbarium, and Dr. Richard A. Howard, Director of the Arnold Arboretum, for the privilege of referring to those respective herbaria.

I. BRISTOL COUNTY, MASSACHUSETTS, *introduced* species believed not to have been previously reported.

1. *Picea Abies* (L.) Karst. A few young trees surrounded by woods, removed from any building, appear to have been self-sown. Dighton, 1957, *Seymour 17,072*. Native of Europe.
2. *Pinus resinosa Ait.* In some cases, this tree has been planted, but in a number of other cases, a group of young trees are irregularly arranged and show no signs of human agency, as in the case of *Seymour 16,507*, Dighton, 1956. Native as near as northern Mass.
3. *Eragrostis multicaulis* Steud. Plentiful along a roadside in Dighton, 1961, *Seymour 19,383*. Not nearly so frequent in the writer's observation as the very similar *E. pectinacea* (Michx.) Nees. Native of e. Asia.
4. *Calamagrostis epigejos* (L.) Roth. var. *georgica* (K. Koch)

Ledeb. Several plants of this grass, as yet rare in New England, were in a neglected field near buildings in Dighton, 1957, *Seymour 17,752.* Native of s. Russia.

5. *Tradescantia virginiana* L. Hardy in cultivation and persisting in more than one locality where it has escaped, as by a roadside, Dighton, 1961, *Seymour 19,279a.* Native as near as Conn.

6. *Salix babylonica* L. A single tree in an open field with no evidence of cultivation. Taunton, 1961, *Seymour 19,146; 19,240,* both from the same tree at different seasons. Native of Eurasia.

7. *Polygonum cuspidatum* Sieb. & Zucc. Large colonies in several spots in and near Taunton, 1961, *Seymour 19,528.* Native of e. Asia.

8. *Polygonum sachalinense* F. Schmidt. Only one colony known. Near site of burned building, Dighton, 1961, *Seymour 19,527.* Native of e. Asia.

9. *Rosa gallica* L. Several bushes in a vacant lot near woods, Dighton, 1961, *Seymour 19,232.* Native of Europe.

10. *Lotus corniculatus* L. First seen by the writer in Topsham, Vt., 1959. Abundant on a hillside and adjacent road, *Seymour 18,180.* New to Vt. The following year, it appeared in considerable quantity along a roadside in Dighton, 1960. *Seymour 18,566.* First collection in southeastern Mass. In 1961, collected along a roadside, Warren, R. I. *Seymour 19,448.* New to Bristol Co., R. I. Native of Europe.

11. *Lathyrus latifolius* L. Along a roadside, Dighton, 1961. *Catherine M. Seymour 19,471a.* Cultivated and escaping. Thoroughly established. Native of Europe.

12. *Erodium cicutarium* (L.) L'Her. Many plants as weeds in a cultivated field, Dighton, 1961. *Wyman E. Hawkes.* Native of Europe.

13. *Catalpa speciosa* Warder. Frequently escaped from cultivation. Small trees seen in various places. Collection from a small tree with several others near a large tree along a roadside, Taunton, 1961. *Seymour 19,311.* A group of small trees in a similar situation but not near any large tree, Raynham, 1961, *Seymour 19,330.* Native as near as Tenn.

14. *Catalpa bignonioides* Walt. Apparently less frequent than *C. speciosa.* Along a roadside, Easton, 1961, *Seymour 19,575.* Native farther south.

15. *Plantago lanceolata* L., var. *sphaerostachya* Mert. & Koch. Roadside, Taunton, 1961, *Seymour 19,242.* This variety new to Bristol Co., Mass. Native of Europe.

16. *Silphium perfoliatum* L. A large colony growing luxuriantly in a vacant lot, in moist soil; observed for several years; Taunton, 1961, *Seymour 19,530.* Native as near as Ont.

17. *Helenium flexuosum* Raf. (*H. nudiflorum* Nutt.). Many plants in a meadow along upper tidal part of Taunton River, Taunton, 1956, *Seymour 16,991.* Native as near as N. C.

18. *Hieracium Pilosella* L. A few plants in an open field far from human habitation, Dighton, 1957, *Seymour 17,081.* Observed in abundance on more than one lawn in Taunton, 1962. It is desirable to record with specimens the first date when plants like this, which are spreading, reach each locality so that the rate and direction of spread may be plotted. Native of Europe.

19. *Hieracium pratense* Tausch. A few plants, Dighton, 1961, *Seymour 19,231.* Glocester, R. I., 1961, with Richard J. Eaton, along roadside, (Previously reported only from Smithfield, R. I.) *Seymour 19,225.* Native of Europe·

20. *Hieracium vulgatum* Fries. Three plants on a lawn where it certainly did not occur the year before, Dighton, 1961, *Seymour 19,473.* Native of Europe.

II. BRISTOL COUNTY, MASSACHUSETTS, *native* species believed not to have been reported previously.

21. *Botrychium matricariaefolium* A. Br. A few plants in shade of young trees and shrubs which were about 1.5 m tall in a neglected field with *Orobanche uniflora* L. *Seymour 19,741.*

22. *Zostera marina* L., var. *stenophylla* Aschers. & Graebn. Washed up on shore, Horseneck Beach, Westport, Mass., *Seymour 19,307.*

23. *Potamogeton gemmiparus* Robbins. A few plants floating free in Barstow Pond, Taunton, Mass., *Seymour 19,516.*

24. *Potamogeton alpinus* Balbis, var. *subellipticus* (Fern.) Ogden. In rapid current, tidal part of Segreganset River, Dighton, 1957, 1961 (with *P. epihydrus* Raf., var. *Nuttallii* (C. & S.) Fern.). *Seymour 17,182; 19,481.*

25. *Spartina* × *caespitosa* A. A. Eaton. Several plants in salt marsh along Taunton River, Dighton, 1961, *Seymour 19,384.*

26. *Zizania aquatica* L., var. *aquatica.* Sizable colony on tidal shore of Segreganset River, Dighton, (near *Potamogeton alpinus,* var. *subellipticus*) 1957, *Seymour 17,183.*

27. *Scirpus robustus* Pursh. A few plants at edge of tidal pool along Taunton River, Dighton, with *S. paludosus* Nels., var. *atlanticus* Fern., 1959, *Seymour 18,393.*

28. *Carex Deweyana* Schwein. Occasional in damp woods, Dighton, 1956, *Seymour 16,512.*

29. *Carex abscondita* MacM. In rich, usually damp woods. Widespread in Dighton and vicinity. In 1916, when the writer was studying the flora of Martha's Vineyard, Mass., it was surprising that although this species occurred in R. I. and Martha's Vineyard, it was unknown in Bristol Co., Mass. Now it is found not only

to occur in the latter county, as was to be expected, but it is widespread and not uncommon. Dighton, 1957. Raynham, 1960. Rehoboth, 1961. Taunton, 1961. Bristol, R. I., 1961. *Seymour 17,122; 18,569; 19,227; 19,251; 19,460; 19,493.*

30. *Carya ovata* (Mill.) K. Koch. Common in Dighton, 1955. From several collections, two are cited from the same tree at different seasons. *Seymour 17,144; 17,679.*

31. *Betula nigra* L. Several young trees along upper tidal part of Taunton River, Taunton, 1955. The trees are irregularly arranged on uncultivated land and appear to be self-sown. *Seymour 16,459; 16,497.*

32. *Hepatica americana* (DC.) Ker. Several plants in thin deciduous woods; known only in this one spot, Dighton, 1959. Guided to the spot by Elliott Walker. *Seymour 18,492; 18,496.*

33. *Prunus americana* Marsh. Occasional in Dighton, 1961. Along a hedgerow, *Seymour 19,230.*

34. *Callitriche verna* L. (*C. palustris* L.) Along Terry Brook, Assonet, Freetown, Mass., *Seymour 19,107.*

III. BRISTOL COUNTY, MASSACHUSETTS, *introduced* species previously reported.

35. *Thuja occidentalis* L. Much cultivated in this county, it is escaping and becoming established. Two medium sized trees not near any building and surrounded by woods show no sign of having been planted. Berkley, Mass., 1961, *Seymour 19,128.* Collected also by Hervey in New Bedford. Native in western New England.

IV. BRISTOL COUNTY, MASSACHUSETTS, *native* species previously reported.

36. *Phragmites communis* Trin., var. *Berlandieri* (Fourn.) Fern. Small colony of a dozen plants in swampy land recently cleared for gas pipe line, Dighton, with *Lycopodium inundatum* L., var. *inundatum*, 1961. Not previously observed in this spot although the writer lived within one quarter mile for eight years. He had collected in that spot the year before. Was it there all the time? Was it self-planted after the land was cleared? Was it growing there but stunted until the land was cleared? Any of these is possible; *Seymour 19,529.* Listed by Hervey from New Bedford, but no specimen seen.

37. *Carex Emmonsii* Dew. Common in Dighton and vicinity, 1956, *Seymour 16,513; 17,078; 18,501.* There is only one other record from Bristol Co.; North Easton, *A. A. Eaton,* 1903.

38. *Trillium erectum* L. A number of plants in swampy woods of hemlock, *Tsuga canadensis* (L.) Carr., 1960. Reported earlier by Wilfred A. Hathaway but no specimen seen previously. *Seymour 18,509.*

39. *Rhododendron canadense* (L.) Torr. Border of swamp, one good-sized clump, Raynham, Mass., 1961, *Seymour 19,180.* Discovered by William N. Andrews, Sr., who directed the writer to the spot. Rare in this county; previously collected only in Attleboro.

40. *Physalis pubescens* L., var. *grisea* Waterfall. One large plant about 1.5 m tall along a roadside, Dighton, 1959. Not found the following year. *Seymour 18,488.* In this county, previously collected only by Hervey in New Bedford.

V. MISCELLANEOUS collections of *introduced* species from outside Bristol County, Mass.

41. *Nymphaea tuberosa* Paine. Large root picked up, floating near shore, Winter Pond, Winchester, Mass., 1962, with Richard J. Eaton. The main root bears several small fusiform tubers. *Seymour 19,702.* Not previously reported from Mass. Native as near as Vt. and southwestern Conn.

42. *Erysimum inconspicuum* (S. Wats.) MacM. A single plant in a vacant lot, formerly a poultry farm, Stoughton, 1961, *Seymour 19,310.* New to Mass. Native as near as Ont.

VI. MISCELLANEOUS collections of *native* species from outside Bristol Co., Mass.

43. *Potamogeton nodosus* Poir. A few plants with *P. gramineus* L. in Pine River, Ossipee, N. H., *Seymour 19,840.* New to N. H.

44. *Trisetum melicoides* (Michx.) Vasey, var. *majus* (Gray) Hitchc. Only one plant seen; Lake Morley, Fairlee, Vt., 1959 *Seymour 18,216.* Reported from northern Vt. in Gray's Man., ed. 8. Rare.

45. *Sphenopholis nitida* (Biehler) Scribn. Scarce; in woods near crags near *Asplenium montanum Willd.*, Glocester, Providence Co., R. I. with Richard J. Eaton. *Seymour 19,205.* Collected in Cumberland, R. I., 1875, and 1878; not collected in this county since.

46. *Rhynchospora capillacea* Torr. Numerous plants in shallow water of shore of Robbins Cove, Berry Bay, Freedom, N. H., with *Ranunculus reptans* L., 1958, *Seymour 17,887.* New to N. H.

47. *Viola pubescens* Ait. Several plants in two different spots in one of the few remaining relatively unspoiled patches of rich woods in Brockton, Plymouth Co., Mass., 1962, *Seymour 19,801.* Not previously reported from Plymouth Co., Mass.

STOUGHTON, MASS.

TETRAPLOID PASSIFLORA INCARNATA IN NORTH CAROLINA. — The genus *Passiflora* L. in North Carolina is represented by two relatively distinct species. *Passiflora lutea* L., the yellow passion-flower, is infrequent and occurs in more mesic environments than the common *P. incarnata* L., the passion-flower or maypops (Blomquist and Oosting, 1959). The latter species has been seen on road banks or railroad banks in dry soils harboring little other vegetation and providing rapid runoff of surface water after summer showers. These are often fully exposed to sunlight throughout the day.

Specimens of *P. incarnata* were collected in July, 1962, one mile north of U. S. Highway 15-501 & 70 bypass on Duke Street, Durham Co., Durham, North Carolina (*Lloyd 1001*, Duke University Herbarium). Buds were opened and fixed in 1:3 acetic alcohol at 11:00 AM, and later squashed in acetocarmine. Microsporogenesis of sporocytes showed 18 bivalents at metaphase 1.

The finding of tetraploid *P. incarnata* coupled with previous counts of $n = 9$ by Storey (1950) and Bowden (1945) establishes the presence of polyploidy in this species. In view of the lack of quadrivalents in the plants I examined they may have been of allotetraploid origin. Diploid (Baldwin, 1949) and tetraploid (Bowden, 1945) strains of *P. lutea* also occur and both species should be investigated further to determine the origin and distribution of their included polyploid races, which may have some application to horticulture.

Special thanks are due the staff of Duke University for the use of their facilities and Dr. Peter Raven for his comments in the preparation of the manuscript. —ROBERT M. LLOYD, DEPARTMENT OF BOTANY, DUKE UNIVERSITY, DURHAM, NORTH CAROLINA.[1]

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A RECENT ILLINOIS COLLECTION OF SANGUISORBA CANADENSIS L. — The last definite date for a specimen of American burnet, *Sanguisorba canadensis* L., in Illinois is fifty-five years ago. This material was collected by E. J. Hill, Sept. 25, 1907, moist prairie by R. I. Railroad, Joliet, Will County. Previous collections by H. L. Boltwood and A. B. Seymour are known from Ottawa, LaSalle County, dated 1880 and 1882. A statement in VASCULAR PLANTS OF ILLINOIS (Jones, Fuller et al., 1955) says: "Moist ground, very rare, or possibly extinct in Illinois." An S. B. Mead specimen is cited in the same publication: "Cass Co.: Beardstown, Aug. 27 — ?". In view of the interval since the last collection of this species and in connection with the questionable date of the Cass County specimen, the following information seems pertinent.

Illinois is perhaps near the southwestern limit of distribution of *S. canadensis* L., and a recent collection by Mr. R. T. Rexroat of Virginia, Illinois, will verify the continued occurrence of this species in the state. Collection data are as follows: Cass Co., Illinois, south of Beardstown, once swampy area (moist only when the specimen was collected), Sept. 15, 1962, *R. T. Rexroat 8577*, (ISM).

Mr. Rexroat, an amateur botanist and collector, has demonstrated the value of such collectors and their contributions to a continued study of the flora of Illinois. Since 1953 Mr. Rexroat has collected eight species of vascular plants previously not recorded for Illinois and six of these are from Cass County. The following list is furnished although many of them were reported in previous issues of RHODORA. Cass

County: *Fimbristylis vahlii* (Lam.) Link, *Scleria reticularis* Michx., *Lipocarpha maculata* (Michx.) Torr., *Cyperus grayioides* Mohlenbrock, *Anagallis arvense* forma *caerulea* (Schreb.) Baumg., and *Arctium tomentosum* Mill. Morgan County: *Eragrostis curvula* (Schrad.) Nees, and from Schuyler County, *Falcaria sioides* (Wibel) Aschers. Mr. Rexroat's work is an example of what careful and continued collecting can accomplish in a state which has been considered well botanized during a century and a half. In spite of opinions of some professional botanists, who regard further collecting in Illinois unnecessary, the effort seems worthwhile. — GLEN S. WINTERRINGER,

ILLINOIS STATE MUSEUM, SPRINGFIELD.

THE FLORA OF THE WOLF ISLANDS
NEW BRUNSWICK*
PART I

RADCLIFFE B. PIKE AND ALBION R. HODGDON

Dwarfed by the nearby Grand Manan Archipelago, the Wolf Islands have received scant attention since their discovery in 1603 by Champlain who gave them the picturesque name, "Les Isles des Perdreaux".

The "Wolves", as these islands are known, have been neglected for excellent reasons; they are both literally and figuratively overshadowed by Grand Manan which has long attracted visitors including botanists; they are so situated in the hazardous waters of the Bay of Fundy as to be unattractive to the usual run of visitors, except fishermen and rare yachtsmen.

The islands are not remote; North Head on Grand Manan is about 12 miles to the south, Campobello Island is 10 miles to the west and the mainland of New Brunswick not more than 8 miles away to the north. The most important factor in their isolation has probably been the nature of the Bay of Fundy itself, its extreme tidal currents and notorious meteorological conditions coupled with the rugged shore lines of the islands themselves.

Of all the accessible islands that lie off the North Atlantic Coast, these are the last to have yielded to the botanist. It

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* Collections of all taxa except *Lycopodium clavatum* were made at least once and often for most of the individual islands, but in the case of common and well-defined species, the records are based in major part of field observations made in July 1962. Specimens are deposited in the University of New Hampshire Herbarium.

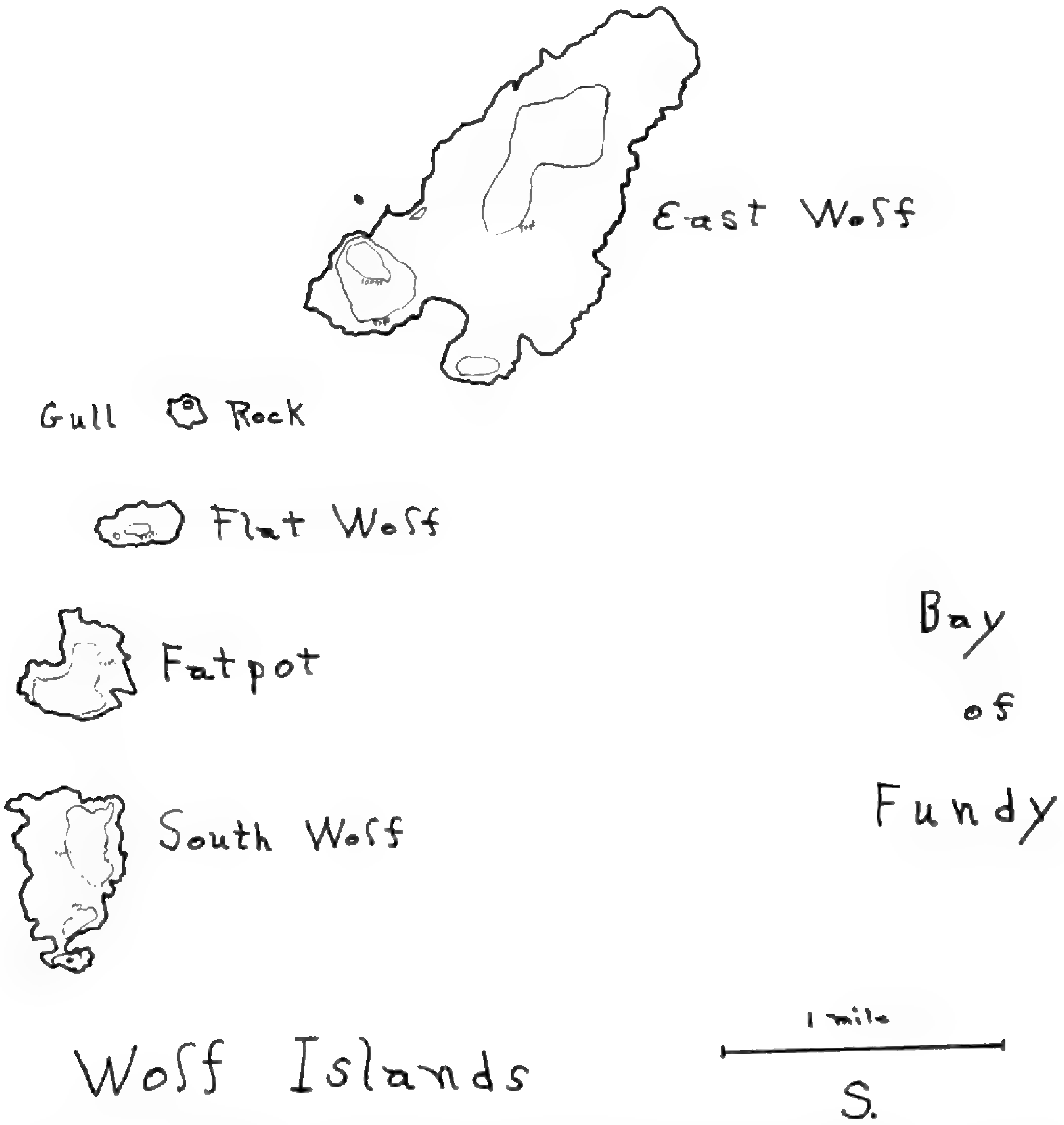

Fig. 1. Map of Wolf Islands, Pennfeld Parish, Charlotte Co., New Brunswick, Canada.

is doubtful indeed if there is anywhere a comparably neglected insular area so near a highly developed coast line.

It is the usual fate of islands in inhabited regions to be ravaged by man. This is true of the Grand Manan group, of Machias Seal and other islands that we have visited in the Bay of Fundy. But the Wolves, to a very considerable extent, have been preserved in nearly their original state. Of the 5 islands (see map), Fatpot and Flat Wolf seem to have been totally undisturbed, also South Wolf in major part and a very considerable portion of East Wolf. On South Wolf the Canadian Government maintains a lighthouse, the keeper of which is the only year-round inhabitant. The area immediately around the lighthouse and a mere fringe of meadow on the western side of the island show the effects of man. Also there has been irregular summer occupancy of the Wolves by fishermen for a long time.

The Hawkins family of Beaver Harbor, New Brunswick, the present owners of East Wolf, have been very helpful in giving us information about the human history of the islands and also have pointed out several interesting species of plants. The occupancy of East Wolf has been sporadic over the years depending on the supply and demand for herring. Cows, pigs and chickens have been kept on the island during the summer fishing season at times, but no sheep were introduced. Thus the destruction of native vegetation has been confined to a few acres in the vicinity of the camps on Paul's Cove on the western side of the island. As is customary on many islands, rabbits have been introduced repeatedly to provide emergency food. These creatures were excessively abundant in 1959 on East Wolf but had declined almost to the point of disappearance by 1962. A great fire set by visiting fishermen many years ago burned the eastern end of East Wolf. Large areas nearer the center of East Wolf also were burned off or cleared many years ago providing at present a savannah-like aspect with scattered large trees mostly of *Betula papyrifera* var. *cordifolia*. The dominant forest trees, *Picea glauca* and *Abies balsamea*, seem to be very slow or quite ineffective in regenerating these cleared areas, many of which are now carpeted with almost unbroken mats of *Cornus canadensis*. Despite these alterations and undoubtedly the cutting of trees at times, the impression one forms after visiting any one of the Wolf Islands is of essentially wild and unspoiled nature — quite in contrast to the feeling evoked by a visit to the Grand Manan group. The virgin character of the coniferous forest is indicated by the deep carpet of lichens and mosses and perhaps by the abundance of three species of orchids; *Habenaria obtusata*, *H. clavellata*, and *Listera cordata*.

The granitic base of the islands rises sheer and bold with very few landing places and only one semi-protected anchorage — at Paul's Cove on East Wolf. The islands are not high, the maximum elevation being about 100 feet, but there are imposing sea cliffs and yawning chasms on the seaward or eastern sides of all the islands, the best development of which occurs on South Wolf. Unlike Grand Manan and the principal other Bay of Fundy islands, the Wolves have no rocks of calcareous affinity nor basaltic origin and as might be expected no species of calcareous affinity occur there. On the smaller islands of the Wolves the soil seems to be entirely litter or humus down to bed rock. On South Wolf the land-bridge connecting the main island with the granite nubble where the lighthouse is placed, is a ridge with much gravel and water-worn cobbles indicating water deposition and a probable former beach line. Marine gravels and clays are revealed at the heads of small coves where the soil profiles are exposed by erosion.

Meteorological conditions can be judged somewhat from the weather bureau records at Eastport, and from Coast Guard and lighthouse records from West Quoddy Head in Lubec, both stations being in Maine within 10 - 15 miles from the Wolves. The temperature of the water of the Bay of Fundy varies little between the high of summer and the low of winter due to the great turbulence and mixing caused by the tides which range from 27.5 to 13.5 ft, the average for the year being 19 ft. The highest surface temperatures are between 52° and 54° F. in summer and the lowest winter temperature of the surface water is between 34° and 32° F. The winter extremes only occur during unusually cold, windy weather and usually in the winter the water is little colder than in the summer. This small range of water surface temperatures has a strong influence on the air temperatures surrounding the islands tending to moderate the seasonal extremes.

These same water temperatures strongly influence the atmospheric moisture producing "vapor'" or "sea smoke" in winter and fog in spring and summer. Nearby Quoddy

Head in Maine has recorded periods of well over 300 hours of continuous fog. Thus the climate of the Wolves is not only decidedly maritime, but somewhat boreal, and in some respects almost montane. This distinctive local climate should be kept in mind during discussions of the flora of these islands.

While attending a botanical meeting in Montreal in August 1959, we discussed together the possibilities of doing some research on the Wolf Islands. The senior author had known of the Wolves since childhood and had frequently seen them on fogless days from Campobello. Neither of us had ever heard of any botanical work being carried on there, nor could we learn of any from the Canadian botanists with whom we talked. Therefore in September the senior author made two brief visits to the Wolves and brought back 62 taxa as representative and interesting samples of the flora. When we studied these it seemed appropriate to compare them with the "List of the Vascular Plants of Grand Manan" (Weatherby and Adams, Contr. Gray Herb. CLVIII, 1945.) Several taxa which were common on the Wolves were not listed at all from Grand Manan. Plans were made for further investigation of the Wolves in particular, but also of Grand Manan (Rhodora 64: 98-108, 1962). All subsequent visits have strengthened the early indications that there are significant differences between these two groups of islands. More detailed analyses of these island differences and other features of phytogeographic interest relating to the Wolves and other Fundian Islands will be covered in subsequent papers. Comparative studies of the floras of islands in North America have been grossly neglected though many fine studies of individual islands have been made.

After four seasons of study involving a total of fifteen days spent on the Wolves extending over a period from June to October in different years, we are impressed with the fact that there are many potential problems for investigation. The ecological features of islands so nearly virgin in character deserve attention. The small size of the islands combined with their isolation have concentrated certain populations of unique character there, affording a natural laboratory for population studies in taxonomy.

LIST OF PLANTS OF THE WOLF ISLANDS*

	East Wolf	Fat Pot	Flat Wolf	South Wolf	Gull Rock
Equisetum arvense L. var. **boreale** (Bong.) Ledeb.	×			×	
E. sylvaticum L. var. **pauciramosum** Milde	×			×	
Lycopodium annotinum L. var. **alpestre** Hartm.	×				
L. annotinum L. var. **pungens** (La Pylaie) Desv.	×				
L. clavatum L.				×	
L. obscurum L. var. **dendroideum** (Michx.) D. C. Eat.	×	×			
Botrychium simplex E. Hitchc. var. **tenebrosum** (A. A. Eat.) Clausen	×				
Osmunda Claytoniana L.	×	×			
O. cinnamomea L.	×	×		×	
Onoclea sensibilis L.	×				
Dryopteris Thelypteris (L.) Gray var. **pubescens** (Lawson) Nakai	×				
D. noveboracensis (L.) Gray	×				
D. disjuncta (Ledeb.) C. V. Mort.	×	×			
D. Phegopteris (L.) Christens.	×				
D. spinulosa (O. F. Muell.) Watt var. **spinulosa**	×	×			
D. spinulosa (O. F. Muell.) Watt var. **intermedia** (Muhl.) Underw.	×				
D. spinulosa (O. F. Muell.) Watt var. **americana** (Fisch.) Fern.	×	×	×	×	
D. cristata (L.) Gray	×				
Dennstaedtia punctilobula (Michx.) Moore	×			×	
Athyrium Filix-femina (L.) Roth var. **Michauxii** (Spreng.) Farw.	×	×		×	
A. Filix-femina (L.) Roth var. **Michauxii** (Spreng.) Farw. f. **laurentianum** (Butters) Fern.			×		
Polypodium virginianum L.	×	×	×	×	
Pteridium aquilinum (L.) Kuhn var. **latiusculum** (Desv.) Underw.	×				

Taxus canadensis Marsh.				×	
Abies balsamea (L.) Mill. var. **phanerolepis** Fern.	×	×	×	×	
Picea glauca (Moench) Voss	×	×	×	×	
P. rubens Sarg.	×	×		×	
P. mariana (Mill.) BSP.	×			×	
Larix laricina (DuRoi) K. Koch	×				
Thuja occidentalis L.	×				
Ruppia maritima L. var. **longipes** Hagstr.	×				
Triglochin maritima L.	×				
Festuca rubra L. var. **commutata** Gaudin	×	×	×	×	
Puccinellia laurentiana Fern. & Weath. var. **laurentiana**	×	×	×	×	
P. paupercula (Holm) Fern. & Weath. var. **paupercula**	×	×	×	×	
P. paupercula (Holm) Fern. & Weath. var. **alaskana** (Scribn. & Merr.) Fern. & Weath.	×	×	×	×	
Glyceria canadensis (Michx.) Trin.	×				
Poa annua L.	×	×	×	×	×
P. compressa L.	×				×
P. pratensis L.		×	×	×	
P. palustris L.		×	×	×	
Agropyron trachycaulum (Link) Malte var. **glaucum** (Pease & Moore) Malte				×	
A. trachycaulum (Link) Malte var. **majus** (Vasey) Fern.			×		
A. repens (L.) Beauv. f. **aristatum** (Schum.) Holmb.	×		×	×	
A. repens (L.) Beauv. f. **trichorrhachis** Rohlena	×			×	
Elymus arenarius L. var. **villosus** Mey.	×	×	×		×
Deschampsia flexuosa (L.) Trin. var. **flexuosa**	×	×		×	×
D. flexuosa (L.) Trin. var. **montana** (L.) Ledeb.	×	×	×	×	
Danthonia spicata (L.) Beauv.	×				
Calamagrostis canadensis (Michx.) Nutt. var. **robusta Vasey**	×	×	×	×	×
C. canadensis (Michx.) Nutt. var. **scabra** (Presl.) Hitchc.	×				
Agrostis alba L. var. **palustris** (Huds.) Pers.	×	×	×	×	×
A. tenuis Sibth.	×			×	
A. scabra Willd.	×			×	
A. perennans (Walt.) Tuckerm. var. **aestivalis** Vasey	×			×	

Cinna latifolia (Trev.) Griseb.			×	×	
Phleum pratense L.	×	×		×	
Alopecurus pratensis L.	×				
Anthoxanthum odoratum L.	×				
Hierochloë odorata (L.) Beauv.	×				
Eleocharis palustris (L.) R. & S.	×				
E. halophila Fern. & Brack.	×				
E. elliptica Kunth	×				
Scirpus validus Vahl. var. **creber** Fern.	×				
S. atrocinctus Fern.	×			×	
Eriophorum spissum Fern.	×			×	
E. tenellum Nutt.	×				
E. angustifolium Honckeny	×			×	
E. virginicum L.	×				
Carex stipata Muhl.	×				
C. disperma Dew.	×				
C. trisperma Dew.	×	×		×	
C. Mackenziei Krecz.	×				
C. canescens L. var. **canescens**	×	×		×	
C. canescens L. close to var. **disjuncta** Fern.	×				
C. canescens L. var. **subloliacea** Laestad.	×			×	
C. brunnescens (Pers.) Poir. var. **sphaerostachya** (Tuckerm.) Kukenth.	×	×	×	×	
C. cephalantha (Bailey) Bickn.	×				
C. angustior Mackenz.	×				
C. scoparia Schkuhr	×			×	
C. hormathodes Fern.	×			×	
C. leptalea Waslenb.	×				
C. Emmonsii Dew.				×	
C. paleacea Wahlenb.	×			×	
C. crinita Lam. var. **crinita**	×				×
C. nigra (L.) Reichard var. **nigra**	×				
C. nigra (L.) Reichard var. **strictiformis** (Bailey) Fern.	×				
C. limosa L.	×				
C. paupercula Michx. var. **irrigua** (Wahlenb.) Fern.	×				
C. debilis Michx. var. **Rudgei** Bailey	×				
C. viridula Michx.	×			×	
C. pauciflora Lightf.	×				
C. intumescens Rudge var. **Fernaldii** Bailey	×				
C. rostrata Stokes var. **rostrata**	×				
C. rostrata Stokes var. **utriculata** (Boott) Bailey	×			×	

Juncus bufonius L.	×	×	×	×	
J. bufonius L. var. **halophilus** Buchenau & Fern.	×				
J. tenuis Willd.	×				
J. effusus L. var. **Pylaei** (Laharpe) Fern. & Wieg.	×				
J. balticus Willd. var. **littoralis** Engelm.	×		×	×	
J. brevicaudatus (Engelm.) Fern.	×			×	
Luzula multiflora (Retz.) Lejeune var. **acadiensis** Fern.	×			×	
Clintonia borealis (Ait.) Raf.	×	×	×	×	
Smilacina stellata (L.) Desf.	×		×	×	×
S. stellata (L.) Desf. var. **crassa** Vict.	×		×		
S. trifolia (L.) Desf.	×		×	×	
Maianthemum canadense Desf.	×	×	×	×	
Streptopus amplexifolius (L.) DC. var. **americanus** Schultes		×	×	×	
S. roseus Michx. var. **perspectus** Fassett		×	×	×	
Sisyrinchium montanum Greene var. **crebrum** Fern.	×		×	×	
Iris Hookeri Penny	×	×		×	
I. versicolor L.	×	×	×	×	×
Cypripedium acaule Ait.	×				
Habenaria clavellata (Michx.) Spreng. var. **ophioglossoides** Fern.			×	×	
H. obtusata (Pursh) Richards.	×	×		×	
Goodyera repens (L.) R. Br. var. **ophioides** Fern.	×				
Listera cordata (L.) R. Br.	×	×		×	
Corallorhiza trifida Chatelain var. **verna** (Nutt.) Fern	×				
Salix rigida Muhl.	×				
S. Bebbiana Sarg. var. **capreifolia** Fern.	×				
S. pedicellaris Pursh var. **hypoglauca** Fern.	×				
S. discolor Muhl.	×				
S. humilis Marsh.	×			×	
Populus tremuloides Michx.	×				
Myrica Gale L. var. **Gale**	×				
Betula lutea Michx. f.	×		×	×	
B. populifolia Marsh.	×			×	
B. papyrifera Marsh. var. **papyrifera**	×				
B. papyrifera Marsh. var. **cordifolia** (Regel) Fern.	×	×	×	×	
Alnus crispa (Ait.) Pursh var. **mollis** Fern.	×			×	

A. rugosa (Du Roi) Spreng. var. **americana** (Regel) Fern.	×				
Urtica gracilis Ait.	× ?		×	×	
Rumex pallidus Bigel.	×		×	×	
R. domesticus Hartm.		×	×	×	
R. Acetosella L.	×	×	×	×	×
Polygonum aviculare L.	×	×	×	×	×
P. aviculare L. var. vegetum Ledeb.				×	
P. aviculare L. var. **littorale** (Link) W. D. J. Koch		×		×	
P. sagittatum L.	×				
P. Convolvulus L.	×				
Rheum Rhaponticum L.	×				
Chenopodium album L.	×			×	
Atriplex patula L. var. **patula**	×				
A. patula L. var. **hastata** (L.) Gray	×	×		×	×
A. glabriuscula Edmondston	×		×	×	
Suaeda sp.	×				
Spergularia marina (L.) Griseb. var. **leiosperma** (Kindb.) Gurke	×	×	×	×	×
Sagina procumbens L.	×	×		×	
S. nodosa (L.) Fenzl	×				
Arenaria lateriflora L.	×	×	×	×	
Stellaria media (L.) Cyrillo	×	×		×	×
S. graminea L.	×	×			
S. calycantha (Ledeb.) Bong. var. **isophylla** Fern.	×	×	×	×	
Cerastium vulgatum L.	×	×	×	×	×
Ranunculus Cymbalaria Pursh	×				
R. acris L.	×	×		×	
Thalictrum polygamum Muhl. var. **polygamum**	×	×	×	×	×
Coptis groenlandica (Oeder) Fern.	×			×	
Capsella rubella Reut.	×				
Cakile edentula (Bigel.) Hook.	×		×		
Raphanus Raphanistrum L.	×				
Sarracenia purpurea L.	×				
Drosera intermedia Hayne	×				
D. rotundifolia L.	×			×	
D. rotundifolia L. var. **comosa** Fern.	×				
Sedum Rosea (L.) Scop.	×	×	×	×	×
Mitella nuda L.	×				
Ribes hirtellum Michx. var. **hirtellum**	×	×	×	×	
R. hirtellum Michx. var. **calcicola** Fern.		×			

R. lacustre (Pers.) Poir.	×				
R. glandulosum Grauer	×	×	×	×	
Spiraea latifolia (Ait.) Borkh.	×				
Pyrus melanocarpa (Michx.) Willd.	×				
P. decora (Sarg.) Hyland	×	×	×	×	
Amelanchier laevis Wieg.	×	×		×	
A. laevis Wieg. × **Bartramiana** (Tausch) Roemer	×	×		×	
A. Bartramiana (Tausch) Roemer				×	
Fragaria virginiana Duchesne var. **virginiana**	×	×		×	
F. virginiana Duchesne var. **terrae-novae** (Rydb.) Fern. & Wieg.	×				
Potentilla palustris (L.) Scop.	×				
P. norvegica L.	×	×	×	×	×
P. simplex Michx. var. **calvescens** Fern.	×			×	
P. anserina L.	×			×	
P. Egedei Wormsk. var. **groenlandica** (Tratt.) Polunin	×	×		×	
Geum rivale L. f. **virescens** Lilja	×				
Rubus pubescens Raf. var. **pubescens**	×	×	×	×	
R. pubescens Raf. var. **pilosifolius** A. F. Hill	×				
R. idaeus L. **var. aculeatissimus** Regel & Tiling	×				
R. idaeus L. var. **strigosus** (Michx.) Maxim.	×			×	×
R. idaeus L. var. **strigosus** (Michx.) Maxim. f. **tonsus** Fern.	×				
R. idaeus L. var. **canadensis** Richards.	×	×	×	×	
R. vermontanus Blanch.	×				
R. canadensis L.	×				
R. allegheniensis Porter	×				
Rosa nitida Willd.	×				
R. virginiana Mill.	×				
Prunus pensylvanica L. f	×		×		
P. virginiana L.	×				
Trifolium pratense L.	×			×	
T. repens L.	×	×		×	×
Lathyrus japonicus Willd. var. **pellitus** Fern.	×	×	×	×	
L. palustris L. var. **linearifolius** Ser.		×		×	
L. palustris L. var. **pilosus** (Cham.) Ledeb.	×	×	×	×	
Oxalis montana Raf.	×	×	×	×	
Empetrum nigrum (L.)	×	×		×	
Ilex verticillata (L.) Gray	×				
Nemopanthus mucronata (L.) Trel.	×	×		×	

Acer spicatum Lam.	×	×	×	×	
A. pensylvanicum L.	×			×	
A. rubrum L.	×				
Impatiens capensis Meerb.	×		×		×
Hypericum canadense L.	×				
H. virginicum L. var. **Fraseri** (Spach) Fern.	×				
Viola cucullata Ait. var. **microtitis** Brainerd	×				
V. septentrionalis Greene	×			×	
V. Mackloskii Lloyd subsp. **pallens** (Banks) Baker	×			×	
V. incognita Brainerd var. **incognita**	×	×	×	×	
V. incognita Brainerd var. **Forbesii** Brainerd	×	×			
Epilobium angustifolium L. var. **angustifolium**	×	×	×	×	
E. leptophyllum Raf.	×			×	
E. glandulosum Lehm. var. **adenocaulon** (Haussk.) Fern.	×	×	×		
E. glandulosum Lehm. var. **occidentale** (Trel.) Fern.	×				
Oenothera perennis L.	×				
Circaea alpina L.	×	×	×	×	
Aralia nudicaulis L.	×	×	×	×	
Carum Carvi L.	×			×	
Ligusticum scothicum L.	×	×	×	×	×
Coelopleurum lucidum (L.) Fern.	×	×	×	×	×
Conioselinum chinense (L.) BSP.	×	×	×	×	
Cornus canadensis L.	×	×	×	×	
C. stolonifera Michx.	×				
Moneses uniflora (L.) Gray	×	×		×	
Monotropa uniflora L.	×	×		×	
M. Hypopithys L.	×				
Ledum groenlandicum Oeder	×			×	
Rhododendron canadense (L.) Torr.	×			×	
Kalmia angustifolia L.	×			×	
K. polifolia Wang.	×				
Cassandra calyculata (L.) D. Don	×				
Gaultheria hispidula (L.) Bigel.	×			×	
Vaccinium angustifolium Ait. var. **laevifolium** House	×			×	
V. Vitis-Idaea L. var. **minus** Lodd.	×	×		×	
V. Oxycoccos L.	×			×	
V. Oxycoccos L. var. **ovalifolium** Michx.	×	×		×	
V. macrocarpon Ait.	×	×		×	

Trientalis borealis Raf.	×	×	×	×
Glaux maritima L.	×			
Lomatogonium rotatum (L.) Fries f. **americanum** (Griseb.) Fern.				×
Menyanthes trifoliata L. var. **minor** Raf.	×			
Convolvulus sepium L. var. **sepium**	×		×	×
C. sepium L. f. **malachophyllus** Fern.	×		×	
Mertensia maritima (L.) S. F. Gray	×			×
Scutellaria epilobiifolia A. Hamilton	×			×
Galeopsis Tetrahit L. var. bifida (Boenn.) Lej. & Court.	×		×	
Lycopus uniflorus Michx.	×	×		×
Euphrasia americana Wettst.	×	×		×
E. Randii Robins. var. **Randii**	×	×		×
E. Randii Robins. var. **Farlowii** Robins.	×			
E. canadensis Townsend	×	×		×
Rhinanthus Crista-galli L. var. **fallax** (Wimm. & Grab.) Druce	×	×		×
Plantago major L.	×		×	
P. juncoides Lam. var. **decipiens** (Barneoud) Fern.	×	×	×	×
P. juncoides Lam. var. **glauca** (Hornem.) Fern.	×			
P. juncoides Lam. var. **laurentiana** Fern.				×
P. oliganthos R. & S. var. **fallax** Fern.	×			×
Galium triflorum Michx.	×	×	×	
G. trifidum L.	×			
G. tinctorium L.	×			
G. tinctorium L. var. **subbiflorum** (Wieg.) Fern.	×			
G. labradoricum Wieg.	×			
Diervilla Lonicera Mill.	×			
Lonicera villosa (Michx.) R. & S. var. **Solonis** (Eat.) Fern.	×			
L. villosa (Michx.) R. & S. var. **tonsa** Fern.	×			
L. canadensis Bartr.		×		×
Linnaea borealis L. var. **americana** (Forbes) Rehd.	×	×		×
Viburnum cassinoides L.	×	×		×
Sambucus pubens Michx.	×	×	×	×
Campanula rotundifolia L.	×	×	×	×
C. rotundifolia L. f. **albiflora** Rand and Redf.		×		
Solidago macrophylla Pursh	×	×	×	×
S. sempervirens L.	×	×	×	×

S. **uliginosa** Nutt. var. **terrae-novae** (T. & G.) Fern.	×				
S. **rugosa** Ait. var. **villosa** (Pursh) Fern.	×	×	×		×
S. **canadensis** L.	×				
S. **graminifolia** (L.) Salisb. var. **Nuttallii** (Greene) Fern.	×				
Aster radula Ait.	×				
A. **foliaceus** L. var. **arcuans** Fern.	×	×	×	×	×
A. **novi-belgii** L.				×	
A. **nemoralis** Ait.	×				
A. **acuminatus** Michx.	×	×	×	×	
A. **acuminatus** Michx. f. **discoideus** Ktze. or f. **virescens** Vict. & Rousseau	×				
A. **umbellatus** Mill. f. **intercedens** Fern.	×	×	×	×	
A. **umbellatus** Mill. var. **pubens** Gray	×	×			×
Anaphalis margaritacea (L.) C. B. Clarke var. **subalpina** Gray	×				
Gnaphalium uliginosum L.	×				
Bidens frondosa L.	×		×		
Achillea borealis Bong.	×	×	×	×	×
A. **lanulosa** Nutt.	?	×		×	
Matricaria matricarioides (Less.) Porter	×	×	×	×	×
Chrysanthemum Leucanthemum L.	×			×	
Senecio vulgaris L.	×				
S. sylvaticus L.	×			×	
Cirsium vulgare (Savi) Tenore				×	
C. **muticum** Michx.			×	×	
C. arvense (L.) Scop.	×			×	
Leontodon autumnalis L.	×			×	
Taraxacum erythrospermum Andrz.	×				
T. officinale Weber	×				
Sonchus arvensis L.	×			×	
S. asper (L.) Hill	×				
Prenanthes trifoliolata (Cass.) Fern. var. **nana** (Bigel.) Fern.	×	×		×	
P. **altissima** L. f. **integra** Rousseau		×	×		
Hieracium aurantiacum L.	×				
H. floribundum Wimm. & Grab.	×			×	

We have made an attempt to get a practically complete list of taxa from each island to determine the relationship between the area of land involved and the number of taxa. Table I shows the estimated relative areas of the Wolf

Islands with the numbers of taxa we have now recorded from each. Undoubtedly there will be some slight changes in the totals, as previously undetected plants come to our attention. The present figures show a substantially correct picture of the relationship of the numbers present to the areas of the individual Wolf Islands. The areal scale was established by regarding Gull Rock, the smallest, as a unit of one and the others as multiples of this unit. Thus with Gull Rock as one, we gave Flat Wolf, the next largest, which is about three times as large, the factor of three and so on up to forty-two for East Wolf, the largest of the islands.

Table I

Total Taxa recorded 314

	East Wolf	South Wolf	Fat Pot	Flat Wolf	Gull Rock
Comparative areas of islands	42	12	6	3	1
Taxa recorded	283	163	115	95	29
Ratio of taxa to area	6.7	13.5	18.1	31.6	29*

*Weather conditions prevented a final collection from Gull Rock which undoubtedly would have added several species to the list.

The larger islands (East and South Wolf) present greater habitat possibilities not only because larger areas provide more ecological niches such as bogs, swamps, barrier beaches, etc., but also because nearly all of the disturbed areas are and have been on these islands. On the other hand, the three smaller islands, particularly Gull Rock, have bird nesting colonies which may strongly influence the presence and absence of various taxa. Regardless of the other factors involved, the number of taxa present bears a fairly distinct relationship to the area involved, with a descending ratio to area as the total area increases. The comparison is an interesting one and should be further tested as more island studies are carried on.

DEPARTMENTS OF HORTICULTURE AND BOTANY,
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THE WIDENING PANORAMA IN MEDICAL BOTANY[1]

RICHARD EVANS SCHULTES

> "And as there are discouvered new Regions, new Kingdoms, and new Prouinces by our Spaniards, so they have brought unto us new Medicines, and newe Remedies, wherewith they do cure many informities, which, if we did lacke them, would bee incurible, and without any remedie . . . for which cause I did pretend to treate, and to write of all things that they bring frem our Indias, apperteyning to the Arte and Use of Medicine, and the remedie of hurtes and diseases that we doo suffer and endure . . ."
> Nicholas Monardes [transl. John Frampton] "Joyfull Newes out of the New-found Worlde" (1956)

I. *Introduction*

From an Andean mountain top overlooking the endless forest of the Amazon, dawn can be beautiful. One sees — one feels — the tropical panorama widen as the solid blanket of morning mist below first breaks into little openings, then, as the sun climbs higher, slowly lifts to bring the foreground into detailed view and the distance into clearer perspective.

I have often experienced such a widening panorama during my years of work in South America. And I have just as often thought of how similar has been our recent experience in medical botany. The widening panorama of the Plant Kingdom as a field of exploration for new physiologically active substances — this panorama has already started to bring the foreground into detailed view and the distance into clearer perspective. For the first time perhaps in all history

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[1] Lecture given at the Medical Center Lecture Series, University of West Virginia, Morgantown, West Virginia, October 29, 1962.

we know in a small way where we are going in our search for plants of promise in man's fight against the ills of his mind and body.

At the Botanical Museum of Harvard University, we have a course entitled "Plants and human affairs", the oldest course in economic botany in this country — going back to 1876. When I was a student in this course in 1935, Professor Oakes Ames spoke somewhat nostalgically when he took up the medicinal plants, because, one by one, the old plant medicines were being synthesized or replaced by coal-tar products. Professor Paul C. Mangelsdorf, who took over the teaching of the course in 1941, felt that, in the future, he might have to discuss plant drugs solely from the historical point of view. Now, in this same course, I divide my lectures on medical botany into *Medicines of the Past, Medicines of the Present* and *Medicines of the Future.*

Such an amazing turn-about has taken place in a quarter of a century that it is not easy for us fully to comprehend the far-reaching implications of the change. Perhaps it is even more difficult for the scientist who is close to the Plant Kingdom — especially a botanist who was fortunate enough to spend many years in the field in intimate association with rich tropical floras. He cannot help being thoroughly overwhelmed with the vastness, the boundless variation, the intricate adaptations, the potentialities of undiscovered constituents of the Plant Kingdom. Familiarity with such a welter of complexity can, of itself, relegate into a truly minor place the relationship between man's ills and the grandeur and universality of the vegetal world.

When I was a graduate student, seeking material for my doctoral thesis amongst Indians isolated in the mountains of Oaxaca, Mexico, I could find no pharmaceutical house in the United States with the time or interest to investigate witch-doctors' plants, and I was forced to send my material to Sweden to the late Dr. C. G. Santesson who, since he was retired, could study whatever it pleased him to investigate.

Now every pharmaceutical house of any size and seriousness has become newly conscious of the Plant Kingdom.

Colleges of pharmacy turn to the vegetal world for problems for doctoral students. Government agencies keep an alert eye on promising openings for research into plant drugs. And this forward step has opened up almost limitless vistas for both academic and practical research programmes.

Yet everything indicates that we are still far from grasping the potentialities which lie before us. We are hesitant to grasp the reality, perchance, just because we can see no bounds. It is this opportunity — never before given to man and fraught with such imponderable promise — that I want to consider.

Perhaps it may be interesting in the beginning to review a few simple figures to bring into higher relief this great opportunity of which I speak. I looked back into my college notes the other day and found that, in 1935, of the ten drugs then in most common use, only two (digitalis and codeine) were of vegetal derivation. The percentage of drugs of plant origin recognized by the United States Pharmacopoeia was steadily declining, whilst that of chemical drugs was steadily increasing. In 1820, our first Pharmacopoeia listed 223 plant drugs; a century and a quarter later, in 1946, the Pharmacopoeia and National Formulary enumerated 244. This would seem to indicate a slight increase, but it is not an indication of their relative importance. For, in 1820, 82% of the medicines listed were of plant origin, 15% of chemical, 3% of animal; in 1946, 38% were vegetal, 56% chemical, 6% animal. To-day, only about 100 of the original 223 are still in use, but these include the "blue-chips" that have paid good dividends in health since earliest times. Perhaps, in passing, it might be interesting to compare this total of 100 plant drugs now in use with the 3800 species recommended medicinally by John Parkinson, the last British herbalist, in his "Theatrum Botanicum" of 1640.[2]

Now, since we are using but 100 of the original 223 drugs of plant origin, how can we be sure that we should delve so deeply and with such great hopes into the Plant Kingdom

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[2] Parkinson, John: "Theatrum Botanicum. The theatre of plantes" (1640).

for new medicines? And when we realize that from 1900 to 1940 only about five new plant drugs were added to our list: Strophanthus, agar, chaulmoogra, Ephedra and Psyllium — what should we think then?

But from 1940 to 1960, a minor miracle has come to pass. As the result of new methods of analysis and refined techniques, many new drugs have been discovered and new uses have been found for some of the older drugs. To-day, 75 to 80% of the drugs most frequently prescribed are recent additions to our pharmacopoeias; most of them, in fact, were unknown in 1940. As a direct result of this rash of discovery, our tempo of research has been steadily accelerated, yet the frontiers for discovery have hardly been touched.

The organic chemist might differ with our predictions, since he may believe that it is only a question of time before everything will be synthetic and that chemistry alone will dominate the field of new drug discovery. No one can deny that great strides have been made in organic synthesis. Many plant drugs have been produced synthetically (witness camphor and quinine) or closely allied substances, sometimes more effective and efficient, have been made (such as aspirin vs. oil of wintergreen, novocaine vs. cocaine). Alkaloids, the active principles of so many drugs, have long baffled the chemist. It took 134 years to synthesize morphine, and production is still in the pilot-plant stage. Fifty-eight years elapsed after atropine was first synthesized before it could be done on a large scale. All of this means that the opium poppy and the belladonna plant are still very much with us.

Yet it is not that we would look to the Plant Kingdom as a commercial supply of our drug compounds, unless it be more economical to isolate them from plants than to produce them synthetically. We should look upon the Plant Kingdom as an almost untapped arsenal of ready-made compounds which, once isolated and understood, can serve us in at least three ways: 1) directly as medicinal agents; 2) as starting points for the elaboration of more complex compounds of therapeutic value; and 3) as academically interesting or stimulating exercises.

II. *The Plant Kingdom*

Since the vegetal world does present this widening panorama, let us start at the beginning and take an appraising look at the Plant Kingdom. Just what does the Plant Kingdom offer?

The most diverse of organisms make up the Plant Kingdom: the Bacteria, Algae, Fungi, Bryophytes, Pteridophytes and Spermatophytes. All told, there may be as many as 800,000 species in the Plant Kingdom. It is hard to appreciate how extensive a field this represents, but it is easy to realize how truly marginal our phytochemical knowledge of this vast assemblage must be.

Estimates, naturally, are subject to appreciable variation, and calculations of the number of species can, of course, be made with greater precision in groups of plants which have been thoroughly studied taxonomically. This means that we are in a better position to calculate how many species of spermatophytes there are than bacteria. Estimates vary, again, with the outlook of the taxonomist, but when we consider the Plant Kingdom as a whole, the personal equation — what sundry taxonomists accept as species limitations — is more or less balanced out.

We do not have a clear idea of how many species of Bacteria there are. This is partly because they have been less thoroughly studied than most other groups of plants and partly because they are often known more from their physiological effects than from structural characteristics. Modern estimates[3] give approximately 1500 species in about 200 genera. The bacteria are, of course, of intense importance in medicine as the causative agents of many ills, but a disappointingly small number of therapeutically promising compounds have been isolated from them.

Estimates for the Fungi have varied from approximately 30,000 to 85,000 species. One of the most recent workers[4],

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[3] Thimann, K. V.: "The life of bacteria — their growth, metabolism and relationships" (1955).

[4] Martin, G. W.: "The numbers of fungi" in Proc. Iowa Acad. Sci. 58 (1951) 175.

however, has written that 100,000 may be highly conservative and that the total may well be over 200,000. Another contemporary worker[5] states that "it seems reasonable to predict that, as more facts are accumulated . . . the fungi will eventually be recognized as bearing the same relationship to the Plant Kingdom (on the basis of numbers of species) as insects bear to the Animal Kingdom." Now the fungi are extraordinarily important to man; but, as sources of medically active compounds, they have, until recently, been of strangely minor significance. The ergot alkaloids come immediately to mind as very old fungal medicines. But the rise of the antibiotics, beginning with the development of penicillin in the early 1940's, has brought into sharp relief as a source of new drugs not only the fungi but the related actinomycetes. The very recent work with hallucinogenic mushrooms and the isolation from them of phosphylated indole derivatives never known to occur in plants has turned our eyes towards this much neglected section of the fungi and may, one day soon, produce spectacular and highly practical medical results. Furthermore, the study of fungi as allergens is still in its infancy and promises many new avenues of approach in research. I cannot tell you how many species of fungi have as yet never been subjected to chemical study; but, if we accept the estimate of 100,000 species for this group of plants, we can easily appreciate the widening panorama here awaiting the attention of our research scientists.

That most varied of plant groups, the Algae, numbers about 19,000 species[6]. Here is a vast and hardly touched field for phytochemical investigation. Since most of the algae are aquatic, many of them marine, the problems as well as the opportunities awaiting us must be both numerous and unique. Only a beginning has been made in the search for medically promising chemicals from the algae.

When we come to that interesting symbiotic group, the Lichens, we find that startling advances have likewise been

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[5] Gray, William D.: "The relation of fungi to human affairs" (1959).

[6] Bold, H. C.: "The plant kingdom" (1960).

registered in recent years. The newest estimates give the lichens some 450 genera and 20,000 species[7]. Since 1944, the bacteria-inhibiting properties of a number of lichens have been noted. In fact, about one-half of the temperate zone lichens have this property, due to lichen acids which can inhibit gram-positive bacteria and even the tuberculosis bacilli and some fungi. Lichen antibiotics are now used commercially in medicinal salves in northern Europe, especially in Finland, Russia and Germany, and there is every reason to believe that the lichens may supply more as well as more diverse antibiotics as research continues. The Japanese are extremely active at the present time in the investigation of chemical components of the lichens.

The Bryophyta, characterized as "a constellation of divergent groups rather than as a homogeneous division or phylum",[8] has been severely neglected in phytochemical investigation. Comprising some 14,000 species and being world-wide in distribution, the bryophytes promise interesting results from a concerted study of their chemical constituency.

When we come to the so-called "higher" plants, the Pteridophyta and the Spermatophyta, we see again the potentialities of a widening panorama, for here we have a significantly large and diversified group of plants.

The pteridophytes — ferns and fern allies — have given us a few folk remedies, but they have been disappointingly parsimonious in contributing to modern medicine. Here is a field, however, which, since it has not been granted the intensive phytochemical efforts that have characterized other groups of the higher plants, may hold hidden surprises. The 250 genera and nearly 10,000 species of ferns and fern allies[9] deserve closer chemical scrutiny, especially those which are known to have outstanding folk uses in primitive societies.

We come now to the seed plants or Spermatophyta, the

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[7] Lamb, I. M.: Personal communication.

[8] Steere, W. C.: "Bryophyta" in "The encyclopedia of the biological sciences" [Ed. P. Gray] (1961) 177-179.

[9] Tryon, R.: Personal communication.

dominant land flora of our present geological epoch. The two Spermatophyte groups, the gymnosperms and the angiopserms, show extreme disparity both in their size and in what they have given to medicine.

There are some 65 genera and 700 species of gymnosperms,[10] from which, in the United States, we use only about two dozen official and unofficial drugs[11] — and these mainly for their volatile oils or resins. Would not a renewed phytochemical attack, utilizing improved techniques, upon this ancient group of spermatophytes seem to be warranted?

It is the angiosperms, above all other groups of plants, which have occupied man's attention from earliest times in his search for medicines. This is easy to understand. The angiosperms are not only numerous, but they are conspicuous and, even to-day, take a position of primacy in the popular concept of the Plant Kingdom. Most of our plant remedies of the past and a very substantial number of the newer advances in medical botany have been made from the angiosperms. Since it is my belief that the potentialities have only been superficially explored, even in this best known part of the Plant Kingdom, I shall discuss somewhat more fully the width of the panorama which the angiosperms present.

It may surprise those who are not taxonomic botanists to hear that no one knows really how many angiosperms there are. Even though the angiosperms are better understood than other groups of plants, estimates vary significantly, and one sometimes wonders: May not even our highest estimates be seriously deficient? Estimates vary greatly, but the figure usually accepted is in the neighbourhood of 200,000 species[10, 12] in some 300 families and some 10,500 genera. The monocotyledons usually are credited as comprising about one quarter as many species as the dicotyledons.

Having spent more than a decade in field work in the Amazon basin and in the northern Andes — one of the richest floristic areas of the world — I have now for some time

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[10] Lawrence, G. H. M.: "Taxonomy of vascular plants" (1951).

[11] Youngken, H. W.: "A text book of pharmacognosy", Ed. 4 (1936).

[12] Ames, O.: "Economic annuals and human cultures" (1939).

given serious thought to this estimate. I am led to the conclusion that we are greatly underestimating the species-wealth of the angiosperms.

I once began to formulate my ideas about the number of species in the flora of the Republic of Colombia. After marshalling many facts and opinions and screening the results of past and current plant exploration, I was obliged to place my census of Colombia's flora in the neighbourhood of 50,000 species of higher plants. Even though Colombia is recognized as one of the two or three richest phytogeographic areas of the world, this calculation at first frightened me. Nevertheless, I published it, together with my reasons for arriving at such a figure.[13] The reaction from botanists was, in general, very favourable.

Now, if we hold to a figure of only 200,000 species of angiosperms, Colombia would then have one quarter of all the world's flowering plants. As rich an area as Colombia is, it cannot be that rich. Then, let us look at it from another vantage point: the Orchidaceae is the largest phanerogamic family, with an estimated 25,000 to 30,000 species; and the next largest family is the Compositae with some 20,000 species. If two of the 300 angiosperm families add up to about 50,000 species, must we not alter our estimate of the total number of flowering plant species? In other words, do these two families comprise one quarter of all the angiosperms? And let us not forget that every exploration beings back species new to science. I have, for myself at least, made the indicated statistical alteration and have felt for a long while that we must allow somewhere near half a million species, instead of 200,000 for the flowering plants. The future — and the very near future, I believe — will justify this point of view.

III. *Plant Constituents*

Perhaps the alkaloids are, to medicine, the most impor-

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[13] Schultes, Richard Evans, "La riqueza de la flora comombiana" in Rev. Acad. Col. Cienc. Exact. Físico-Quím. Nat. 8 (1951) 230. — "Hacía un censo de la flora de Colombia" in Univ. Nac. Col., no. 23 (1958) 77.

tant constituents — and certainly they are one of the most widespread — in the plant world, even though we cannot forget the glycosides, essential oils, gums, mucilages, tannins, fatty oils, colouring matters, resins and other types of chemical substances which man has sometimes found useful therapeutically. There is no question that the Plant Kingdom has yielded an amazing variety of products in this field and, as chemical methods and laboratory techniques become more sophisticated, we can see no end to the useful materials available from the thousands of species as yet untouched.

Notwithstanding the vast amount of research that remains to be done, perhaps more chemical and medical work has been carried out on alkaloids than on any other kind of plant constituent. A recent and most thorough compilation of alkaloids[14] enumerates 3671 species of plants (including cryptogams) in which alkaloids have been found. Not all of these have been structurally identified. Some of them are undoubtedly "duplicates" — alkaloids which may be shown to be identical to others. In the flowering plants, certain families are known to be rich in alkaloids, but even in these families the figures indicate only partial study. Two good examples are the Leguminosae, a family of at least 15,000 species, in which 1525, or about 10%, are listed as having alkaloids; and the Solanaceae, with upwards of 2500 species, where 252, or again only 10%, are alkaloid-bearing. About 10% of the known alkaloids have been recorded from one family, the Apocynaceae, as a result of the effort initiated by Rauwolfia investigations during the past ten years. From the chemist's point of view, there are other families in which a concentration of work, if it could be justified on other than purely academic grounds, would likewise yield large numbers of compounds. And probably an equally large variety of structures would appear as well.

The potentialities are obvious. To-day our techniques of alkaloidal detection — as well as tests for other types of constituents — are greatly improved. A recently perfected

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[14] Williams, J. J. and Bernice G. Schubert: "Alkaloid-bearing plants and their contained alkaloids", U. S. D. A. Techn. Bull. no. 1234 (1961).

spot test for alkaloids,[15] which can be applied to fresh plant material in the field or to fragments from herbarium specimens, promises rapidly and widely to extend our knowledge of the distribution of alkaloids in the higher plants. It will not, of course, tell us what kind of alkaloid is present; that must await more detailed examination. But it will tell us whether or not an alkaloid is present. The potentialities offered by this simple spot test can hardly be over-emphasized, for it opens up for quick and easy preliminary study all the spermatophytes and some other plant groups.

One American pharmaceutical house has tested some 15,000 to 20,000 species for alkaloids.[16] On a random basis, about 15% would have been found to be alkaloid positive, but, since certain families (Solanaceae, Papaveraceae, Amaryllidaceae, etc.) with alkaloids of well known structure were eliminated, the percentage would run probably about seven or eight of positives. In any case, about half of the 15% are suspected of possessing alkaloids in such minute amounts as to preclude a practical study of their chemistry or pharmacology. About half of the remainder contain some previously recorded alkaloid. Thus, we are left with about 4% of the species examined with possibly new alkaloids, hence potentially new medicinal agents. This means at least 8000 new alkaloids, more than three times the number now known, remain to be discovered.

I have stressed the alkaloids, but we must bear in mind that alkaloids are not the only plant compounds of interest to medicine. There are another 3000 non-alkaloidal plant principles of known structure, many of which have or have had some application in or bearing upon medical problems. These include about 150 cardiac glycosides of the types which have been used as starting material for modern syntheses of the steroid hormones.

IV. *Methods of Investigation*

Now, this brings us face to face with the question: How

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[15] Raffauf, Robert F.: "A simple field test for alkaloid-containing plants" in Econ. Bot. 16 (1962) 171.

[16] Raffauf, Robert F.: Personal communication.

can we take fullest advantage of this widening panorama? There is only one answear: *Exploration.*

Exploration to hasten the widening of our panorama in medical botany may be done in the literature, both the ancient and the modern; in the herbarium; and in the field. And exploration for our present purposes had best be done along all three lines simultaneously.

The literature of the ancients, the herbals of mediaeval Europe and the writings of modern anthropologists, travellers and missionaries must still be treated as repositories of much uninvestigated information. We should never pass quick judgment on statements in any of this literature concerning plant uses simply because they seem to be ridiculous. To do so might cause the loss to science, at least for many years, of plant medicines of supreme importance. This has happened frequently. Had we seriously studied the Egyptian papyri, we might many years ago have found a hint to the anti-bacterial activity of certain actinomycetes or fungi. And, had the ethnobotanical references in the chroniclers of post-conquest Mexico been seriously studied, we would not have had to wait until this past quarter century for a knowledge of the hallucinogenic mushrooms and morning glories. It is, nonetheless, true that this literature must be employed with wise restraint, since much of it may be scientifically unsound. To base an entire programme of research on literature alone, as some pharmaceutical houses are doing, appears to me to be a highly suspect *modus operandi.*

Recently, our herbaria have come into their own as sources of ethnobotanical observations made in the field by plant collectors of the past. These reports have several advantages. Unlike much of the literature, they are, in great part, firsthand; they are attached to an actual plant specimen, and there can be, therefore, no problem concerning the proper identification of the plant; the ethnobotanical data are anchored down, through the information on the specimen label, to a definite locality and oftentimes to specific peoples who employ the plant. The vastness of our herbarium resources has hitherto not fully been recognized. The Harvard

University Herbarium, for example, has a total of some 2,200,000 sheets. There is now underway a project consisting of a sheet by sheet search for records of medicinal uses amongst primitive peoples.[17] It appears probable, on the basis of the first six families studied, that we may find in the entire collection in the neighbourhood of some 3700 notes of interest. If we vouchsafe that about half of these may be unpublished or new to science, there remain for investigation about 1800 reports. We know that about 40% of the notes — or about 720 — are specifically medical. And we may be justified in assuming that about half of these — or 360— might prove to be of some real interest to pharmaceutical science. This may give us some inkling into the panorama as seen from the point of view of our herbarium resources.

The herbarium may assume an even greater "exploratory" importance with the application of the spot test for alkaloids which can be made upon very small fragments. Here we have assembled in dried form material of most of the higher plants and from the farthest corners of the globe, and a drop of reagent on a few scraps can, in a few minutes and in the quiet of our own laboratories, tell us whether or not there are alkaloids in a tree from the Tibetan Himalayas, a shrub from driest Australia or a liana from the muddy banks of the Amazon.

But field work still offers our very best opportunity of discovering new physiologically active substances.

Because I am emphasizing the ethnobotanical aspects of field work, I must mention the rather generalized tendency in both popular and scientific circles to over-emphasize the importance of folk medicines. Notwithstanding the fact that primitive peoples *do* possess valuable understanding of plant properties, their knowledge has been optimistically exaggerated in the past and is far from being complete. It, therefore, behooves us to carry out our own phytochemical studies of the flora in general in the field, and this is probably best done

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[17] von Reis, S.: "Herbaria: sources of medicinal folklore" in Econ. Bot. 16 (1962) 283.

along two paths: 1) intensive examination of families and genera known to be rich in active principles and 2) a systematic examination, species by species, of a random sampling of floras. I cannot take up this most interesting and promising type of exploration for lack of space but I do want to keep its fundamental importance in mind throughout our consideration of other aspects of the medico-botanical panorama.

Perhaps the most satisfying way of advancing our knowledge of medicinal plants is direct investigation amongst primitive peoples, and I shall discuss this aspect of our research, endeavouring the while to avoid exaggeration of its importance or of suggesting that it has any special exclusivity or primacy in ethnobotanical research.

The discovery of some drug plants has been attended by exciting adventure. Knowledge of others was gained from travel incidental to "conquest, colonization or religious conversion".[18] Still others have been found through the efforts of individuals or groups specifically sent out to learn of their identity and use.

There is a tendency now to send out expeditions exclusively to discover new drug plants. There is historical precedence for this procedure. Shortly after the conquest of Mexico, Philip II of Spain sent his personal physician, Dr. Francisco Hernández, to the new realm to study its medicinal plants, animals and minerals. After field work from 1570 to 1575, he had finished 16 folio volumes containing an unbelievable wealth of native medical lore. What has been published of his work is still replete with uninvestigated opportunities for modern scientists.[19] This represents undoubtedly the first *offiicial* purely scientific expedition in history, and it was sent out for the sole purpose of trying to capitalize on the medical knowledge of the conquered peoples of a country rich in natural history.

In 1714, Peter the Great ordered the establishment of the Apothecaries' Garden in Russia and commissioned the Ger-

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[18] Cheney, Ralph H. and B. L. Milana: "Medicine and plant exploration" in Am. Journ. Pharm. 119 (1947) 323.

[19] Hernández, Francisco: "Rerum medicarum Novae Hispaniae thesaurus . . ." (1651).

man botanist Messerschmidt to collect the medicinal flora of Russia between 1720 and 1727. We could cite other examples in historic times where the search for drug plants was the unique purpose of an expedition.

There were other expeditions, however, which set out to study the flora in general, the useful plants as well as those which were not employed. Most of the truly outstanding explorations were of this kind. The work of the 17th Century Dutch botanist, Rumphius, basic to natural history research in the East Indies, could be cited,[20] for he wrote about the native uses of more than 700 plants. We could mention the three botanical expeditions sent out in the late 1700's by the King of Spain: Sessé & Mociño to Mexico; Mutis to Colombia; Ruíz & Pavón to Peru. All of these expeditions gave very special attention to folk-medicines while studying general floristics.

Although we have returned to the custom of sending out expeditions exclusively to search for new drug plants, I am not at all convinced that this is usually the most efficient way of working in the field. It may be the quickest and most direct way, when we are after a specific drug, the identity of which we know and about which we have a large fund of ethnobotanical knowledge. But to visit an area in the hope that a brief sojourn amongst natives will uncover their plant remedies — no; we should not be so sanguine.

Many of our official drugs have come incidental to the work of individual botanists busy with some larger project, and I am convinced that most of the new discoveries will be made by botanists, ethnobotanists or anthropologists engaged in leisurely fashion in their own research rather than by expeditions sent out "to find new drugs". And we must not minimize or overlook the role which the layman has played in this work, both in the past and in the present.

Perhaps because my own expeditions were carried out in this way, I hold out greater hope for success for resident work amongst native peoples, which does not unduly emphasize the search for drug plants. Few botanists, I realize, are

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[20] See De Wit, H. C. D. [Ed.]: "Rumphius memorial volume" (1959).

fortunate enough to spend an almost uninterrupted twelve years in the field. Long residence in one region most certainly enhances opportunity for ethnobotanical discovery through the creation of a rapprochement with natives, a familiarity with their languages and customs and an intimate knowledge of the flora itself. Few botanists, I realize further, are fortunate enough to work in such an ethnobotanically rich and untouched area as the northwest Amazon. And I realize, finally, that, in such a virgin area as the northwest Amazon, any naturalist of long residence could not but uncover both botanical and ethnobotanical rarities and novelties.

Like most primitive peoples, the Amazon Indian cannot comprehend any purely academic interest in plants. His only understanding is of their utilitarian or magical value. The botanist who works amongst them is easily accepted, for here is a man who spends all of his time collecting plant specimens. The native lives intimately with his plant environment. Consequently, from the start, the botanist has a common interest with the native.

During my twelve years in the Amazon, I made some 24,000 collections of the Amazon flora. Only a small fraction were reputedly medicinal. If an Indian helper asked, during my collecting activities, why I wanted a certain plant, the only explanation which he could understand was that I needed it for a remedy. Now, the very fact that he asked about *that* particular plant, and no other at the moment, indicated that perhaps he had a medicinal use for it and wanted to see if his use and my reason for wanting it coincided. In such a case, I would contrive the next day or so to collect the same species farther up stream, followed a few days later with another collection — all the while saying nothing about the plant. If it were really a plant of utilitarian importance to the native, he would most certainly, after seeing me collect it several times, begin to discuss it. This "cat-and-mouse" technique uncovered many ethnobotanical facts which, had I pressed impatiently at the start, would not have been divulged.

When I first went into the Colombian Putumayo in 1941, I was anxious to identify botanically "yoco", a plant employed by the Indians as the source of a strong stimulant known for years only by its vernacular name. Persistent research for nearly a year failed to uncover a flowering or fruiting specimen of the liana which clambers through the crowns of 100-foot jungle trees. I had alerted Indians far and wide of my need for flowers of yoco. Finally, after eight months, serious leg ulcers from work in inundated forests forced me to go to a small Colombian naval base on the Putumayo River to await a hydroplane to civilization. The clean accommodations offered me on a river gun-boat by the officers were so pleasant that when an Indian, who had paddled downstream in search of me, reported that he had seen the liana in flower, I was reluctant to leave. Yet intuition told me that I should, so back I went two days upstream and a day through flooded swamp-forest. Locating the liana, the ground under it strewn with minute white flowers, we had to fell seven trees to bring it down. But we were rewarded in being able to establish the identity of the elusive yoco, later shown to be rich in caffeine, as an undescribed species of the sapindaceous genus *Paullinia*.[21] This experience is indicative of the interest and loyalty which I found at all times amongst the Indians of the region. I cannot subscribe to the widespread belief that he regards his plant lore as something secret zealously to be guarded and that civilized man must pry it from him by ingenious duplicity.

A sympathetic understanding and tolerance of his beliefs and ways and a participation in his customs do more than anything else to win the Indian's respect and confidence. I naturally learned to chew his coca and, finding it to be not only a pleasant but a most helpful custom, used it for eight years myself. This may explain perhaps why certain Makunas of the Apaporis River, where I spent a total of some three years, told me of a remote and isolated group of Tanimukas which prepared a superior type of coca. Finally making a trip to investigate this report, I learned of a most

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[21] Schultes, Richard Evans: "Plantae Colombianae II" in Bot. Mus. Leafl. Harvard Univ. 10 (1942) 301.

ingenious method of infusing into coca powder the acrid incense of the resin of the tacamahaca tree *(Protium heptaphyllum)*, one of the few variations ever found in the preparation of this widespread narcotic masticatory, the source of the alkaloid cocaine.[22]

Anthropological writings indicate (but we now know that they are in error) that the narcotic snuff yopo, prepared from the seeds of Piptadenia, is employed throughout the upper Orinoco and much of the Amazon basin. I was puzzled, however, by my failure to encounter a single tree of this plant in the northwest Amazon. Yet the witch-doctors employed a highly narcotic snuff which was not tobacco. What could it be? Had I been insistent, I might never have known. After nine years, one of my Puinave boys, himself the son of a medicine-man, suddenly said one day: "This is the tree that gives yakee snuff." Controlling my excitement, I showed only mild interest. We decided to prepare snuff from it. From strips of bark, the boy scraped off a reddish exudate, mixed it with water, boiled it down in four hours to a thick syrup which he allowed to sun-dry. The resulting solid, pulverized and mixed with bark-ashes of a wild cacao tree, gave us the snuff. Since I believe in experimenting with these plant products personally in the field, I took one-quarter the dose normally snuffed by a medicine-man to produce the psychotomimetic effects essential for his divination and diagnosis of disease. I was ill in my hammock for several days, so strong was the snuff. Strangely enough, the source of yakee snuff belongs to the myristicaceous Virola and is, therefore, related to our nutmeg, which has itself been employed as a narcotic.[23]

The moral from this experience is that patience will usually pay good dividends in this kind of work, but time for such patience is not to be had on the usual expedition set up with the purpose of looking for medicinals and nothing else.

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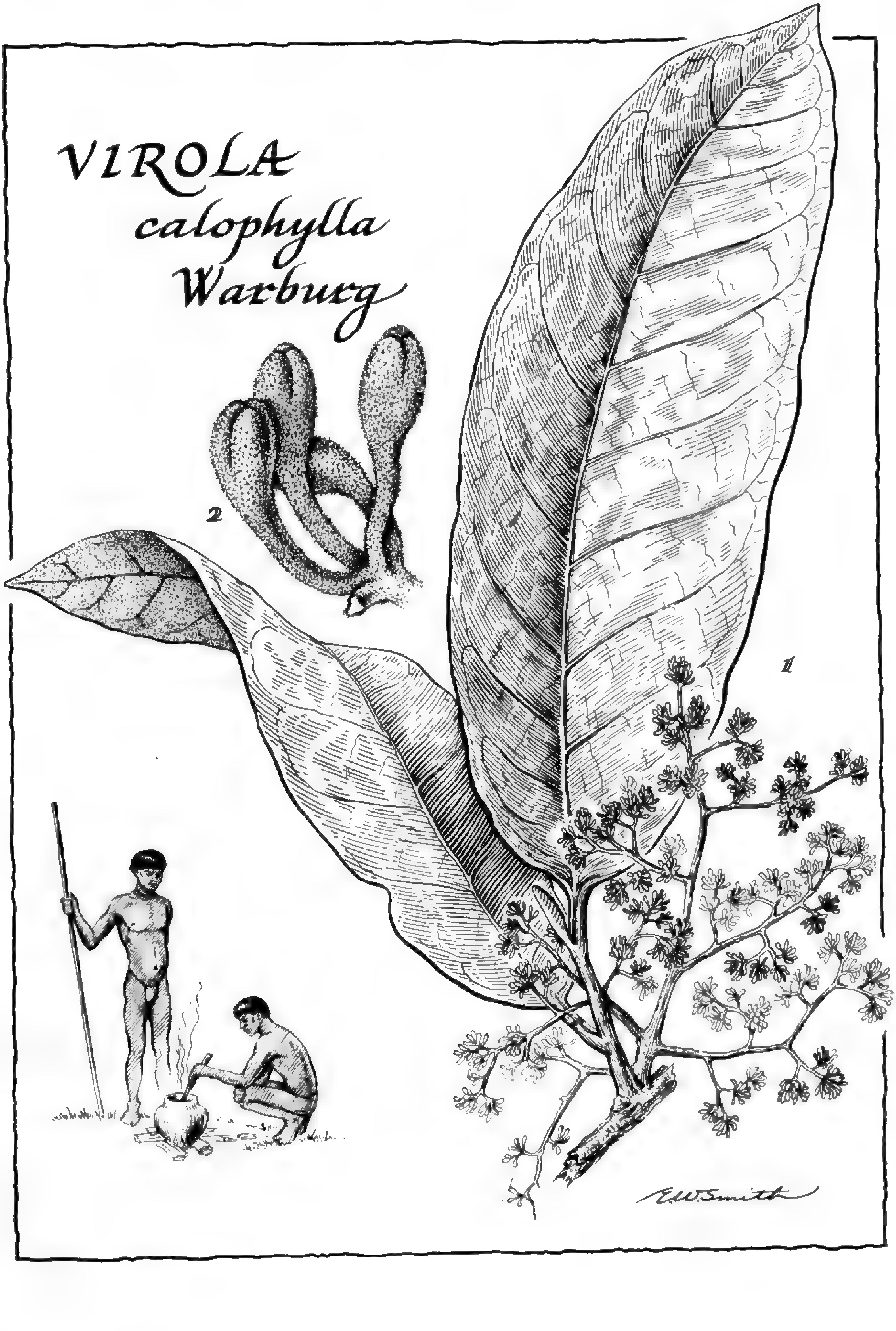
[22] Schultes, Richard Evans: "A new method of coca preparation in the Colombian Amazon" in Bot. Mus. Leafl. Harvard Univ. 17 (1957) 241.

[23] Schultes, R. E.: "A new narcotic snuff from the northwest Amazon" in Bot. Mus. Leafl. Harvard Univ. 16 (1954) 241.


VIROLA
calophylla
Warburg
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E.W. Smith

I might go on in such a vein, telling how, without prying or seeking to outwit the Indian, knowledge of folk-medicines accumulated along with my general botanical work. I could relate the unexpected circumstances which led me to information about plants employed as styptics, to treat conjunctivitis, as snake-bite remedies, in treating burns — not to mention the many everyday uses such as carminatives, febrifuges and purgatives. I could tell about the fascinating detective work with curares which uncovered for the first time the use as a basic arrow poison component a species of Thymelaeceae, *Schoenobiblus peruvianus*. Or I might relate how participation in native dances and rituals when hallucinogens are taken gave me a deeper understanding of the extensive use of the numerous vision-producing narcotics of the region, some hitherto botanically unknown. I might explain how there are still psychotomimetic agents lurking unidentified in these forests for future study. It might be interesting to discuss my work in Mexico on the sacred Mexican mushrooms and on the narcotic morning glory, *Rivea corymbosa*. It would be interesting to relate the circumstances which led me to identify three species of aroids used in different tribes in various parts of the Amazon of Colombia as oral contraceptives. I could occupy many pages discussing the many poisonous plants, some of them species new to science, known and used by these people. But the panorama is too vast to allow a discussion of all of its details.

V. *Final Considerations*

This widening panorama — can we avail ourselves of it? The answer, at the present time, is: "No". The reason is simple: we do not have the trained man-power for the effort. There is no reason why we cannot rectify this short-coming, and there are vaguely discernible signs that perhaps we are beginning to take steps in this direction.

There is an urgency to our training of the needed corps of investigators.[24] Civilization is on the march in many, if not

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[24] Schultes, R. E.: Tapping our heritage of ethnobotanical lore" in Econ. Bot. 14 (1960) 257.

SCHOENOBIBLUS
peruvianus
Standl.

most, primitive regions. It has long been on the advance, but its pace is now accelerated as the result of world wars, extended commercial interests, increased missionary activity, widened tourism. The rapid divorcement of primitive peoples from dependence upon their immediate environment for the necessities and amenities of life has been set in motion, and nothing will check it now. One of the first aspects of primitive culture to fall before the onslaught of civilization is knowledge and use of plants for medicines. The rapidity of this disintegration is frightening. Our challenge is to salvage some of the native medico-botanical lore before it becomes forever entombed with the cultures that gave it birth.

Though it is by no means an insurmountable task, it will not be the easiest accomplishment to prepare enough men thoroughly to cope with all the ramifications of the widening panorama in medical botany. They may be basically anthropologists, botanists, medical or pharmaceutical scientists, but they must have an interdisciplinary training. Here is where all of us, as members of teaching and training institutions, must contribute to progress in medical botany. We should watch for the student keen for this kind of research, appraise him of the sundry needs in the field and counsel him as to the best type of preparation and where it may best be acquired. This will demand on our part continual alertness and an imaginative flexibility in our counselling. We cannot now fail medical science, for never before has history offered us similar opportunities.

The task before us is big, but never, I am certain, have we had the human material, scientific tools and financial support more adequate to a frontal attack and, cognizant as all of us must be of the virgin fields that lie ahead, we must utilize these resources conscientiously and efficiently.

I cannot close with words more appropriate than those written in 1754 by the great Linnaeus himself in the preface to a museum catalogue.[25] In expressing what has been aptly described as his creed, words most appropriate for us as we

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[25] See Krutch, J. W.: "The gardener's world" (1959) 177.


GORDON W. DILLON
RIVEA
corymbosa (L.) Hall. f.

stand upon the threshold of great new advances, he said in part: "Man, ever desirous of knowledge, has already explored many things; but more and greater still remain concealed; perhaps reserved for far distant generations, who shall prosecute the examination of their Creator's work in remote countries, and make many discoveries for the pleasure and convenience of life. Posterity shall see its increasing Museums, and the knowledge of the Divine Wisdom, flourish together; and at the same time all the practical sciences . . . shall be enriched; for we cannot avoid thinking, that what we know of the Divine works are much fewer than those of which we are ignorant."

BOTANICAL MUSEUM
HARVARD UNIVERSITY

HELIANTHUS LAETIFLORUS AND HELIANTHUS RIGIDUS — HYBRIDS OR SPECIES?

SARAH CLEVENGER AND CHARLES B. HEISER, JR.

The identification of perennial sunflowers has long been a persistent source of difficulty, resulting in a large part from the blurring of species lines by hybridization. Through field and experimental studies, it has been established that interspecific hybridization between diploid members of the genus is common (see Heiser *et al.*, 1962, for references). In the present paper four hexaploid taxa, *Helianthus laetiflorus* Pers., *H. rigidus* (Cass.) Desf., *H. subrhomboideus* Rydb. and *H. tuberosus* L. are considered.

Although *H. tuberosus* has been accepted as a species by all who have worked on the genus, the other three taxa have been treated in a variety of ways. Watson (1929) recognized *H. laetiflorus* and *H. rigidus* as distinct species and considered *H. subrhomboideus*, a synonym of the latter; he also described two new species, *H. suberbus* and *H. severus*, which we feel should be referred to *H. laetiflorus*. Fernald (1946) recognized but a single species, *H. laetiflorus* and treated *rigidus* and *subrhomboideus* as varieties. Cronquist (1952) accepts but a single species, *H. laetiflorus*, and recognizes no varieties.

We would like to extend thanks to the curators of the following herbaria: University of Arkansas, Duke University, Gray Herbarium, Michigan State University, Missouri Botanical Garden, New York Botanical Garden, University of Wisconsin, and the United States National Herbarium. The distributions shown in the maps have been compiled from the specimens in these herbaria and the ones at Indiana University. We would also like to thank Prof. J. Leandri of the Museum National d'Histoire Naturelle, Paris, who furnished us with the photograph of the type of *H. laetiflorus*. Type material of *H. subrhomboideus* in the herbarium of the New York Botanical Garden has also been examined, but we have not yet been able to secure authentic material of *H. rigidus* and our interpretation rests on Cassini's original description. A grant to the senior author from the American Philosophical Society made it possible to examine certain European types. This research was also aided by a grant from the National Science Foundation to the junior author.

DISTRIBUTION: *Helianthus subrhomboideus* (Fig. 1) is a prairie plant widely distributed in Canada from Alberta east to Quebec and extending southward through the plains to western Texas and New Mexico. *Helianthus rigidus* (Fig. 2) is found in the central United States and in the northern and western portion of its range is sympatric with the preceding species. These two species may be found occasionally in the eastern United States as adventives or escapes from cultivation. The third taxon, *H. laetiflorus* (Fig. 3), has a scattered distribution in the central United States where it is usually associated with both *H. rigidus* and *H. tuberosus* and has a spotty distribution in the east, where it has been widely cultivated as a garden ornamental. Many plants of *H. laetiflorus* from the east are seed sterile probably indicating that they came from members of a single clone. The last species, *H. tuberosus*, (Fig. 4) has a wide distribution in central and eastern North America, broadly overlapping the areas of the previous two species, and extending into the range of *H. subrhomboideus* in the north central states. In general, it grows in somewhat wetter habitats than do the others. As the "Jerusalem artichoke," it has been widely cultivated and since it also readily escapes, it is practically impossible to determine its prehuman distribution. All of these species reproduce vegetatively from rhizomes or tubers and are quite aggressive, frequently bcoming established as escapes.

MORPHOLOGY: In their extreme forms, the four taxa considered here are quite distinct, but intergradations are frequent in nature. The principal features of each are given in Table I. Many characters, such as leaves, are extremely variable and, hence, it is difficult to give precise measurements. The phyllaries (Fig. 5) seem to offer the most stable

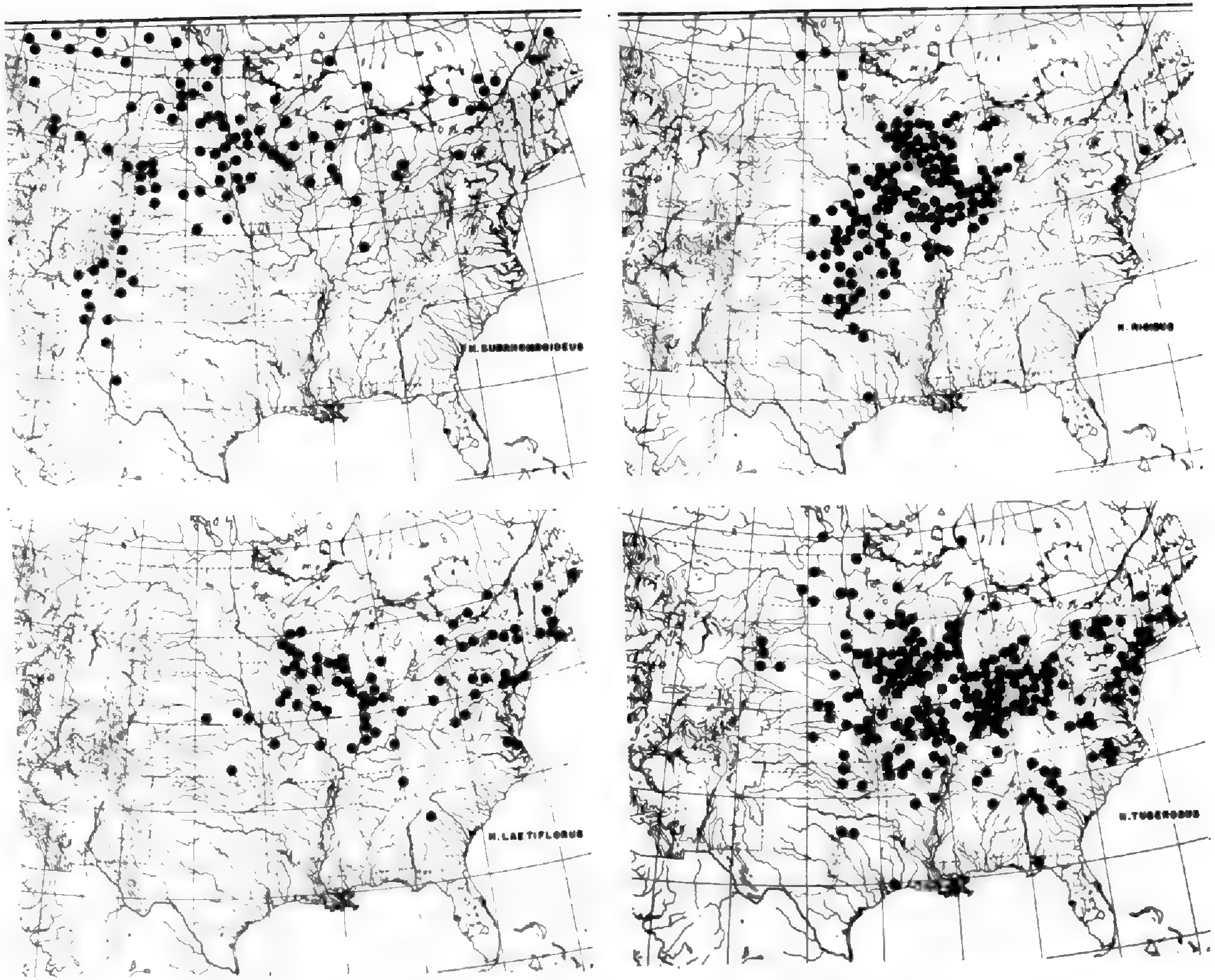

Figure 1-4. Maps showing the distribution of *H. subrhomboideus*, *H. rigidus*, *H. laetiflorus* and *H. tuberosus*. Base map used through the courtesy of Dr. R. E. Woodson, Jr. and the Missouri Botanical Garden.

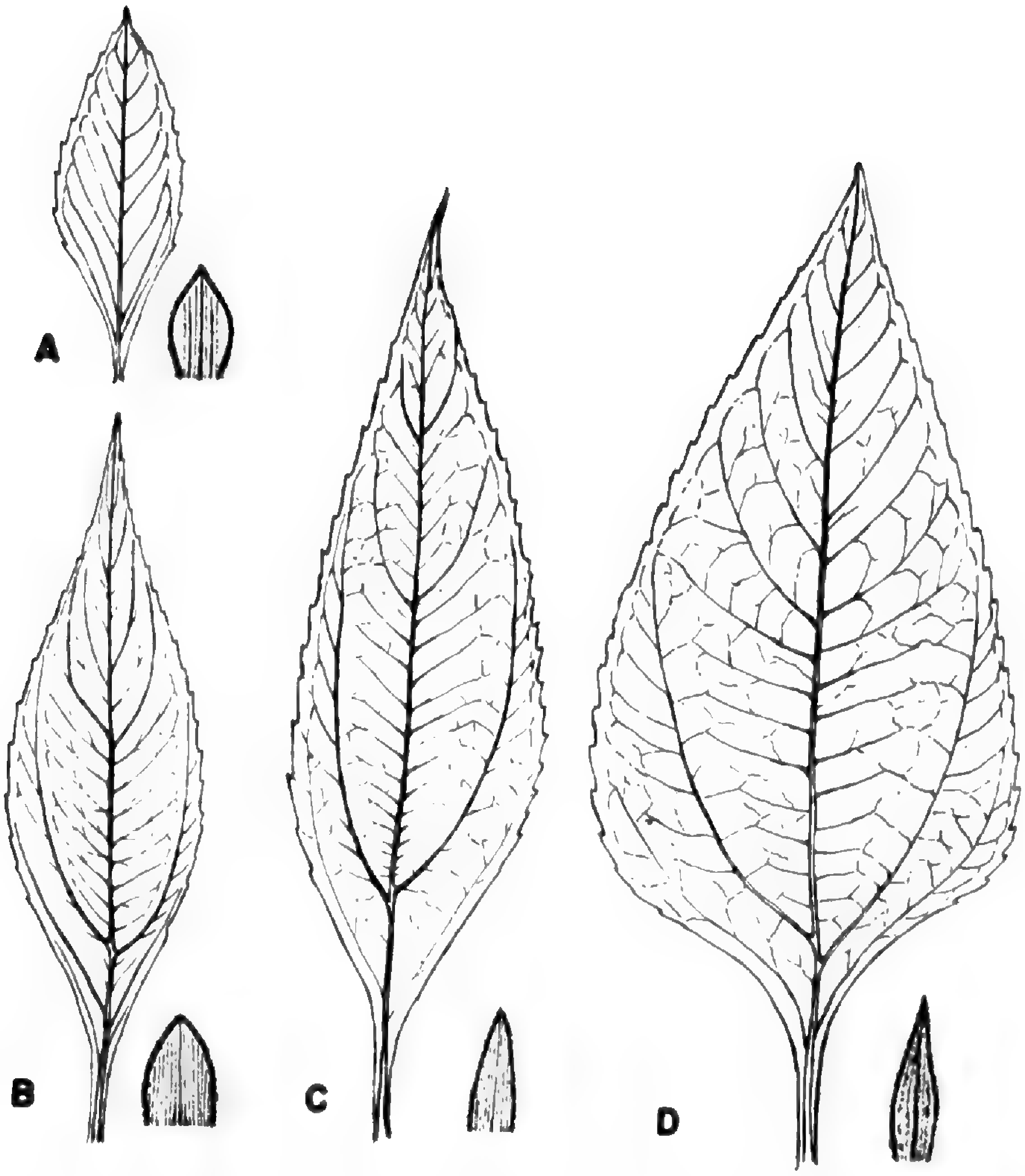

Figure 5. Leaves and phyllaries of *Helianthus subrhomboideus* (A) from *Heiser 3111; H. rigidus* (B), *Steyermark 9064; H. laetiflorus* (C), *Breitung 6154;* and H. tuberosus (D), *Ownbey 1166.* Leaves, × 2/5. Phyllaries, slightly enlarged.

characters, and perhaps are of the greatest value in delimiting the taxa.

From the table it can be seen that *H. subrhomboideus* and *H. tuberosus* represent the extremes. *Helianthus laetiflorus* has no unique features and is largely intermediate between *H. rigidus* and *H. tuberosus. Helianthus rigidus,* on the other hand, approaches either *H. subrhomboideus* or *H. laetiflorus* or is intermediate between them. A scatter diagram (Fig. 6), based on herbarium material, illustrates this situation for phyllary length and leaf length.

Artificial Hybrids: Reciprocal hybrids, excepting the

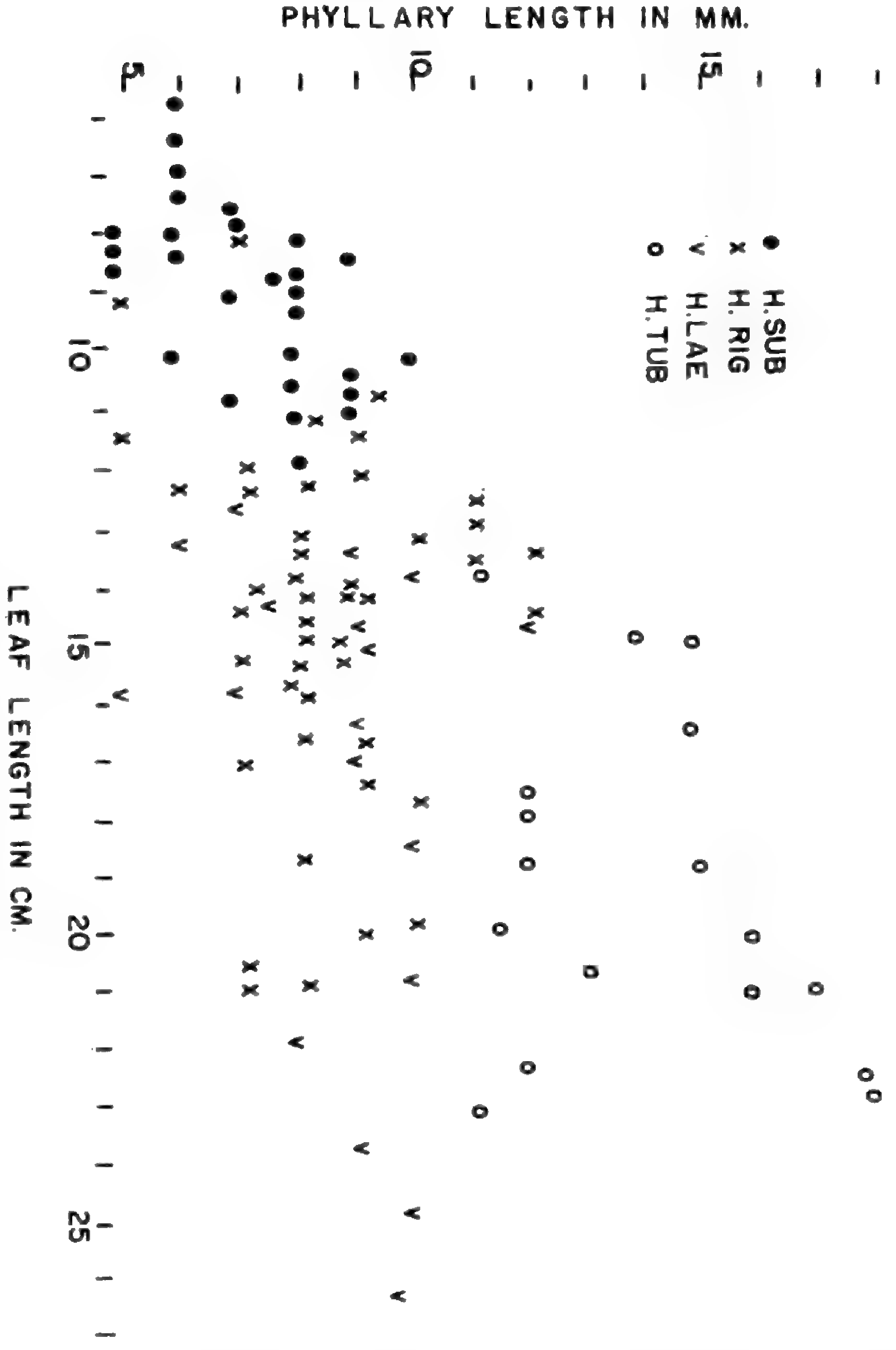

Figure 6. Scatter diagram showing the relation of phyllary length and leaf length in *H. subrhomboideus*, *H. rigidus*, *H. laetiflorus*, and *H. tuberosus*.

combination, *H. subrhomboideus* × *H. laetiflorus*, have been made involving the four taxa discussed above. All of the hybrids obtained were vigorous and fertile and largely intermediate morphologically with the exception of those so indicated below. Hybrids have also been made between sister plants and between different races of *H. subrhomboideus* and *H. tuberosus*, and all gave progeny closely resembling their parents. Since all of these species are normally self-incompatible, it has been impossible to obtain

TABLE 1
COMPARISON OF CERTAIN MORPHOLOGICAL FEATURES OF FOUR HEXAPLOID SUNFLOWERS

	H. subrhomboideus	*H. rigidus*	*H. laetiflorus*	*H. tuberosus*
Tuber	lacking	lacking	occasionally present	frequently present
Stem	usually simple	simple to branched	branched	branched
height	0.5-1.0 m.	0.8-2.0 m.	1.5-2.5 m.	1.8-2.6 m.
Leaves	opposite	opposite to alternate	upper alternate	upper alternate
surface	scabrous below	scabrous below	scabrous below	glabrous to puberulent or tomentulose below
length	5-12 cm.	8-27 cm.	12-25 cm.	14-23 cm.
color	grey-green to light-green	grey-green to light-green	grey-green to dark-green	dark-green
shape	linear to rhombic or ovate	lanceolate to ovate	lance-ovate	lance-ovate to ovate
petiole	very short	short to medium	medium	long
Peduncles	long, leafless	long, nearly leafless	medium long with reduced leaves	short, leafy
Disk-flowers	dark, red-brown	red, rarely predominately yellow	yellow or only slightly red	yellow
Phyllaries	tightly appressed	tightly appressed	appressed	loose, sometimes reflexed
shape	elliptical to oblong-ovate	oblong-ovate	oblong-lanceolate	lanceolate
pubescence				
margin	conspicuously ciliate	conspicuously ciliate	conspicuously ciliate	inconspicuously ciliate
surface	glabrous	glabrous	glabrous to pubescent	frequently pubescent
length	shorter than disk 5-10 mm.	shorter than disk, 5-12 mm.	equalling the disk, 5-12 mm.	longer than disk, 11-18 mm.

selfs. The small population size of most of the hybrid populations resulted from failures of seed germination which is not uncommon among perennial sunflowers. Herbarium specimens of the parents and representatives of the hybrid populations are deposited at Indiana University.

H. subrhomboideus × *H. tuberosus* (P29 x P59). The 15 reciprocal F_1's were largely intermediate, but with a leaf shape nearer *H. subrhomboideus* and phyllaries with acute tips similar to that of *H. laetiflorus*. Seventeen F_2 plants were secured which showed a variety of leaf shapes approaching, but not reaching the parental types. All had phyllaries similar to *H. laetiflorus* and the amount of stainable pollen varied from 70 to 95%. Most of the F_2 plants would have been identified as *H. laetiflorus* had they been collected in the wild. Meiosis in the F_1 showed mostly pairs with a few multivalents, which is similar to the pairing found in the parental species. An F_1 generation between P29 x P21 gave plants essentially similar to the above. In an F_2 of 29 plants of this combination most of the plants were nearer to *H. rigidus,* although some broad leaf and yellow disk segregation appeared. Thirteen of these plants showed considerable weakness and died before maturity.

H. subrhomboideus × *H. rigidus* (P79 x P147A). The seven F_1's were for the most part intermediate in morphology and fertile.

H. rigidus × *H. tuberosus* (P147A x P21). The three F_1 plants obtained were intermediate except for the leaves which were nearer to those of *H. tuberosus.* These plants were all fairly good matches for *H. laetiflorus.* An F_2 of 24 plants was grown and these were similar to the F_1 plants or closely approached *H. tuberosus* in appearance.

H. rigidus × *H. laetiflorus* (P147A x N3). The F_1 generation of twenty plants was fairly uniform, and the plants resembled typical *H. rigidus* except for the more leafy peduncles and variations in leaf shape and size.

H. rigidus × *H. laetiflorus* (P147A x B). Seeds for both of the parent plants came from the same population in White County, Illinois. Only three F_1 plants were obtained. Two of these were very similar to P147A, but the third had yellow disks and leaves resembling those of *H. tuberosus* in shape. In a second cross (P147 x Ar1) all of the 14 plants secured were more like the *H. rigidus* parent but one plant was completely sterile, two showed low pollen stainability (45 and 59%), and three were quite weak. A third combination (N3 x 147A) gave 11 plants which while showing some plant to plant variation were essentially similar to *H. rigidus* and were all fertile.

H. laetiflorus × *H. laetiflorus* (P147B1 x 2). Although this cross was made several times, only one seed was ever obtained. The plant secured from it was nearly sterile and had leaves resembling *H. tuberosus*, but with shorter petioles and a dense pubescence quite unlike that found in any of the species under consideration here. It is unlikely that contamination could have occurred, and moreover it is difficult to visualize any species that could have crossed with *H. laetiflorus* to produce such a hybrid. It is possible that the plant represents a type of recombinant which is not successful in the wild. More than 50 seeds were obtained in a cross involving two different accessions of *H. laetiflorus* (N3 x Ar1) but only one seed germinated giving rise to a fertile plant, approaching *H. rigidus* in appearance.

H. laetiflorus × *H. tuberosus* (P147B x P22). Thirty-seven F_1's, were secured, all of which appeared very similar to the *H. tuberosus* parent except for the slightly shorter phyllaries. Some of the plants showed reduction in seed set when intercrossed or backcrossed, but when open pollinated gave good seed set. Fifty F_2 plants were grown which gave segregates approaching the parental types as well as the plants similar to the F_1. A second cross of these two species (H408 x Ar1) gave only five seeds, one of which germinated to give rise to a plant with 93% pollen stainability and showing some features of both parents.

These crosses indicate that hybrids involving these four taxa are readily obtained, and that with the exception of certain crosses involving *H. laetiflorus* are fertile and vigorous. Moreover, it is clear that hybrids between either *H. subrhomboideus* or *H. rigidus* with *H. tuberosus* give plants resembling *H. laetiflorus*. It is unfortunate that more hybrids of *H. laetiflorus* × *H. laetiflorus* were not secured, but it does appear significant that neither of the two plants obtained from this cross resembled their parent.

PROGENY TESTS: P68. *H. laetiflorus*. Three plants were secured which showed considerable variation, particularly in regard to leaf shape and size. Plants of *H. tuberosus* are known to occur in the area and could have served as the pollen parent.

L1. The parent plant was somewhat intermediate between *H. tuberosus* and *H. laetiflorus*. One of the three offspring resembled *H. rigidus* and the other two approached *H. tuberosus.*

L2. *H. laetiflorus*. The 11 offspring produced little pollen but the stainability ranged from 60 to 90% with a mean of 79%. The plants all showed various combinations of characters of *H. laetiflorus* and *H. tuberosus.*

Although the pollen parent is unknown for all of these plants, they are of significance in showing either that natural cross pollination takes place between species or that *H. laetiflorus* shows segregation.

DISCUSSION: Although the four hexaploid sunflowers, *H. subrhomboideus, H. rigidus, H. laetiflorus,* and *H. tuberosus,* are quite distinct in their extreme form, they intergrade so freely that it is difficult to describe limits to these taxa. This blurring of the species boundaries could be explained by natural hybridization, and it is possible that two of the taxa, *H. laetiflorus* and *H. rigidus,* are of hybrid origin.

Plants which have been identified as *H. laetiflorus* could represent F_1 hybrids or hybrid derivatives of *H. tuberosus* × *H. rigidus* (or perhaps *H. subrhomboideus*). The evidence for this conclusion rests on the following: (a) *H. laetiflorus* has no unique characters, but combines various features of its putative parents; (b) artificial hybrids between the postulated parents can be obtained and would be classed as *H. laetiflorus;* (c) *H. laetiflorus* apparently does not breed true from seed; and (4) this taxon is generally found in areas where the two supposed parents grow. The species was described in 1807 from plants grown in Europe, and although only one of its putative parents was known there at this time, we nevertheless feel that it is most likely that the type is based on a hybrid (Heiser, 1960).

Helianthus rigidus might be postulated to have a hybrid origin from *H. subrhomboideus* × *H. tuberosus. Helianthus rigidus* shows no character which could not have come from the supposed parents, although it does occur in areas outside of the range of one of the "parents" (Fig. 2). If it were to have originated from introgression of *H. tuberosus* into *H. subrhomboideus,* however, selection for certain introgressive types might have resulted in constancy and the introgressants might have been able to invade new areas or effectively replace *H. subrhomboideus.*

Since the species are all polyploids, certain other explanations for the intergradation must be explored. Although at present we cannot definitely identify all the diploid progenitors, it is likely that the hexaploids are partly or entirely allopolyploid in origin. Kostoff (1939) on the basis of analysis of the hybrid between *H. annuus* and *H. tuberosus* has suggested the genomic formula $A_{t1} A_{t1} A_{t2} A_{t2} B_t B_t$ for *H. tuberosus* with the B genome being nearly homologous with that of *H. annuus.* The A_t genomes could come from one of the three closely related tetraploids of the eastern United States, *H. hirsutus, H. strumosus,* or *H. decapetalus* which themselves may be of alloploid origin (Smith, 1961). Most hybrids of the diploid perennials exhibit good pairing (Heiser, *et al.*, 1962) which could account for the similarity of the two A genomes postulated by Kostoff for *H. tuberosus.* Let us therefore, for the present study, assume a genomic formula for *H. tuberosus* of $A_1A_1A_2A_2BB$. *Helianthus laetiflorus* might conceivably be $A_2A_2A_3A_3BB$; *H. rigidus,* $A_3A_3A_4A_4BB$; and *H. subrhomboideus* $A_4A_4A_5A_5BB$, where A_1, A_2, etc. represent genomes from closely related perennial diploids. Such a hypothesis would explain the essentially good pairing and interfertility between all the hexaploid species as well as the morphological similarities and differences.

Segregation in such polyploids might give results resembling interspecific hybridization. Stebbins (1950) has pointed out that segmental allopolyploids, in contrast to strict alloploids, may give segregates approaching one or the other of the parents. Smith (1961) found plants of the tetraploid *H. strumosus* apparently showing introgression from *H. hirsutus,* even though the latter did not grow in the same area, and he suggested the possibility of allotetraploid segregation. Although we have no evidence that allopolyploid segregation is occurring in the hexaploids, it nevertheless offers an alternative hypothesis to interspecific hybridization.

It is, of course, feasible that we may have various combinations of the possibilities discussed above — part of the variability may result from allopolyploid segregation, part from hybridization. Considering all the possibilities, however, we feel that there is fairly good evidence that *H. laetiflorus* is a hybrid. On the other hand, while *H. rigidus* may owe its origin to hybridization, we do not feel that any definite decision can be reached at present.

In regard to taxonomic treatment, this group of taxa offers certain difficulties inherent in many plants of polyploid origin which have no barriers to interbreeding. *Helianthus tuberosus,* in spite of some intergradation with other species, deserves recognition as a species. On the other hand, if *H. laetiflorus* is a collection of hybrids or hybrid derivatives, it does not deserve designation as a species. Although in general, we are opposed to giving distinct names to hybrids, in the case of a well established binomial, it is perhaps best to continue its use with indication that it is a hybrid.[1] The authors are not in agreement as to the treatment of the other two taxa. One feels that *H. subrhomboideus* should be treated as a species and *H. rigidus* as a hybrid, whereas the other thinks that they should be considered races of a single species. If the latter course is adopted, *H. subrhomboideus* becomes a subspecies of *H. rigidus.*

SUMMARY: The four hexaploid sunflowers, *H. subrhomboideus, H. rigidus, H. laetiflorus,* and *H. tuberosus* form a morphological series with the first and last named species representing the extremes. Artificial hybrid combinations of all the species, except *H. subrhomboideus* × *H. laetiflorus,* were largely fertile. Certain of the hybrids of *H. tuberosus* × *H. subrhomboideus* and *H. rigidus* strongly resemble *H.*

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[1] The name then becomes *H.* x *laetiflorus* Pers. (pro. sp.) Syn. 2: 476. 1807.

TABLE II

SOURCE OF PLANTS USED IN THE CROSSES AND PROGENY TESTS

Number	*Name*	*Locality and Collector*
Ar1	*H. laetiflorus*	Cult. Monroe Co., Ind. (Heiser)
H408	*H. tuberosus*	Darke Co., Ohio (R. T. Neher)
L1	*H. laetiflorus-tuberosus*	Auburn, Mass. (B. N. Gates)
L2	*H. laetiflorus*	Worcester, Mass. (B. N. Gates)
N3	*H. laetiflorus*	White County, Ind. (Heiser)
P21	*H. tuberosus*	Polk Co., Iowa (Heiser)
P29	*H. subrhomboideus*	Cass Co., N. D. (O. A. Stevens)
P59	*H. tuberosus*	Hennepin Co., Minn. (Gerald Ownbey)
P68	*H. laetiflorus*	Cult. Monroe Co., Ind. (Heiser)
P79	*H. subrhomboideus*	Lawrence Co., Ind. (Heiser)[2]
P147A	*H. rigidus*	White Co., Ill. (Heiser)
P147B	*H. laetiflorus*	White Co., Ill. (Heiser)

laetiflorus. On the basis of the study of morphology, geographical distribution, and the hybrids, it is suggested that *H. laetiflorus* is of hybrid origin and that *H. rigidus* possibly represents an introgressant. On the other hand, it is also possible that allopolyploid segregation is occurring in these species giving results suggestive of hybridization.

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[2] Plants from this same colony *(Kriebel 3965)* were originally identified as *H. silphioides* Nutt. by Fernald (1946) who later admitted his misidentification in a letter to the junior author. So far as is known *H. silphioides* does not occur in Indiana.

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A NEW FEATURE IN BAMBOO RHIZOME ANATOMY[1]

F. A. McClure[2]

In the course of my search for vegetative characters that effectively differentiate the two currently recognized species of *Arundinaria* native to the United States I discovered that, in cross section, the rhizomes of *A. tecta* (Walt.) Muhl. show well-developed peripheral air canals (fig. 1),[3] a feature of bamboo anatomy apparently not hitherto reported. In both living plants and dried herbarium specimens, this feature was present in all rhizomes associated with flowering material identified as belonging to this species. I have not, however, found air canals in the rhizome of any plant or specimen typical of *A. gigantea* (Walt.) Muhl. (fig. 2) the only other currently recognized species native to this country.

This anatomical feature is presumed to originate in the same manner as similar spaces found in the stems of some herbaceous grasses of the genera *Leersia*, *Oryza*, *Sacciolepis*, etc. (cf. C. R. Metcalfe, Anatomy of the Monocotyledons, I. Gramineae. The Clarendon Press, Oxford. lxi and 731 p., illus., bibl. 1960.)

Anatomical details shown by cross sections of bamboo rhizomes are illustrated by Shibata (1900, fig. 2 & 3) for *A. nipponica* (as *Bambusa nipponica*) and for *A. japonica;* by Takenouchi (1931, pl. 1, fig. 2-4) for 3 species in 2 genera; and by Takenouchi (1932, fig. 7-10) for 7 species in 4 genera. No illustration or mention of the presence of air canals in the bamboo rhizome appears in any of these works. No other illustration or discussion of bamboo rhizome anatomy has come to my attention.

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[1] This paper was prepared with the assistance of a grant from the National Science Foundation. The facilities made available by the Department of Botany, U. S. National Museum, Smithsonian Institution have been indispensable.

[2] Honorary Research Associate, Smithsonian Institution.

[3] Rhizome sections and the photographs on which the illustrations are based were prepared by Professor Yong-no Lee, on leave from the Department of Biology, Ewha Woman's University, Seoul, Korea, using facilities made available by the Department of Botany, Yale University.

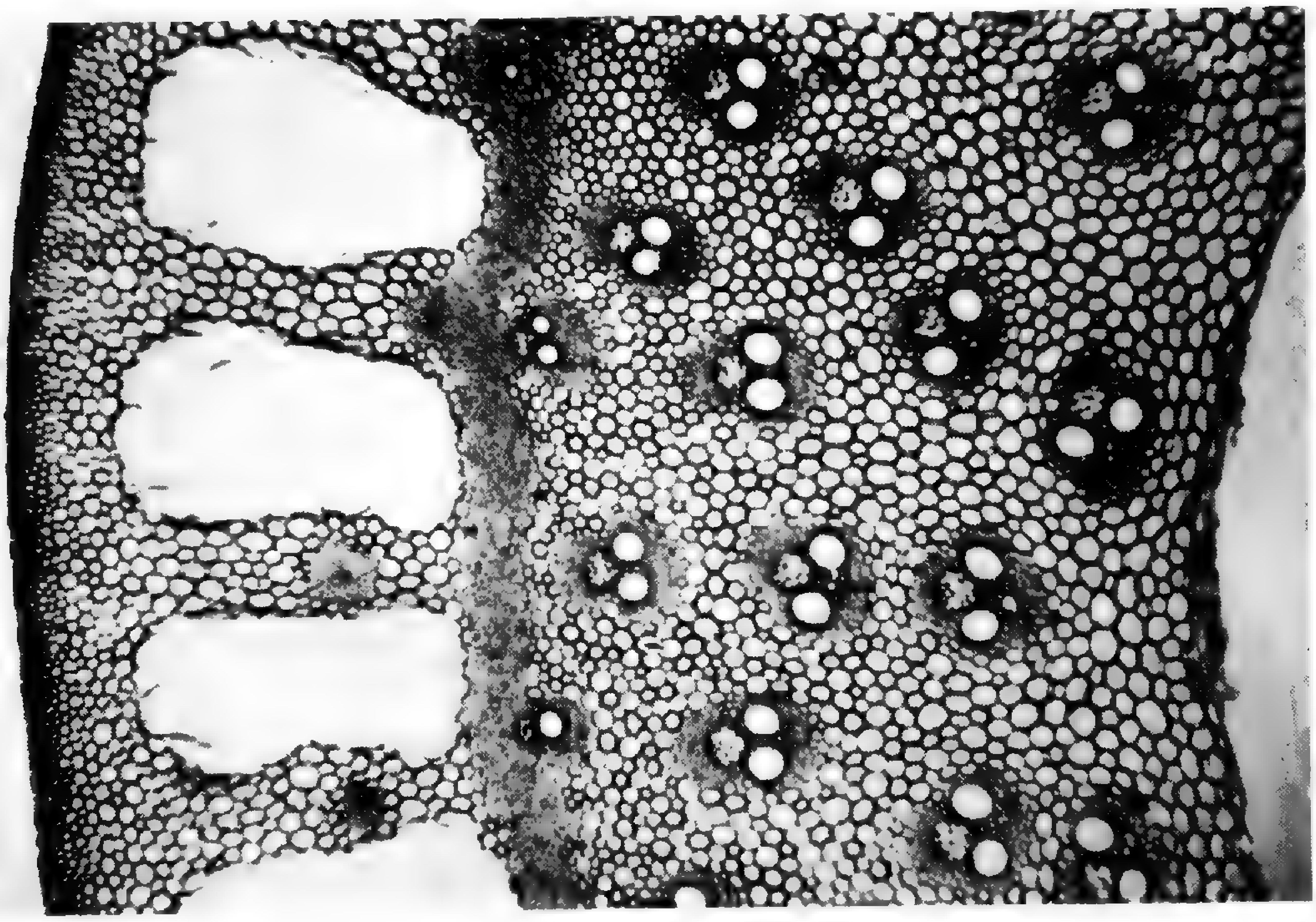

Fig. 1. Cross section of a young rhizome of *A. tecta*, showing air canals, ca. × 25. Study material taken from living plants originally native at Stony Run, Anne Arundel Co., Md., cultivated under *MBG 2762* at 5507 Charles Street, Bethesda, Md.

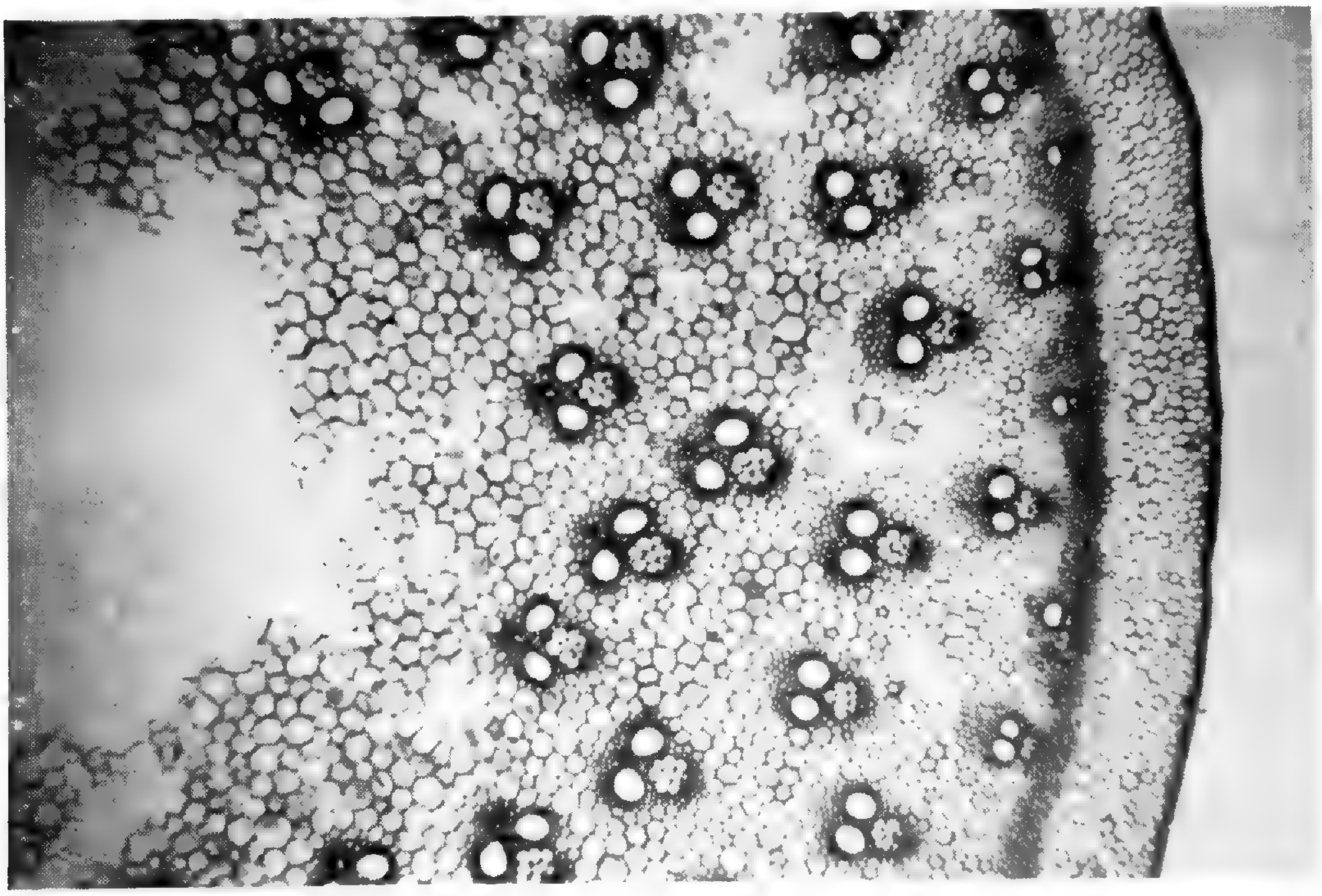

Plate 1884

Fig. 2. Cross section of a young rhizome of *A. gigantea*, showing absence of air canals, ca. × 25. Study material taken from living plants originally native at Lebanon, Warren County, Ohio, cultivated under *MBG 2792* at 5507 Charles Street, Bethesda, Md.

Although the presence of air canals in their rhizomes may be presumed to have certain adaptive advantages to plants growing in waterlogged soil or on frequently inundated sites, its presence or absence apparently is not, in our native bamboos, influenced in any way by the ecological conditions under which the plants happen to be growing. This is presumed, therefore, to be an inherited, rather than an ecological manifestation.

The results of exploratory studies in field and herbarium indicate that the presence or absence of air canals in the rhizomes can be used with confidence to differentiate plants typical of these two species, even in the sterile condition.

This feature was originally discovered by means of a 9× hand lens, and the presence or absence of air canals can be diagnosed easily without the use of a compound microscope. Air canals in the rhizomes of *Arundinaria tecta* are typically continuous, longitudinally, through the nodes and internodes, and are typically distributed uniformly around the periphery of the rhizome axis. However, two specimens have been found, in which their distribution is discontinuous, both peripherally and longitudinally: Biltmore *1405* [leg. *C. D. Beadle* ?], and *Radford & Wood 6879*-A, both from North Carolina.

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POLLEN MORPHOLOGY AS A TAXONOMIC TOOL IN LINUM[1]

K. S. XAVIER AND C. MARVIN ROGERS

Among modern palynologists, Wodehouse (1935) and Erdtman (1952) most successfully show the use of pollen characters in taxonomy. The latter brings the knowledge of pollen morphology in 98 families of angiosperms, including the *Linaceae* more or less up to date. He classifies and describes the pollen of about 36 species, representing 14 genera of the family, including, however, only five species of *Linum*, all of which are of the Old World.

Small (1907) has provided the most thorough taxonomic treatment of the genus in North America, recognizing 60-70 species *(Linum* and *Cathartolinum)*, but the relationships of these to one another and to species in other parts of the world have never been too clearly known. It was hoped that knowledge of the comparative morphology of the pollen might provide additional information and, for that reason, preliminary studies were undertaken, of which the present paper gives some results. Since these are sufficiently encouraging, a more extensive survey of the genus is now under way.

Fourteen species and six varieties of *Linum* were examined, principally eastern North American taxa, but including certain selected western North American and cultivated species.

Some of the pollen grains were collected from living plants, but most have come from herbarium specimens, since such grains are not only intact and perfectly usable, but scarcely differ from those taken from living plants of the same species.

The pollen was prepared according to Brandt's method as described in Wodehouse (1935) except that, in order to view the surface sculpturing better, most of it was left unstained. The grains were removed from the anther, placed on a slide,

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[1] Contribution No. 96 from the Department of Biology, Wayne State University.

cleared in 95% alcohol and embedded in pure glycerin jelly. At ordinary temperatures, these slides are permanent. The shape as well as the external features of the pollen may be easily observed when the grains are floated in 95% alcohol in a deep well slide.

Two significant facts became quickly apparent. One, the pollen grains within most species show comparatively little variation, even when the plants have come from widely separated localities. Two, there is a rather remarkable amount of diversity among the different species.

Because of their variation and the clearness with which they can be seen, the pollen characters found to be most helpful in differentiating species are the size and shape of the grain, number, size and shape of the germ pores or furrows, the thickness of the exine and the nature of its sculpturing. Diameter of the grain varies from 38.5-112 μ. Shape ranges from triangular to subspherical. Triangular grains have three meridionally extended germ furrows which may be acute or blunt at the ends and vary in width and length in different species. Spherical grains have about 20 more or less circular pores while intermediate types have the surface undulated due to the protruded germ pores which are six to twelve in number and oblong in shape. Thickness of the exine ranges from 2-9 μ. The sculpturing of the exine consists of verrucoid (wartlike) excrescences, which may be mono-, di- or polymorphic and range from 0.5-5.25 μ in diameter. They may be rounded or many sided as viewed from above and be rounded or irregularly truncate at the summit. The excrescences vary in abundance and on the furrow membrane they may be absent, few, or as dense as on the other sporoderm surfaces.

Though some species are more clearly distinct than others, it is possible to construct a key based on pollen characters alone, by which most of the species studied may be identified. The sizes given in the key and in the descriptions which follow were obtained by making three to five series of measurements of each specimen. In using the key, one must take care to choose only polar views of fully expanded, unbroken grains.

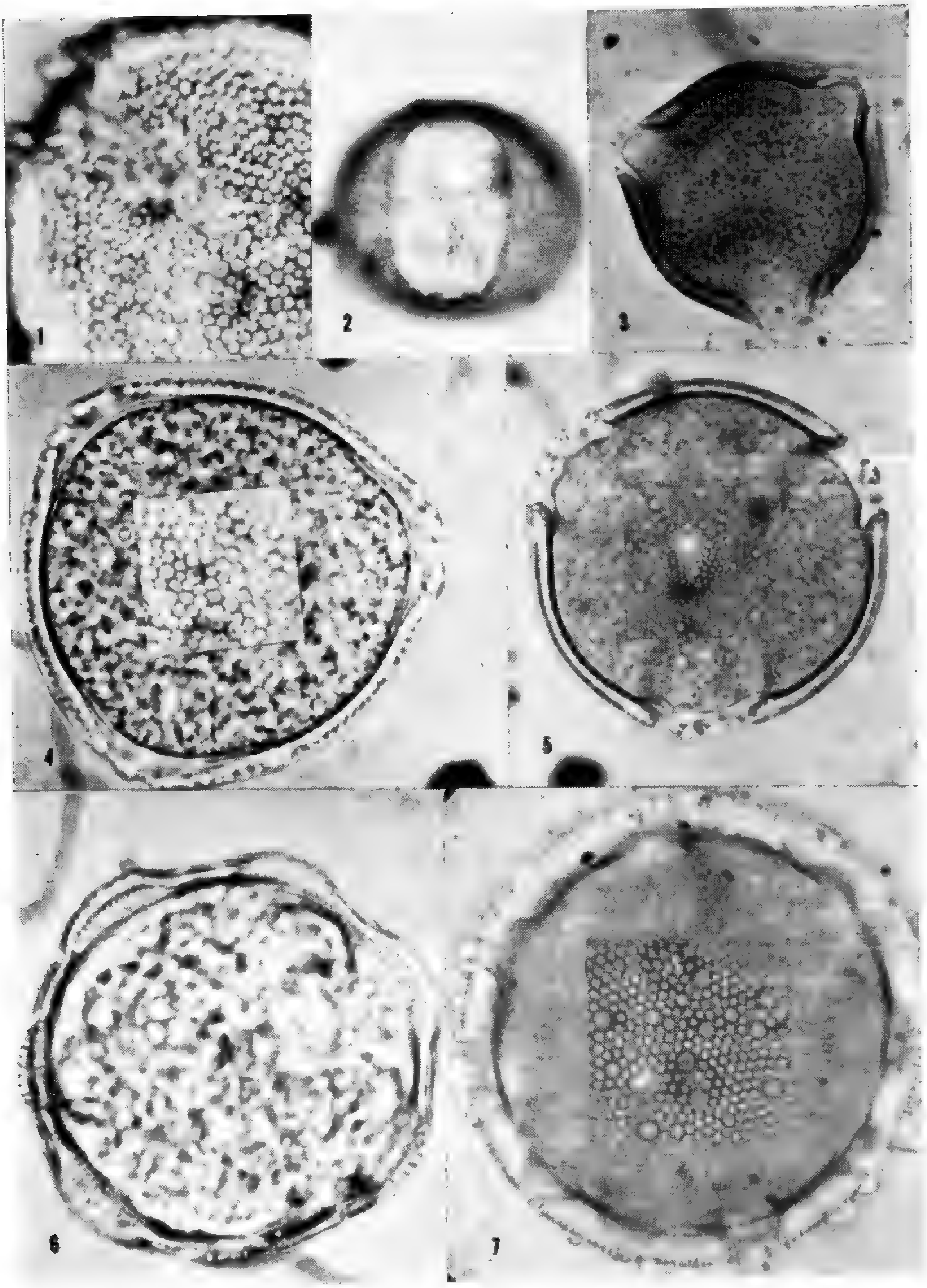

Plate 1285

Fig. 1-7 Pollen grains of *Linum*. Fig. 3 and 7 × 600; others × 750. 1. *L. lewisii;* 2. *L. striatum;* 3. *L. usitatissimum;* 4. *L. lewisii;* 5. *L. bahamense* var. *bracii;* 6. *L floridanum* var. *floridanum;* 7. *L. rigidum* var. *rigidum.*

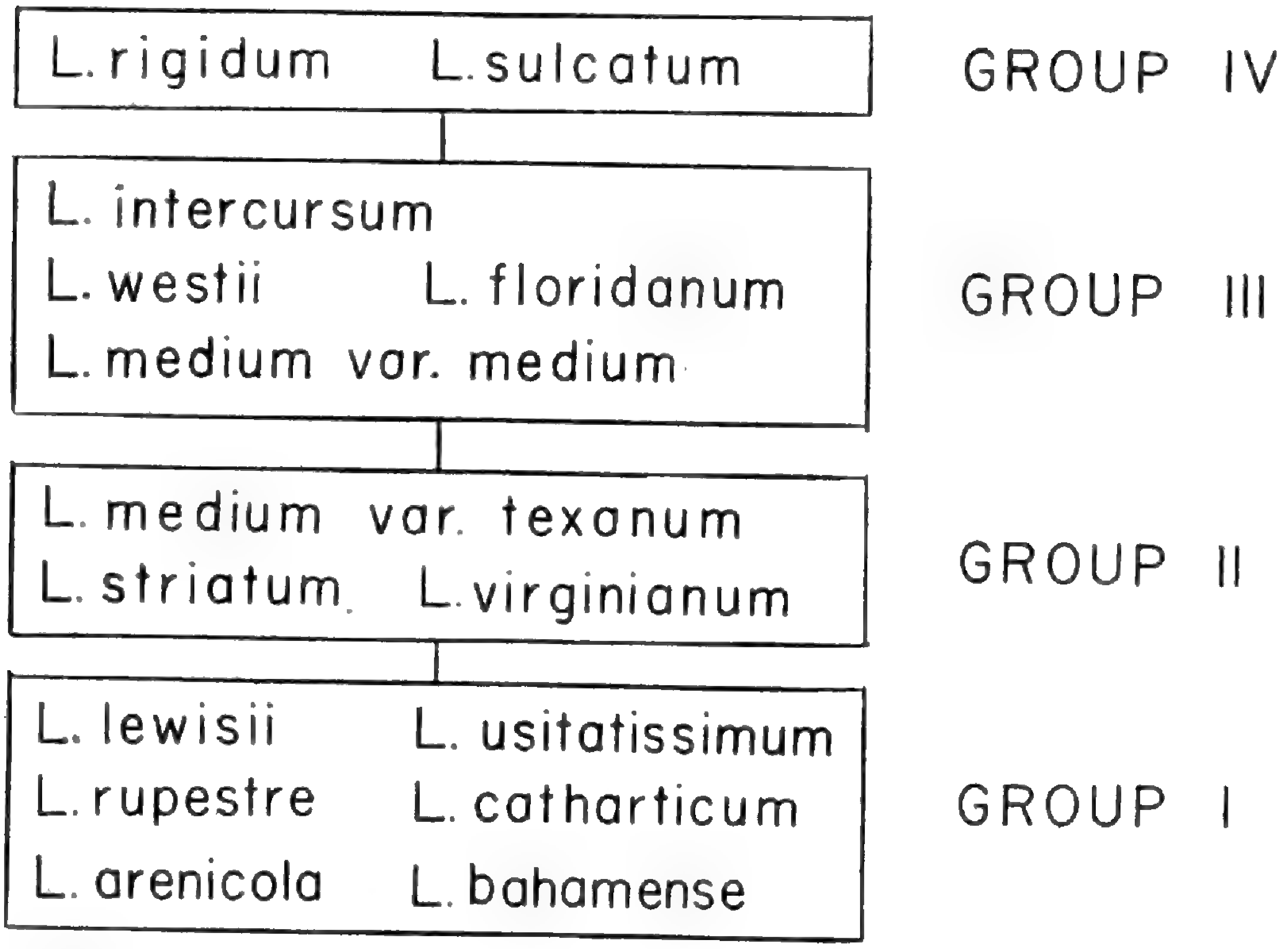

Fig. 8. The species of *Linum* studied, arranged in four groups on the basis of pollen morphology, with Group I being most primitive and Group IV most advanced.

KEY TO THE SPECIES

Germ furrows three.
  Germ furrows pointed at the ends (Group I) (Fig. 1).
    Excrescences 0.75-3 μ in diameter; intine broadly rounded at the furrows (Fig. 4).
      Diameter of grains 38.5-45.5 μ. 1. *L. catharticum*
      Diameter of grains 52-73.5 μ.
        Germ furrows 27 μ wide. 2. *L. rupestre*
        Germ furrows 10.5-21 μ wide.
          Excrescences 0.5-2 μ in diameter, 84-90 per 10 μ^2 (Fig. 5). 3. *L. arenicola* and 4. *L. bahamense*
          Excrescences 1.5-3 μ in diameter, 28-30 per 10 μ^2 (Fig. 4). 5. *L. lewisii*
    Excrescences 0.5-0.75 μ in diameter; intine subacute at the furrows (Fig. 3). 6. *L. usitatissimum*
  Germ furrows rounded at the ends (Group II) (Fig. 2).
    Exine 2 μ thick; excrescences 70-72 per 10 μ^2. 7. *L. striatum*

Exine 2.75-3.5 μ thick; excrescences 40-53 per 10 μ^2.
8. *L. virginianum* and
9. *L. medium* var. *texanum*

Germ pores six to twenty.

Germ pores six to twelve; surface of grain undulated (Group III) (Fig. 6).

Germ pores six.

Germ pores tapering toward the ends, 14 μ wide; excrescences in a central patch on the pore membrane.
10. *L. westii*

Germ pores subcircular, 21 μ in diameter; excrescences uniformly sparse on the pore membrane.

Excrescences with central pits, 40-44 per 10 μ^2.
9. *L. medium* var. *medium*

Excrescences without central pits, 67-75 per 10 μ^2.
11. *L. floridanum* var. *chrysocarpum*

Germ pores ten to twelve.
11. *L. floridanum* var. *floridanum* and
12. *L. intercursum*

Germ pores about twenty; surface of grain not undulated (Group IV) (Fig. 7).

Exine 5.25-7.5 μ thick.

Grains 70-87.5 μ in diameter; largest excrescences 3 μ in diameter.
13. *L. sulcatum*

Grains 84-112 μ in diameter; largest excrescences 5.25 μ in diameter.
14. *L. rigidum* var. *rigidum*

Exine 8.75-9 μ thick.
14. *L. rigidum* var. *carteri*

DESCRIPTIONS OF THE SPECIES

1. *L. catharticum* L. Compressed triangular, diam 38.5-45.5 μ; colpi 3, very long, narrow, pointed, 7-10.5 μ wide; exine 3.5-4.75 μ thick; excrescences monomorphic, diam 1.75 μ, many sided, sparse, absent on furrow membrane.

2. *L. rupestre* Engelm. Compressed, subtriangular, diam 70-73.5 μ; colpi 3, pointed, 27 μ wide; exine 3 μ thick; excrescences polymorphic, diam 0.75-2.5 μ, rounded, with central pits, very sparse on furrow membrane.

3. *L. arenicola* Small. Oblate triangular, diam 56-66.5 μ; colpi 3, long and pointed, 17.5-21 μ wide; exine 3 μ thick; excrescences polymorphic, diam 1-2 μ, rounded, with minute central pits, very sparse on the slightly bulging germinal furrows.

4. *L. bahamense* Northrop, including var. *bracii* (Small) Rogers and var. *corallicola* (Small) Rogers. Oblate triangular, diam 52.5-66.5 μ; colpi 3, long and pointed, 10.5-21 μ wide; exine 2.25-3 μ thick; excrescences rounded, di- or polymorphic, diam 0.5-1.5 μ, very sparse on the furrow membrane.

5. *L. lewisii* Pursh. Oblate triangular, diam 63-73.5 μ; colpi 3, 21 μ wide, pointed; exine 3-4.5 μ thick; excrescences di- or polymorphic, diam 1.5-3 μ, rounded or many sided with central pits, very sparse on furrow membrane.

6. *L. usitatissimum* L. More or less oblate triangular, diam 52.5-59.5 μ; colpi 3, short, pointed, 7-10.5 μ wide; exine 3.5-4.25 μ thick; excrescences dimorphic, diam 0.5-0.75 μ, absent on furrow membrane.

7. *L. striatum* Walt. Oblate triangular with blunt angles, diam 42-49 μ; colpi 3, oblong, 14-24.5 μ wide; exine 2 μ thick; excrescences monomorphic, diam 1.5 μ, many sided, with central pits, fewer on the furrow membrane.

8. *L. virginianum* L. Oblate triangular with blunt angles, diam 45.5-59.5 μ; colpi 3 (one specimen with 4), elliptic, 21-28 μ wide; exine 2.75 μ thick; excrescences monomorphic, diam 1.5 μ, many sided, with central pits, sparse on furrow membrane.

9. *L. medium* (Planch.) Brit. var. *medium*. Oblate triangular but tending toward spheroidal, diam 52.5-70 μ; pori 6, elliptic, 21 μ wide; exine 3-3.75 μ thick; excrescences monomorphic, diam 1.5-1.75 μ, many sided, with central pits, sparse on pore membrane.

L. medium var. *texanum* (Planch.) Fern. Compressed triangular, diam 42-56 μ; colpi 3, elliptic, 28-32 μ wide; exine 3.25 μ thick, excrescences monomorphic, diam 1.5-2.5 μ, fewer on the furrow membrane.

10. *L. westii* Rogers. Spheroidal with undulate surface, diam 63-66.5 μ; pori 6, oblong, with slightly tapering but blunt ends, 14 μ wide; exine 3 μ thick; excrescences monomorphic, diam 1 μ, rounded, without central pits, arranged on the furrow membrane as a central longitudinal patch.

11. *L. floridanum* (Planch.) Trel. var. *floridanum*. Spheroidal with undulate surface, diam 50.5-59.5 μ; pori about 10, small, rounded, diam 12-14 μ; exine 3.5 μ thick; excrescences monomorphic, diam 1.25 μ, rounded, without central pits, somewhat fewer on the bulging pore membrane.

L. floridanum var. *chrysocarpum* Rogers. More or less similar, sometimes appearing four-sided, diam 52.5-63 μ; pori usually 6, diam 21 μ; excrescences monomorphic, diam 1.75 μ, many sided, sometimes with central pits, fewer on the pore membrane.

12. *L. intercursum* Bickn. Spheroidal with undulate surface, diam 52.5-66.5 μ; pori about 12, rounded, diam 17.5 μ; exine 2.25 μ thick; excrescences monomorphic, diam 1.75 μ, many sided, somewhat fewer on furrow membrane.

13. *L. sulcatum* Ridd. including var. *harperi* (Small) Rogers. Subspheroidal, diam 70-87.5 μ; pori about 20, circular, diam 10.5-14 μ; exine 5.25-7.5 μ thick; excrescences polymorphic, diam 1.5-3 μ, cylindrical with rounded summit, nearly as dense on the pore membrane.

14. *L. rigidum* Pursh var. *rigidum*. Subspheroidal, diam 84-112 μ; pori about 20, circular, diam 10.5-12.5 μ; exine 5.25-7 μ thick; excres-

cences polymorphic, diam 1.5-5.25 μ, cylindrical, rounded at the summit, equally abundant on the pore membrane.

L. rigidum var. *carteri* (Small) Rogers. Similar, diam 91-108.5 μ; exine 8.75-9 μ thick.

It is generally thought that pollen grains with many circular pori and with excrescences on the pore membrane are more specialized than those with few, slender, pointed furrows with naked membranes. Correlated with these advanced traits in *Linum* are large excrescences and thick exine. Certainly additional species should be examined before definite conclusions can be drawn, but on the basis of those thus far studied, the pollen features thought to be primitive or advanced can be shown as follows:

PRIMITIVE FEATURES	ADVANCED FEATURES
Germinal furrows three	Germinal pores about twenty
Grain triangular	Grain spherical
Furrows slender, with pointed ends	Pores circular
Furrow membrane naked	Pore membrane with excrescences
Excrescences small	Excrescences large
Exine thin	Exine thick

Upon taking these characteristics into consideration, it is possible to segregate the species studied into four groups, the members of each group resembling one another in their important features. These groups are shown in Fig. 8.

It is not to be implied that the species studied or the groups shown constitute a single line of evolution, for information from pollen morphology alone is too scanty and data from all other sources possible must contribute to our knowledge. However, the species in Group I combine the greatest array of primitive features, those of Group IV, the largest number of advanced features, while Groups II and III are intermediate.

On the basis of observations on the general morphology of the various species, it would appear that Group I is a heterogeneous one in which, though evolution has proceeded in other directions, the pollen has remained rather unspecialized. *Linum arenicola, L. bahamense* and *L. rupestre* have very similar pollen. That of *L. lewisii* and *L. usitatissi-*

mum is rather different and the relationship of these species to each other and to the other species in the group is not clarified here.

Groups II and III, from their gross morphology, would be judged to be quite closely related to one another. The pollen morphology of the wide ranging species, *L. medium* var. *texanum*, *L. striatum* and *L. virginianum*, is very similar, as is that of *L. floridanum* and *L. intercursum*. *Linum westii*, *L. floridanum* var. *chrysocarpum* and *L. medium* var. *medium* appear to be intermediate between members of Groups II and III. The present studies indicate that the systematic position of the varieties of *L. medium* needs clarification.

The species of Group IV possess pollen that is significantly different from that of the other groups and the relationship of members of this group to those of the others needs further study.

Conclusions from other data (Rogers, 1963) that some members of Group I are most primitive and that Groups II and III and Group IV may be natural assemblages of successively more highly evolved species is given considerable support by the results of the study of pollen morphology.

Many workers in palynology have found it almost impossible to separate species within a genus and sometimes even different genera within a family on the basis of pollen morphology alone. In the species of *Linum* studied, generally speaking, though the pollen characters within a species are without much variation, one can distinguish many species rather readily. The large amount of variation, involving several characters, especially since it appears to be correlated with differences in gross morphology, may indicate that the usual treatment of *Linum* as a single genus is too conservative. The examination of other species, both Old and New World, may provide further information as to the proper systematic treatment of the genus. In any case there is little question but that the use of pollen characters will constitute a valuable additional tool in the study of the taxonomy of the genus.

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PHYTOGEOGRAPHIC NOTES ON ROTTBOELLIA, PASPALUM, AND MISCANTHUS (GRAMINEAE)[1]

RICHARD W. POHL

Paspalum fimbriatum H. B. K. Additional records from Florida.

This tropical species occurs in northern South America and the West Indies but has not been previously reported from the continental United States. It is abundant in orchards north of Homestead, Florida, and occurs along the Keys Highway. The author has made the following collections:

FLORIDA: DADE COUNTY: In an avocado orchard west of Princeton, Sec. 27, R. 39 E, T. 56 S. *Pohl 7589.* June 22, 1957 (ISC). MONROE CO.: Median strip of U. S. Hy. 1, Key Largo, 3 miles by road n. of Port Largo. Pohl 9182. April 13, 1962 (ISC).

Rottboellia exaltata L.f.: A second American station.

This Asiatic species was reported by Hitchcock and Chase (1950) from Miami. It grows in abundance on dry coral in vacant lots in Homestead, forty miles southwest. First seen there by the author in 1957, it had increased markedly by 1962.

FLORIDA: DADE COUNTY: Weed in vacant lot on dry coral, Homestead. *Pohl 7584.* June 22, 1957. (ISC); Homestead. *Pohl 9177.* April 12, 1962. (ISC).

Miscanthus sacchariflorus (Maxim.) Hack. in the Midwest.

The Asiatic ornamental grass, *M. sacchariflorus* (Fig. 1) was first listed by Hitchcock and Chase (1950) from Clinton Co., Iowa, where it was an escape from cultivation. Steyermark, *et al*, (1957) gave several Illinois localities as well, and I have reported it from fourteen counties of eastern Iowa. On recent field trips in southeastern Iowa, I have noticed this species spreading aggressively along roadsides throughout this area. Apparently it is introduced as an

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[1] Journal paper No. J-4484 of the Iowa Agricultural and Home Economics Experiment Station, Ames, Iowa. Project No. 1136.

ornamental and later spreads by rhizomes from cultivated patches, particularly along roadsides and ditches. Spread by seed is evident in some areas, where small satellite colonies occur near original plantings. Many of the colonies observed during 1962 were remote from buildings and probably arose from seed. *M. sacchariflorus* was also seen growing as an ornamental in southern Minnesota. Four recent collections from Wisconsin now add that state to the range of this species. The writer is indebted to Dr. Hugh Iltis for the loan of two of the Wisconsin specimens cited below.

The vigor and large size of *M. sacchariflorus,* coupled with its aggressive rhizomatous spread, make it a potentially dangerous weed, with many of the qualities which Johnson grass exhibits in the South.

WISCONSIN: LAFAYETTE CO.: Two colonies along n. side of Hy. 11, 1.5 mi. e. of South Wayne. *Pohl 9330.* August 6, 1962. (ISC, MIL). This colony has existed for at least ten years, according to the author's observations. GRANT CO.: Sec. 21, T 1 N, R 2 W, Jamestown Twp. Roadside and field on east side of Wis. Hy. 35; one colony about 8 ft. in diameter. *R. W. Freckmann,* (F). *62*-158. Oct. 13, 1962 (ISC);T 1 N, R 2 W, Sec. 28. *H. H. Iltis 18478.* Aug. 10, 1961 (WIS). WAUSHARA Co., T 8 N, R 9 E, Sec 30. Road bank. *K. Pochmann 49.* Sept. 5, 1957 (WIS).

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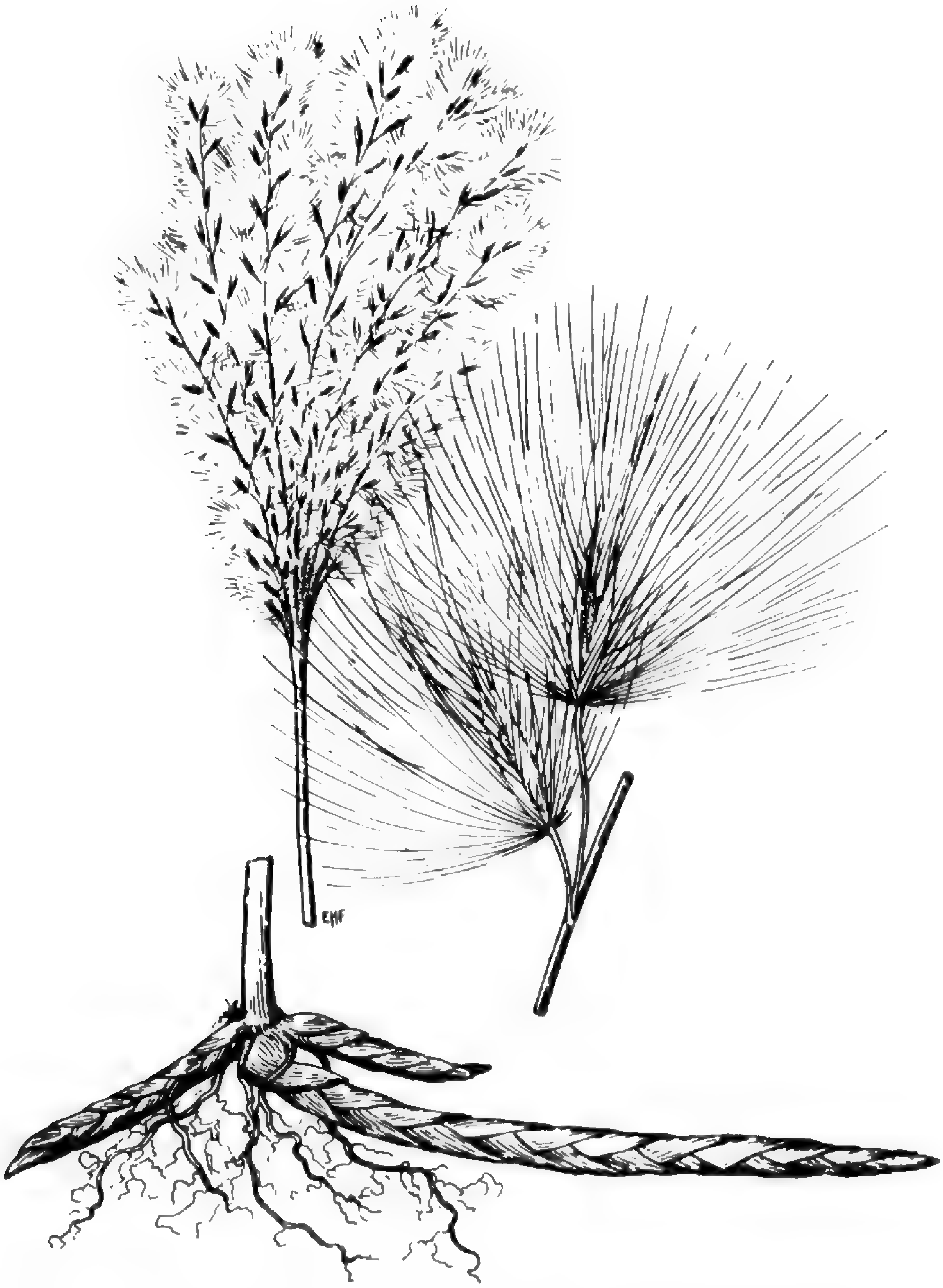

Fig. 1. *Miscanthus sacchariflorus.* Inflorescence and rhizome.

LIFE-FORMS IN THE PLAINS FLORA OF SOUTHERN MACKENZIE, NORTHWEST TERRITORIES

JOHN W. THIERET

This paper presents a life-form analysis of the 558 species of seed plants that are reported to be native or naturalized in the Great Plains of southern District of Mackenzie. The life-form classification used here is that of Raunkiaer (1934), which is based on the kind and degree of protection given to the perennating buds during the unfavorable season. Of the several life-form systems that have been proposed, that of Raunkiaer is most widely used, in large measure because of its simplicity and ready applicability.

Apparently the only life-form studies previously made on Canadian floras are those of Raunkiaer (1934), which were first published in 1908, and those of Scoggan (1950). Raunkiaer based his work on such floristic lists as were then available for the regions he chose to analyze. These lists, some of which had been compiled a number of years before Raunkiaer made use of them, were for the most part quite incomplete accounts of the various floras. As a result, the life-form studies based on them present statistics and conclusions that may not be entirely valid. Scoggan's studies, in contrast, were based on his own and other relatively complete and recent accounts of the eastern Canadian floras concerned. If the Raunkiaer system of classification of life-forms is to be tested for boreal America, many additional life-form analyses are needed. The present paper is offered as a contribution to this end.

The Great Plains of southern Mackenzie extends from the Laurentian Plateau on the east to the Mackenzie Mountains on the west and from the Mackenzie-Alberta border (60°N) on the south to latitude 62°N on the north. The area encompassed is about 45,000 square miles. Elevation varies from about 520 feet at Great Slave Lake to 1600 feet in the Mackenzie Lowlands east of the Liard River. The region lies wholly within the boreal forest and principally in the

Mackenzie Lowlands. The climate can be described as northern continental, with short, dry, and relatively warm summers and long cold winters. (see climatological data in Table 1).

The region was chosen for life-form analysis because of three main considerations. First, the flora of the Great Plains of southern Mackenzie is better known than that of any other large portion of the district and is on record in relatively few publications (Cody, 1957, 1961; Jeffrey, 1961; Raup, 1947; and Thieret, 1961, 1962, in press). Second, the over-all climate of the region appears not to vary markedly either from east to west or from north to south, as can be seen by examining climatological data (Table 1) from Fort Simpson, Hay River, and Fort Smith, three widely separated settlements. Third, the author has carried out field work during four seasons of study of flora and vegetation along the Great Slave Lake Highway and has observed in the field and collected about 80 percent of the species considered in the preparation of this paper. Too often, life-form studies are based almost entirely upon herbarium specimens and not upon all-important field observations on the plants concerned.

Table 1.

Climatological data for Fort Simpson, Hay River, and Fort Smith, N.W.T. (from Anonymous, 1954).

	Fort Simpson	Hay River	Fort Smith
Mean annual precipitation in inches	12.13	12.02	12.63
Mean annual rainfall in inches	7.61	7.34	7.97
Mean June, July, and August rainfall in inches	5.46	4.06	5.05
Mean January temperature in degrees F	—15	—12	—13
Mean July temperature in degrees F	62	60	61

Raunkiaer's life-form system is completely independent of the usual classification of plants into species, genera, etc., and recognizes five principal classes, which may be characterized as follows.

Class I. PHANEROPHYTES (Ph) bear their perennating buds well above the ground and they are almost all trees and shrubs. Because the buds are elevated and exposed to the full impact of the environment, and because the severity of conditions increases with height above the ground, the phanerophytes are logically subdivided into height classes for life-form analysis: megaphanerophytes (Mg), over 30 meters tall; mesophanerophytes (Ms), between 8 and 30 meters tall; microphanerophytes (Mc), between 2 and 8 meters tall; and nanophanerophytes (N), between 25 centimeters and 2 meters tall. As a class, the phanerophytes are predominant in humid tropical floras and tend to decrease in proportion to other life-forms in regions with climates less favorable to plant growth.

Class II. CHAMAEPHYTES (Ch) have their buds above the ground but lower than 25 centimeters, so that in the unfavorable season they may receive some protection from fallen snow and leaves or from the dense growth of the plant itself. The buds of this class are obviously less exposed to the impact of the environment than are those of phanerophytes. In a general way, the percentage of chamaephytes in a flora tends to increase with increasingly high altitude or latitude or both. An especially high proportion of chamaephytes appears to characterize floras of arctic and alpine regions.

Class III. HEMICRYPTOPHYTES (H) have their buds in the surface of the soil and are thus even better protected than chamaephytes. This class tends to be dominant in floras of temperate regions and often constitutes half or more of the species of an area, especially in grasslands and in deciduous forests; they are also common in tundra except under extreme conditions (Cain, 1950). Raunkiaer distinguished three principal subtypes: the non-rosette or protohemicryptophytes (Hp), the semirosette (Hs), and the rosette types (Hr). The first type is without basal rosettes of leaves; the second has both basal and stem leaves; and the third has its leaves in a compact basal rosette.

Class IV. CRYPTOPHYTES (Cr) have their buds beneath the surface of the soil, in water, or in the substratum under the water. The buds are manifestly much better protected than those of plants whose bud-bearing shoots are in or above the surface of the soil. Raunkiaer recognized three principal subdivisions: geophytes, helophytes, and hydrophytes. Geophytes are land plants, and their perennating structures are commonly bulbs, corms, rhizomes, stem-tubers, or root-tubers. Helophytes grow in soil saturated with water, or in the water itself, but their vegetative shoots are emergent. The hydrophytes include those aquatics that are free-floating and those that root in the substratum beneath the water but whose vegetative shoots are submerged. In the present study, as in most other life-form analyses, the hydrophytes and helophytes are combined into one class (HH). Cryptophytes appear not to be the dominant life-form of any particular climate.

Class V. THEROPHYTES (Th) are annual plants, which survive the unfavorable season in the form of seeds. They are particularly abundant in desert floras and in the weedy communities that develop where native vegetation is disturbed.

The "life-form spectrum" of a particular flora shows the percentage-distribution of the five life-form classes in that flora. Such a spectrum can be used, in comparison with spectra of other floras, to reflect phytoclimatic differences between regions and can give an indication of the type of phytoclimate (i.e., whether phanerophytic, chamaephytic, hemicryptophytic, or therophytic) of the region concerned. Raunkiaer's "normal spectrum" was developed by him as the result of 1000 random samplings of the world flora. It may or may not represent accurately the flora of the world as a whole, but it does serve as a useful standard for comparison. Every regional spectrum will have at least one class whose percentage is higher than that of the normal; this class can be taken as an indicator of the phytoclimate of the region (Oosting, 1956).

The data used in the present study were obtained from field work and from supplementary observations on dried specimens in the herbaria of Chicago Natural History Museum, the University of Minnesota, and the University of Southwestern Louisiana. The field work was supported by Chicago Natural History Museum (1958, 1959) and by a grant from the National Science Foundation (1961, 1962). A few species that have been reported to occur in the southern Mackenzie Great Plains were not considered during the compilation of the data for this paper because these plants are seemingly waifs and not truly naturalized members of the flora.

Table 2.

Life-form distribution of the southern Mackenzie Great Plains flora. Data obtained from the study of 558 species.

	total species		percent of flora	
PHANEROPHYTES (Ph)				
Megaphanerophytes (Mg)	1		0.2	
Mesophanerophytes (Ms)	7		1.2	
Microphanerophytes (Mc)	16		2.9	
Nanophanerophytes (N)	39		7.1	
Total Phanerophytes		63		11.3
CHAMAEPHYTES (Ch)				
Herbaceous chamaephytes (Chh)	23		4.2	
Woody chamaephytes (Chw)	18		3.2	
Total Chamaephytes		41		7.3
HEMICRYPTOPHYTES (H)				
Protohemicryptophytes (Hp)	49		8.9	
Semi-rosette hemicryptophytes (Hs)	214		38.9	
Rosette hemicryptophytes (Hr)	37		6.7	
Total Hemicryptophytes		300		53.8
CRYPTOPHYTES (Cr)				
Helo-Hydrophytes (HH)	41		7.3	
Geophytes (G)				
Rhizome geophytes (Grh)	44		8.0	
Stem-tuber geophytes (Gst)	6		1.1	
Root-tuber geophytes (Grt)	3		0.5	
Bulb geophytes (Gb)	3		0.5	
Root-bud geophytes (Gr)	1		0.2	
Root parasites (Gp)	1		0.2	
Total Cryptophytes		99		17.7
THEROPHYTES (Th)		55		9.8

During the course of the field work, specimens for life-form analysis were collected toward the end of the growing season or even after the first frost in order to assure that the perennating structures would be as nearly as possible in winter condition. Colonies or individuals of the various species were located earlier in the season and were suitably marked for later study. For all collections, data were recorded concerning the position of perennating structures in relation to the soil surface. These field data are especially important in the case of hemicryptophytes and cryptophytes, which may be difficult to assign to the proper life-form class on the basis of herbarium study alone.

Table 3.

Life-form spectrum of the southern Mackenzie Great Plains flora, compared with the "normal spectrum" and with spectra of other North American regions.

	Ph	Ch	H	Cr	Th
Southern Mackenzie Great Plains	11.3	7.3	53.8	17.7	9.8
"Normal Spectrum"	46.0	9.0	26.0	6.0	13.0
Ellesmere Island (Raunkiaer, 1934)	—	23.5	65.5	11.0	—
Baffin Island (Raunkiaer, 1934)	1.0	30.0	51.0	16.0	2.0
Canadian Eastern Arctic (Scoggan, 1950)	3.5	29.4	54.5	10.5	2.1
Sitka, Alaska (Raunkiaer, 1934)	11.0	7.0	60.0	17.0	5.0
Bic and Gaspe (Scoggan, 1950)	10.3	7.8	48.7	18.9	14.1
West and Central Quebec (Scoggan, 1950)	16.6	3.5	43.6	22.4	13.8
Indiana (McDonald, 1937)	15.3	1.7	50.3	19.6	13.0
Illinois (Hansen, 1952)	13.9	2.0	47.5	17.1	14.4
Kentucky (Gibson, 1961)	17.6	1.4	52.6	16.6	11.8
Connecticut (Ennis, 1928)	15.0	1.9	49.4	21.7	11.7
Olympic Peninsula, Washington (Jones, 1936)	11.0	6.0	52.0	22.0	9.0

A tabulation of life-form data for the southern Mackenzie Great Plains is given in Table 2. In Table 3 comparison is made between the "normal spectrum," the spectrum of the Mackenzie plains, and the spectra of several other North American regions.

The following excerpt from Raunkiaer (1934, p. 133) serves well as an introduction to a brief discussion of the data in tables 2 and 3.

> In the northern cold temperate and cold zones as we gradually go towards the north we find that the biological spectrum of the vegetation changes in a very definite manner. The Phanerophytes and the Therophytes decrease and finally disappear. The Cryptophytes, too, which are well represented throughout most of the region, disappear entirely from the hostile regions of the extreme north. The percentage of Hemicryptophytes keeps fairly constant, being approximately double the percentage found in the whole world. The Chamaephyte percentage on the other hand gradually increases towards the north; in the southern parts of the region it is a long way below the Normal Spectrum, but after reaching this figure it soon doubles it. Ultimately the Chamaephyte percentage becomes three times or more that of the Normal Spectrum. All these changes follow the same series everywhere, whichever meridian we follow.

It is evident from the data in Tables 2 and 3 that the phytoclimate of the southern Mackenzie Great Plains is decidedly hemicryptophytic. The hemicryptophyte percentage is about double that of the "normal spectrum," in line with Raunkiaer's assertion. Although Raunkiaer states that the percentage of hemicryptophytes keeps fairly constant in the northern cold temperate and cold zones, there seems to be a tendency for this class to increase somewhat, to a point at least, with increase in latitude and with accompanying decrease in phanerophytes and therophytes. The significance and constancy of this tendency cannot be known until many more life-form data are available than at present.

The phanerophyte percentage is, as could be expected, somewhat lower than that of regions further south. The total percentage and the phanerophyte-subdivision percentages provide statistical demonstration of the well-known phenomenon that the stature of woody plants is progressively reduced as the continental tree-limit is approached. About 130 feet is the maximum height for trees in the southern Mackenzie Great Plains. The only megaphanerophyte is *Picea glauca;* all other trees in the region *(Picea mariana,* *Pinus banksiana, Abies lasiocarpa, Larix laricina, Betula papyrifera, Populus tremuloides,* and *P. balsamifera)* are mesophanerophytes here but may be megaphanerophytes further south. Other good examples of the change in life-form of woody plants with increase in latitude are seen in *Prunus virginiana* and *P. pensylvanica,* which in southern Mackenzie, at the northern edge of their range, are nanophanerophytic, reaching about 5 feet in height. Further south each of these species may be mesophanerophytic, reaching at least 30 feet in height.

The chamaephyte percentage is considerably above the percentage of this class shown by floras of parts of North America with a climate more favorable to plant growth. This relationship is in harmony with Raunkiaer's postulate that the chamaephyte percentage in floras tends to increase with increase in latitude. Of particular interest in the southern Mackenzie Great Plains flora is the preponderance of herbaceous forms among the chamaephytes.

According to Raunkiaer, the cryptophytes are well represented throughout most of the northern cold temperate and cold zones. They are well represented in the southern Mackenzie Great Plains flora, the percentage being neither greatly above nor greatly below the percentage for other studied North American floras, except those in the extreme north.

In connection with the therophyte percentage in the southern Mackenzie Great Plains flora it should be noted that most of the introduced plants in the region are annuals and that these introduced annuals constitute one-half of the therophyte population. The subarctic climate is, of course, not too favorable to the therophytic habit; it may account for the low percentage (4.9) of native therophytes in the flora and may explain, in part at least, why more introduced annuals are not present.

In summary, the data in this life-form study indicate that a climate most suitable to hemicryptophytes prevails in the southern Mackenzie Great Plains. Those data are generally in harmony with Raunkiaer's assertions concerning the change in life-form spectra of floras in cold temperature and cold zones with increase in latitude.

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A REVISION OF THE NORTH AMERICAN GENUS UVULARIA (LILIACEAE)

ROBERT L. WILBUR[1]

The endemic North American genus *Uvularia* is comprised of five species with one or more of these being frequently encountered from Nova Scotia south into northern Florida and west into Louisiana and eastern North Dakota. All of the species are very attractive members of the early spring flora and hence are widely known and often collected.

As is befitting a small and uncomplicated genus, its history is a simple one. It was founded by Linnaeus in 1738 in his Hortus Cliffortianus but takes 1753 as its starting point for nomenclatural purposes. Linnaeus recognized three different species (*U. amplexifolia, U. perfoliata* and *U. sessilifolia*) of which only the second and third species, which possess capsular fruit, are now considered to belong to that genus, or by some to it and a closely related segregate. Linnaeus' *U. amplexifolia*, whose fruit is a berry, has been treated as a member of the genus *Streptopus* since the early nineteenth century. As is demonstrated by the extensive list of "excluded names" at the end of this paper, earlier botanists had a much broader concept of the genus which included members of the following genera: *Disporum* (including *Prosartes*), *Fritillaria, Streptopus* and *Tricyrtis.* However, at least by the last quarter of the nineteenth century, these extraneous elements had been removed and the

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genus (or the group of two closely related genera) was restricted to the same eastern North American species that we recognize today.

Watson (Proc. Am. Acad. 14:221, 268, 269. 1879) segregated the two sessile-leaved species recognized by him from the perfoliate species, naming the first mentioned group *Oakesia*. In reviewing this paper, Asa Gray (Am. Jour. Sci. ser. 3. 18: 314. 1879) expressed his disinclination to accept the segregate although admitting the several "good" differences upon which the separation was based. The genus was taken up, however, in the sixth edition of Gray's Manual which Watson co-edited with Coulter. The segregate was also recognized by Small who, however, provided the substitute name *Oakesiella* since, under the American Code, which he more or less followed (as under the more recent versions of the International Code), a later homonyn could not be employed even if the first use of the name were treated as a synonym. In addition to Gray, mentioned above, the segregate has been rejected by Bentham and Hooker (Gen. Pl. 3:830. 1833), Engler (Nat. Pflanzf. II. 5: 24. 1888), Britton (Bull. Torrey Club 18: 272. 1891), Fernald (Gray's Man. 8th ed. P. 428, 429. 1950), and Gleason Ill. Fl. 1:428. 1952), while *Oakesia* or *Oakesiella* has been taken up by Small (Fl. Se. U. S. 271, 272. 1903; Man. Se. Fl. 299, 300. 1933), Robinson and Fernald (Gray's Man. 7th ed. p. 280, 285, 286. 1907), Macbride (Contr. Gray Herb. 53:5. 1918) and Rydberg (Fl. Plains & Prairies p. 219, 221, 222. 1932).

INTERGENERIC RELATIONSHIPS

Unfortunately, it is not possible to discuss meaningfully the generic affinities of *Uvularia*. The tribe Uvularieae has been variously interpreted since it was first published by Kunth (Enum. Pl. 4: 199-214. 1843). In addition to *Uvularia* it then included such American genera as *Streptopus* Michx. (including *Hekorima* Raf.), *Disporum* Salisb. (including *Prosartes* Don), and four other genera from the Old World. There is a high degree of correspondence as to the contents of the tribe in the works of Bentham and Hooker

(Gen. Pl. 3:829-832. 1883), Engler (Nat. Pflanz. II. 5: 24-27. 1888) and Hutchinson (Fam. Fl. Pl. 2:606. 1959). The last two authors however, restrict the tribe to capsuled genera, thus excluding the baccate *Disporum* which was relegated by both of them to the tribe Polygonateae. None of the other genera included in the tribe by Hutchinson possesses a range that is ordinarily to be expected for very close relatives of eastern North American plants. Engler placed the eight genera of his concept in his Melanthioideae — Uvularieae all of which, with the exception of *Uvularia*, are confined to the Old World continents of Africa, Asia and Australia. Only one of the Asian genera, the aberrant, septicidally dehiscent *Tricyrtis* (considered by Hutchinson as the type of another small, ditypic tribe), reportedly from Japan, Korea, China and the Himalayas, possesses a range that is an expected one for close relatives of eastern North American plants. Until considerably more knowledge is acquired, the classifications of the Liliaceae, like most large taxa, will continue to be artificial, being largely based upon one or very few characters, and hence speculation as to the generic relatives of a genus such as *Uvularia* will remain most unproductive and unconvincing.

MORPHOLOGY

HABIT. All five species are perennial herbs whose aerial parts die back to the ground each winter.

UNDERGROUND PARTS. The five species are divisible into two distinct groups upon the basis of their underground parts. Three species possess a very short (less than 1 cm long) underground rhizome from which arise the annual aerial stems and from which descend a cluster of thickened roots. One of these species (*U. perfoliata*) spreads by means of a pair of slender, subterranean stolons, each of which forms buds and roots at its distal end, after which the connecting portion of the stolon disintegrates. These structures have been seldom observed but this is not surprising as considerable care must be devoted in securing them intact. Whether they are present or absent in the other two species (*U. grandiflora* and *U. puberula*) with a similar rhizome and root system is at present unknown but they have at least not been observed. Two species (*U. sessilifolia* and *U. floridana*) possess elongate (10 cm long or more), thickened rhizomes from which descend scattered fibrous roots and from the tips of which ascend the aerial stems.

AERIAL STEMS. In all species flowering or fruiting stems appear to be once-branched if one ignores the short, flowering or fruiting branches. The branching pattern is sympodial. The stems of the perfoliate species are terete and hollow while those of the sessile-leaved group are typically strongly angled (at least above) and solid.

LEAVES. The genus is divisible into two distinct groups based upon whether the leaves are perfoliate or sessile. (The two groups however are not the same as would result from a division based upon the subterranean parts.) The upper leaves of the perfoliate group are merely sessile and strongly clasping or amplexicaul. The leaf margins of the perfoliate-leaved species are perfectly smooth while those of the sessile-leaved species are all very minutely papillose.

INFLORESCENCE. The flowers are solitary and terminal although superficially appearing lateral or axillary and often so described (*e. g.* Dietz, p. 221). The pattern of growth is hence sympodial. The flowers of *U. floridana, U. perfoliata,* and *U. grandiflora* are borne on short branches bearing a small to large leaf (= bract) at the base of the pedicel. This feature has been rarely seen on specimens of *U. puberula* and it has never been observed in *U. sessilifolia.* It would be of considerable interest to know if there is any anatomical evidence as to whether those species lacking the flower-or fruit-subtending bract have merely lost the bract or have lost both bract and the supporting stem.

INDUMENT. *Uvularia perfoliata, U. floridana* and *U. sessilifolia* are completely glabrous. The lower leaf-surface of *U. grandiflora* is usually densely short-pubescent but the degree of pubescence varies from dense to almost, or rarely even completely, glabrous. Dietz (1952) has concluded that this variation is due to introgression from *U. grandiflora* into the glabrous *U. perfoliata* but, as areas of comparative glabrousness of what surely is *U. grandiflora* are to be found in Arkansas and Minnesota far from the influence of *U. perfoliata,* it would seem that another or an additional explanation is required. *Uvularia puberula* is exceedingly variable as to the presence and amount of pubescence, its distribution and even the length of the trichomes. The pubescence is usually to be found, when present, upon the angles of the upper portion of the stem but sometimes extends onto the lower surface of the leaves along the elevated principal veins. In some specimens of this species no pubescence is to be detected and this feature is characteristic of the so-called var. *nitida.*

PERIANTH. The perianth is a typically liliaceous one consisting of 6 distinct tepals arranged in two imbricate series. The tepals of *U. perfoliata* are the most distinctive in the genus because of the presence of granular papillosities on their inner surface. There is a tendency for the size and shape of the tepals to be more or less characteristic of each species but the variation is so great that the tendencies are not too helpful. The tepals are rendered somewhat gibbous at base through the presence of a nectariferous pouch at the base of each perianth-segment. Small (1903, 1933) was in error in stating that the sessile-leaved species (*Oakesiella*) lack nectaries. Watson (1879) stated that the perfoliate species were characterized by the presence of a callus or ridge on either side of the nectary while the sessile-leaved group lacked the ridge. Study of pickled flowers of all five species indicated that a moderately to slightly elevated, thin flap was present on each side of the nectariferous depression in the two perfoliate-leaved species while only the slightly hardened wall of the nectary was present in the sessile-leaved species. This distinction is however, difficult to detect and hence of little taxonomic utility.

STAMENS. The six stamens usually have been described as adnate to the very base of the tepals and this may be their actual condition but they appear to me to be attached to the receptacle slightly above the tepals. The slightly flattened filaments are about half-again as long (or even less) as the linear, laterally dehiscing, extrorse, adnate anthers. The stamens appear to be of slightly different lengths in two alternating series but this is the result of the slight difference in attachment levels of the two series. The connective extends beyond the anther-sacs in all the species but is most obviously exserted in *U. perfoliata.* The degree of exsertion is quite variable.

PISTIL. The ovary is sessile or very nearly so in all species but *U. sessilifolia,* which possesses a stipitate ovary. The stipe appears to be merely the sterile base of the ovary. The ovary is in general rounded (although lobed) in the two perfoliate-leaved species but sharply angled in the three sessile-leaved species. The stigma is moderately to deeply cleft in the various species, being probably most deeply divided in *U. puberula* and *U. grandiflora* and the least so in *U. floridana* and *U. sessilifolia.* Fernald (Rhodora 37: 409. 1935) reported that *U. puberula* exhibits heterostyly (which, if true, would be a most unusual condition in the Liliaceae) but it appears from admittedly casual observations that the variation in length of style and exsertion of the stigmatic branches beyond the anthers within a given species is almost completely a matter of age. The flowers are apparently protandrous.

FRUIT. The loculicidally and tardily dehiscent capsules offer a ready means of identification but the distinguishing features are often lost in pressed specimens. The fruits of the perfoliate-leaved species are more or less truncate at the apex while those of the sessile-leaved species gradually taper to an acute (*U. puberula* and *U. sessilifolia*) or even to a long-beaked apex (*U. floridana*). The fruit of *U. perfoliata* is more or less angularly obpyramidal and each of the three lobes is deeply bifid, thus appearing 6-horned. The fruit of *U. grandiflora* is more roundedly obpyramidal and with very little or no evidence of deeply bifid or 2-horned angles. The fruits of the sessile-leaved species are much more sharply angled, with *U. sessilifolia* being at once distinguished by its long-stipitate base in contrast to the sessile or very nearly sessile bases of the other two species.

The long-rostrate beak of *U. floridana* distinguishes that species from *U. puberula* as well as all other species in the genus.

SEEDS. The seeds of the perfoliate-leaved species, which possess an apparent outgrowth of the raphe which at first is a swollen, balloon-like sac but at maturity deflates into a thin membrane nearly half-enveloping the seed, are at once distinguishable from the two turgid ridges which parallel the raphial slit in the seeds of the three sessile-leaved species. The nature of these outgrowths is unfortunately unknown.

ANATOMY

Holm (Bull. Torrey Club 18: 1-5. 1891) presented the only account known to me concerned with the internal anatomy of any species of this genus. He compared the anatomy of two species: *U. perfoliata* and *U. sessilifolia.* The results of his anatomical comparison are presented in the chart below.

		U. sessilifolia	*U. perfoliata*
1.	Walls of endodermis	Thin	Thick
2.	Number of fibro-vascular bundles in root	20	10
3.	Number of layers of cells between epidermis of stem and mechanical tissue	1	2
4.	Number of layers in mechanical tissue of stem	5	2

Eames (Chronica Bot. 14: 128, 129. 1953), although presenting no supporting evidence, made the following statement: "Anatomically there is no basis for the maintenance of *Oakesia.* There is more anatomical difference between *U. perfoliata* and *U. grandiflora* than between *U. grandiflora* and *Oakesia.*" It is to be hoped that the evidence for such a sweeping statement will soon be presented, for it is difficult to conceive of anatomical evidence that would show a closer relationship of *U. perfoliata* to a species such as *U. sessilifolia* than to *U. grandiflora.*

Anderson and Hubricht (Am. Nat. 77: 285-287. 1943), by making celloidin peels of herbarium specimens, found that the "epidermal cells of *Uvularia grandiflora* tend to be larger, more irregular and more variable than those of *U. perfoliata*" and concluded that this tendency resulted in "a coarser, cruder leaf-texture".

CYTOLOGY

Anderson and Whitaker (1934) reported the chromosome number for three species (*U. grandiflora, U. perfoliata* and *U. sessilifolia*) to be $n = 7$. The chromosomes were found to be large, and each was identifiable by its distinctive morphology. They concluded from this study that "there is no evidence that chromosome duplication or chromosome interchange are of phylogenetic importance in *Uvularia.*" Previously Belling (Jour. Genetics 15: 245-266. 1925) demonstrated in *U. grandiflora* that under experimental conditions non-disjunction, fragmentation, lack of pairing and duplication of all or part of the chromosome complement all occur.

Belling also reported that meiosis of the pollen mother cells in his plants of *U. grandiflora* grown in a cool greenhouse took place in late February. Alden (Bull. Torrey Club 39: 439-446. 1907) reported for *U. sessilifolia* that mature microspore mother cells are to be found by the middle of September and that these divide by October and overwinter as microspores. Meiosis within the ovule however did not occur prior to late April and even the megaspore mother cells were not formed prior to mid-March.

Sato (Jap. Jour. Bot. 12: 76. 1942) reported that the *U. sessilifolia* studied by him (apparently grown from botanical garden material) had $2n = 16$ and not $2n = 14$ as indicated by Anderson and Whitaker. The reason for this discrepancy has not been determined. Since the chromosome number of several Japanese species of *Disporum* including *D. sessile* (=*Uvularia sessilis*) is $2n = 16$, suspicion is aroused as to the identity of Sato's material.

INTRAGENERIC RELATIONSHIPS

A suggestion as to the probable relationships between the species is presented in the accompanying figure (fig. 1). Such a hypothetical scheme is of course highly subjective and hence open to criticism but for most taxa of plants we now have little choice but to attempt to visualize a hypothetical ancestral type from which a suggested "phylogeny" for the group may be logically derived.

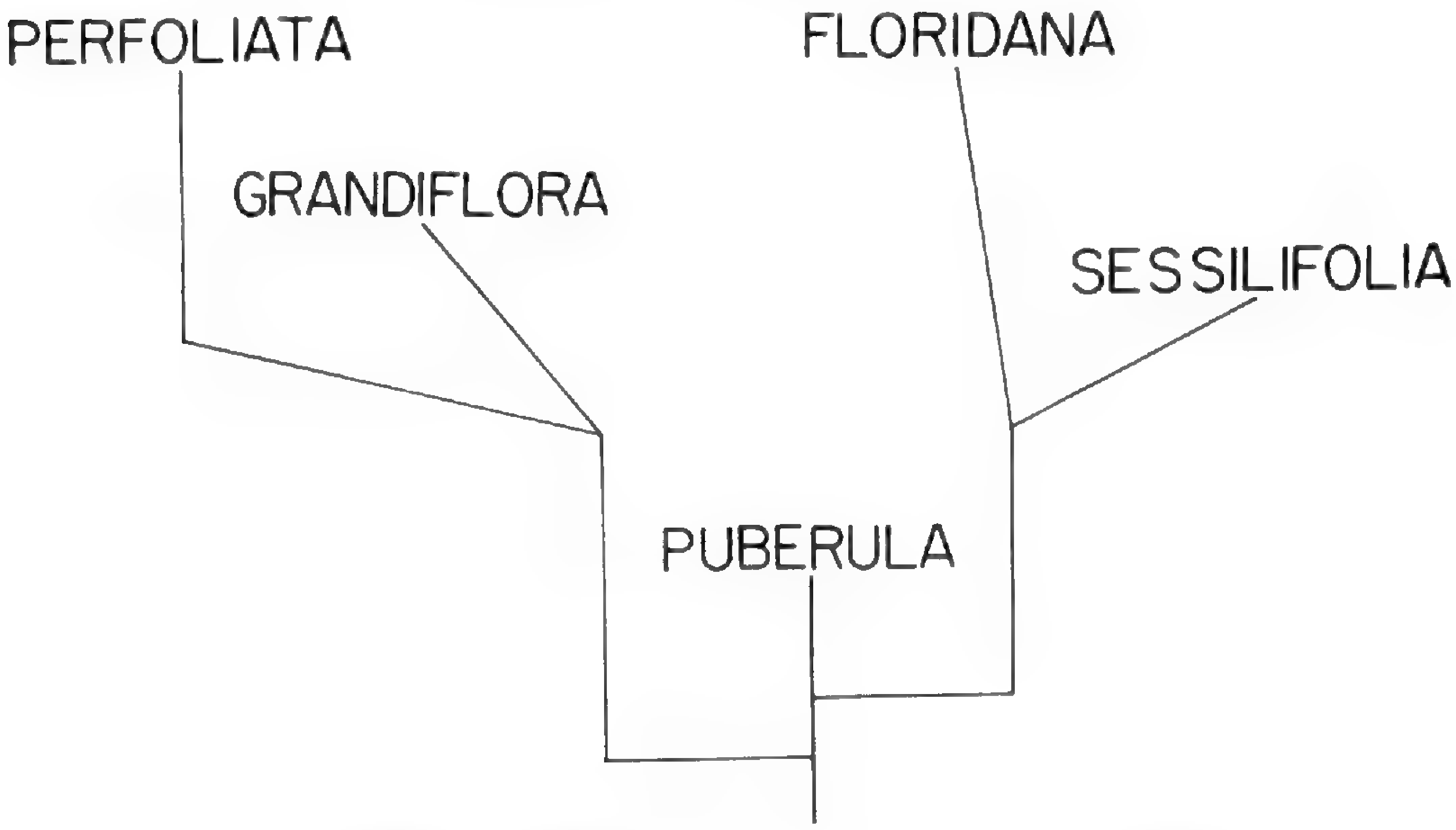

Fig. 1. Probable relationships of the species of *Uvularia*

An attempted reconstruction of the more immediate hypothetical ancestral taxa of these five species of *Uvularia* would result in a perhaps pubescent perennial with a very short rhizome or caudex, fleshy roots, sessile leaves and sympodially arranged flowers borne on a leafy-bracted short branch. This plant would most closely resemble *U. puberula* which, however, only very rarely possesses a leafy bract.

There would seem to be no doubt that sessile leaves are more primitive than perfoliate ones. (The presence of sessile leaves at the ends of the branches and the increasing perfoliateness of leaves are thought to be evidence of this.) There is certainly much less evidence that a very short rhizome is more primitive than an elongate rhizome or that the presence of pubescence is a primitive characteristic and its absence an indication of evolutionary advancement. But both of these assumptions are here made since the short-rhizomed, puberulent, sessile-leaved species, *U. puberula*, resembles the two perfoliate-leaved species in its underground parts. With its similar unornamented tepals, *U. puberula* is seemingly more closely related to the puberulent *U. grandiflora* than to the apparently more specialized papillate-tepaled *U. perfoliata.* The presence of leafy bracts below the flowers or fruits of *U. floridana, U. grandiflora* and *U. perfoliata* is here interpreted to be a primitive character. Those species lacking this bract are thought to have lost it through suppression. Several specimens of otherwise unmistakable *U. puberula,* but with a small subtending bract, were noted in this study. (It would be, however, of considerable interest to know if there is any anatomical evidence of the hypothesized suppressed leafy bract within the two species.) And finally the stalked fruit of *U. sessilifolia* is thought to be an indication of advancement.

SUBGENERIC CLASSIFICATION

Evaluation of the taxonomic merit of such a segregate as *Oakesiella* (= *Oakesia*) is of course highly subjective. The two groups give every morphological evidence of being natural and yet whether the two taxa are better accorded generic or subgeneric rank is largely a matter of individual taste. It is believed however that criteria suggested by McVaugh (Wrightia 1: 15, 16. 1945) for the evaluation of proposed generic segregates are met with by *Oakesiella.* I choose to recognize the two taxa as well-defined sections but others with whom I could not argue no doubt would consider that the differences warranted subgeneric status and still others would deem the degree of divergence represented as meriting no more than the rank of series. And of course many would perhaps rightly consider it folly to erect a formal subgeneric classification within so small and relatively homogeneous a taxon.

SYSTEMATIC TREATMENT

Uvularia L., Sp. Pl. 304. 1753; Gen. Pl. 144. 1754.

Anonymos Walt., Fl. Car. 122. 1788. *nom. illegit.* Art. 20. *Oakesia* S. Wats., Proc. Am. Acad. 14:221. 1879; not *Oakesia* Tuckerm., Hook. Lond. Jour. Bot. 1: 445. 1842 which = *Corema* G. Don, Edinb.

New Phil. Jour. **2**: 63. 1826. *Oakesiella* Small, Fl. Se. U. S. 271, 1328. 1903.

Pubescent or glabrous, occasionally glaucous, perennial herbs with very short or elongate rhizomes and with thickened or fibrous roots. Stems erect, terete to strongly angled, and, excluding the flowers, but once branched, with several sheathing, papery cataphylls below the blade-bearing leaves. Branching-pattern sympodial. Leaves alternate, perfoliate or sessile, oblong-linear to oblong-ovate and longitudinally several- to many-nerved. Flowers solitary, terminal but appearing axillary, pendant, narrowly campanulate. Perianth 6-parted; the segments multiveined, similar to one another in two imbricate series, distinct, pale- to deep-yellow, linear-oblong, obtuse to acute, slightly gibbose at base with a nectariferous depression, dropping off along with the stamens several days after pollination. Stamens 6, hypogynous, apparently completely free from the tepals, always shorter than the perianth segments; filaments slightly flattened and dilated below, rather short, being several times exceeded in length by the pollen sacs; usually noticeably but slightly alternating with one another in length with 3 longer and 3 shorter; anthers elongate, linear-oblong, extrorse, adnate, dehiscing by a longitudinal slit down the abaxial face; connective slightly to conspicuously exserted, its apex acute to obtuse or even truncate. Pistil 3-carpellate; ovary 3-loculate, sessile to conspicuously stipitate, rounded- to sharply-triangular in cross-section, truncate to acute or even rostrate at apex, acutely tapering at the base; style united for about one-third to two-thirds the distance from ovary to the tip of the tripartite stigma, deciduous at maturity; stigmas linear, at first appressed together but arching outward at maturity and stigmatic along inner surface. The style and stigmatic lobes at first exceeded in length by the anthers but later exceeding them. Ovules anatropous, 2-6 per locule, horizontal from axile placentae. Fruit a greenish to stramineous (or in age becoming brownish) loculicidal capsule with walls smooth or pebbled within. Seeds globose, smooth, few (1-3) in each locule at maturity, with a very small embryo and a hard, white endosperm.

LECTOTYPE: *Uvularia perfoliata* L. (First chosen by Britton and Brown, Ill. Fl. ed. 2. 2: 518. 1913, but indirectly determined by Watson's exclusion of *U. sessilifolia* in 1879.)

KEY TO THE SECTIONS OF UVULARIA

Leaves sessile, their margins scarious but also very minutely papillose-denticulate; seeds with a thick ridge-like crest bordering each side of the slit-like raphe; capsule acute at apex; the inner surface of fruit smooth or at least not densely pebbled. .. Section 1. OAKESIELLA.

Leaves perfoliate, their margins scarious but smooth; seeds largely surrounded by a bladdery sac, this later becoming a flattened, membranous, loose envelope nearly half-enclosing the seed; capsule truncate at apex or at least not gradually tapering from near the middle; inner surface of fruit densely pebbled. .... Section 2. UVULARIA.

Section 1. OAKESIELLA (Small) stat. nov.

Oakesia S. Wats., Proc. Am. Acad. 14: 269. 1879; not *Oakesia* Tuckerm., Hook. Lond. Jour. Bot. 1: 449. 1842 = *Corema* G. Don, Edinb. New Phil. Jour. 2: 63. 1826. *Oakesiella* Small, Fl. SE. U. S. 271, 1328. 1903.

Pubescent or glabrous herbs with elongate or very short rhizomes and with either scattered fibrous or clustered, thickened, fleshy roots. Stems triquetrous, at least above. Leaves sessile and, if sometimes appearing somewhat clasping at base, never perfoliate, margins minutely denticulate. Ovary conspicuously 3-angled in cross-section and tapering from middle to both apex and base. Capsule acute at apex; the inner surface of fruit smooth or slightly ridged but never densely pebbled. Seeds with two swollen, elevated ridges paralleling the raphial slit.

LECTOTYPE: *Oakesiella sessilifolia* (L.) Small = *Uvularia sessilifolia* L. (Chosen by Small, Fl. Se. U. S. 1328. 1903).

KEY TO THE SPECIES OF THE SECTION OAKESIELLA

1. Stigmatic lobes nearly equaling or at least not more than twice exceeded by the undivided style; upper stems and sometimes the lower surfaces of the leaves often moderately to densely puberulent but occasionally glabrous; aerial stem arising from a very short rhizome (less than 0.5 cm. long) with clustered, thickened roots .... 1. *U. puberula.*
1. Stigmatic lobes 3-5 times exceeded by the length of the undivided style; stem and lower surfaces of the leaves always glabrous; aerial stem arising from an elongate fleshy rhizome with scattered fibrous roots.
    2. Short flowering-branchlet bearing a foliaceous bract stigmatic lobes 3 mm. long or longer; capsule sessile at base and conspicuously rostrate at apex; connective of filament exserted 0.5 mm. or more beyond anther-sacs; tepals with an acuminate apex .... 2. *U. floridana.*
    2. Short flowering-branchlet lacking a bract; stigmatic lobes less than 3 mm. long; capsule clearly stipitate and lacking a rostrate beak; connective of filament barely, if at all, exserted beyond anther-sacs; tepals rounded to acute at apex .... 3. *U. sessilifolia.*

Section 2. UVULARIA.

Pubescent or glabrous herbs with very short rhizomes and with clustered, thickened, fleshy roots. Stem terete. Leaves perfoliate (except for the uppermost which is merely sessile); margins smooth. Ovary rounded in cross-section although usually with 3 principal lobes and each of these bilobed to a lesser extent. Capsule truncate at apex; the inner surface of fruit densely pebbled. Seeds first partly enveloped by a large, swollen, balloon-like sac which at maturity becomes deflated and then forms a membrane which half envelopes them.

KEY TO THE SPECIES OF SECTION UVULARIA

Perianth-segments glabrous within; leaves usually at least moderately puberulent beneath but rarely glabrate; connective of filament extended less than 0.8 mm. beyond anther-sacs; principal capsule-lobes neither deeply lobed nor 2-horned; blade-bearing leaves below the lowest branch typically but one .... 4. *U. grandiflora.*

Perianth-segments conspicuously granular-papillate within; leaves glabrous beneath; connective of filament extended more than 0.8 mm. beyond anther-sacs; principle capsule-lobes deeply 2-lobed or 2-horned; blade-bearing leaves below the lowest branch typically 3-4 .... 5. *U. perfoliata.*

1. **Uvularia puberula** Michx., Fl. Bor.-Am. 1: 199. 1803. (Type presumably at Paris, but not seen. Description is such that no other species could have been meant.) *Oakesia puberula* (Michx.) S. Wats., Proc. Am. Acad. 14: 269. 1879. *Oakesia sessilifolia* var. (?) *nitida* Britt., Trans. N. Y. Acad. Sci. 9: 13. 1899. (Type! NY, Isotypes GH, CHRB.) *U. sessilifolia* var. *nitida* (Britt.) Morong, Mem. Torrey Club 5: 111. 1894. *U. nitida* (Britt.) Mackenzie, Torreya 8: 14. 1908. *Oakesiella puberula* (Michx.) Small, Fl. Se. U. S. 272, 1328. 1903. *Oakesiella nitida* (Britt.) A. A. Heller, Muhlenbergia 6: 83. 1910. *U. puberula* var. *nitida* (Britt.) Fern., Rhodora 37: 407. 1935. *U. pudica* var. *nitida* (Britt.) Fern., Rhodora 41: 536. 1939.

Plant usually moderately to densely short-puberulent on the upper portion of the stem, especially at the nodes and occasionally sparingly so on the lower surface of the leaves but rarely glabrous or very nearly so throughout; the stem conspicuously angled above and often triquetrous, about (2.0-) 2.5-4.5 (-5.0) dm. tall with several stems arising in a cluster from a very short rhizome and with a cluster of descending fleshy roots. Leaves dark green above and lighter green beneath, glabrous or very sparingly short-puberulent below, especially near the base of the principal veins, mostly (3.5-) 4.5-7.5 (-8.5) cm. long and (1.0-) 1.7-3.2 (-4.0) cm. wide, oblong-elliptic to broadly elliptic in general outline with a broadly rounded, sessile to subclasping base, and an acute to even abruptly short-acuminate apex; the leaf subtending the first branch about (3.7-) 4.5-6.5 (-8.0) cm. long and (0.9-) 1.0-2.0 (-2.5) cm. wide. Blade-bearing leaves below the first branch typically but one. Leaf-margin very minutely but abundantly papillose-denticulate and very slightly scariously edged. Flower borne solitary and terminating the stem but appearing as if lateral and borne opposite the leaf; its downwardly arching peduncle lacking a leaf or bract and in flower about 0.5-1.4 (-2.0) cm. long and glabrous to densely short-puberulent. Perianth segments about (1.0-) 1.5-2.5 (-2.7) cm. long and (1.5-) 2.0-4.0 (-5.0) mm. wide; each tepal more or less tapering to a rounded apex. Tepals fleshy-thickened for about the basal 1-1.5 mm. with an indistinct, shallow, wedge-shaped, nectariferous depression about 1 mm. long and 0.5-0.8 (-1.2) mm. wide; the nectary scarcely bordered on either side by a short ridge that is but little elevated above the surface of the tepal. Filaments smooth, oblong to linear and scarcely if at all tapering from middle to either apex or base, about (1.5-) 2.0-4.0 (-5.5) mm. long and about 0.8-1.2 mm. wide. Connective extending beyond the anther-sacs for about 0.6-0.8 mm. and about 0.5 mm. wide, very slightly inwardly arching and very conspicuously truncate. Anther-sacs about (5.0-) 7.0-12.0 (-13.0) mm. long. Ovary conspicuously triquetrous (except through abortion of one locule), tapering distinctly to both apex and base, hence appearing shortly stipitate; the three sides of the ovary appearing slightly concave but not at all medially lined or grooved, about 0.5-0.8 cm. high and each face about 2.5-3.5 mm. wide. Style united for about one-half the distance to the stigmatic tips which somewhat reflex with age; style and stigmas together about 8.0-14.0 mm. long. Capsule typically conspicuously three-winged, triquetrous and roundedly tapering to both apex and base, its sides somewhat concave and each face appearing broadly elliptic in outline; its base scarcely stalked (at most 1-1.5 mm.); about (1.5-) 1.8-2.7 (-3.5) cm. long and (1.0-) 1.5-2.0 (-2.2) cm. wide, dotted reddish-brown. Seed globose or nearly so, about 3.0-5.0 mm. in diameter, reddish-brown at full maturity but straw-colored when it first reaches full-size and with a thickened mound-like crest extending along either side of the slit-like raphe and about half encircling the seed. Usually in moist but well-drained wooded sites from New York (Long Island) and New Jersey, then in the Coastal Plain and lower Piedmont of southeastern Virginia south into Georgia and in the mountains and upper Piedmont from southern Pennsylvania south to west-central Georgia (Fig. 2).

There is considerable variation in the amount of pubescence exhibited by individual plants of this species, ranging from glabrous to very densely puberulent. The representatives of the species found in New Jersey are apparently all of the glabrous type, but elsewhere within the range of the species equally glabrous plants are to be found. And even more frequently encountered are individuals that are only moderately to sparsely puberulent. The glabrous tendency has been treated as a variety by Britton, Morong, and Fernald and as a species by Mackenzie. Fernald stressed, in addition to the glabrousness of this taxon, its thinner and

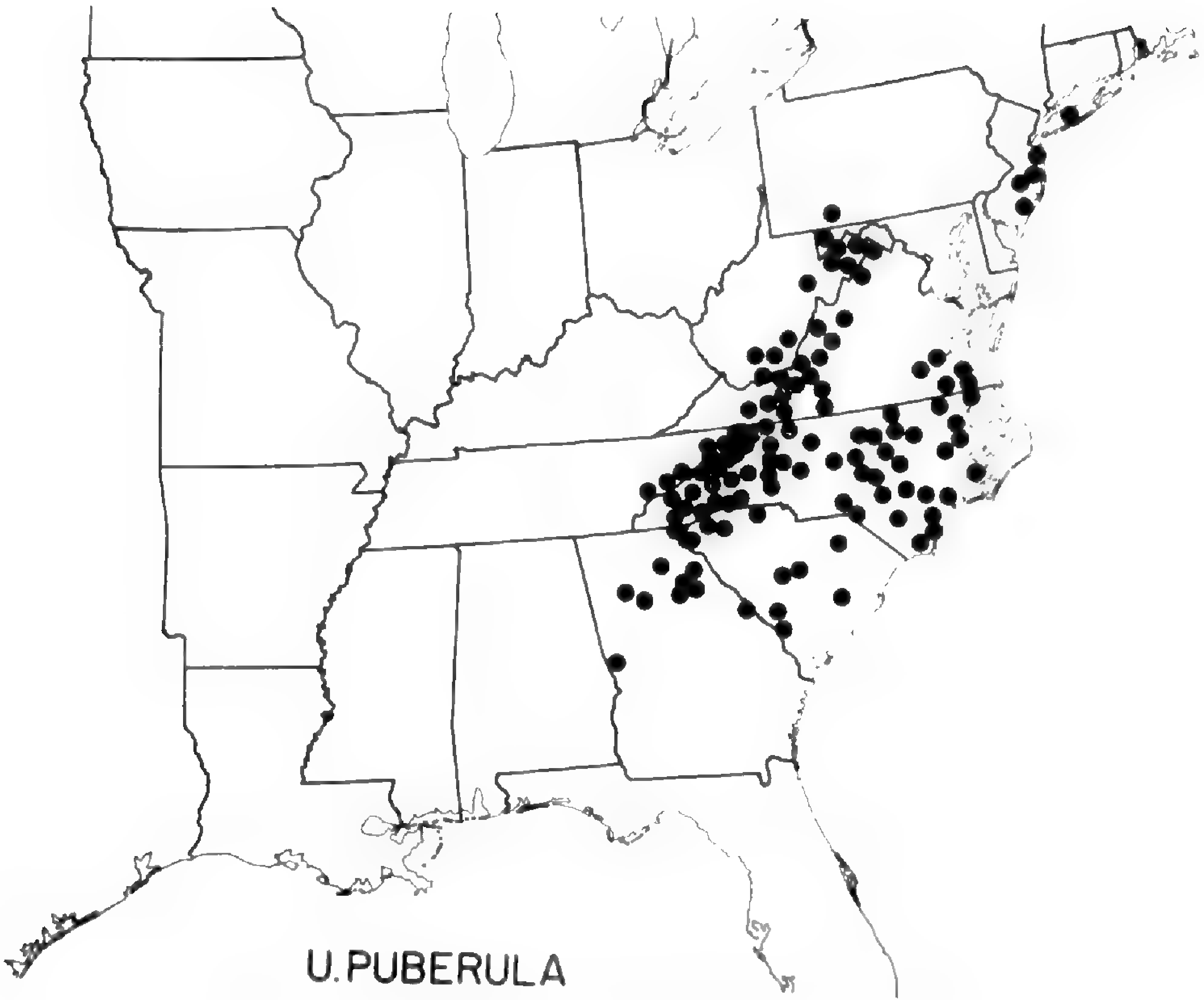

Fig. 2. Distribution of *Uvularia puberula*

less prominently reticulate leaves and gave its range as Long Island, New Jersey and southeastern Virginia. I have found equally glabrous plants (often included on the same sheet as densely puberulent ones) in the mountains of Virginia, West Virginia and the Carolinas but have not considered that the variation warranted formal taxonomic recognition. Although glabrous plants are more frequent in the Coastal Plain, puberulent individuals are also encountered there. Recognition of a glabrous variety largely restricted to the Coastal Plain would appear somewhat more plausible if the individuals were either glabrous or densely puberulent instead of ranging fully between the two extremes.

The vegetative parts of this species are thicker and more sturdy than those of any other species and its leaves and fruit persist in a green and apparently vigorous condition until frost or for several months later than its congeners.

As discussed in the section on "Dubious and Excluded Names", I now believe that I was too hasty in proposing a new combination, based upon Gmelin's *Erythronium carolinianum,* as the proper name of this species.

2. **Uvularia floridana** Chapm., Fl. S. U. S. 487. 1860. (Type not seen. Original description thought to be conclusive.) *Oakesia floridana* (Chapm.) Macbride, Contr. Gray Herb. n.s. 53: 5. 1918. *Oakesiella floridana* (Chapm.) Small, Fl. Se. U. S. 272, 1328. 1903.

Plants completely glabrous and the upper stem and lower surfaces of the leaves slightly glaucous; the stem about 2.5-4.0 (-4.5) dm. high and triquetrous at least above and arising from a branching, whitish, fleshy rhizome about 3-5 mm. in diameter. Leaves glabrous, narrowly to broadly elliptic with a tapering to rounded base and an acute to rounded apex, mostly 4.0-7.0 (-8.5) cm. long and (1.2-) 1.8-3.0 cm. wide; the leaf subtending the lowest branch mostly about 4.0-7.5 cm. long and 1.2-2.8 cm. wide. Blade-bearing leaves below the lowest branch 1-2. Leaf-margin scarious and very minutely but densely denticulate. Fertile branchlet composed of a strongly 3-angled, slightly hyaline-winged stem about (0.8-) 1.2-1.6 (-2.0) cm. long; an ovate to lanceolate foliaceous bract with a rounded base and an acute apex mostly 1.0-2.0 (-3.0) cm. long, and a terete peduncle about 2-8 mm. long and

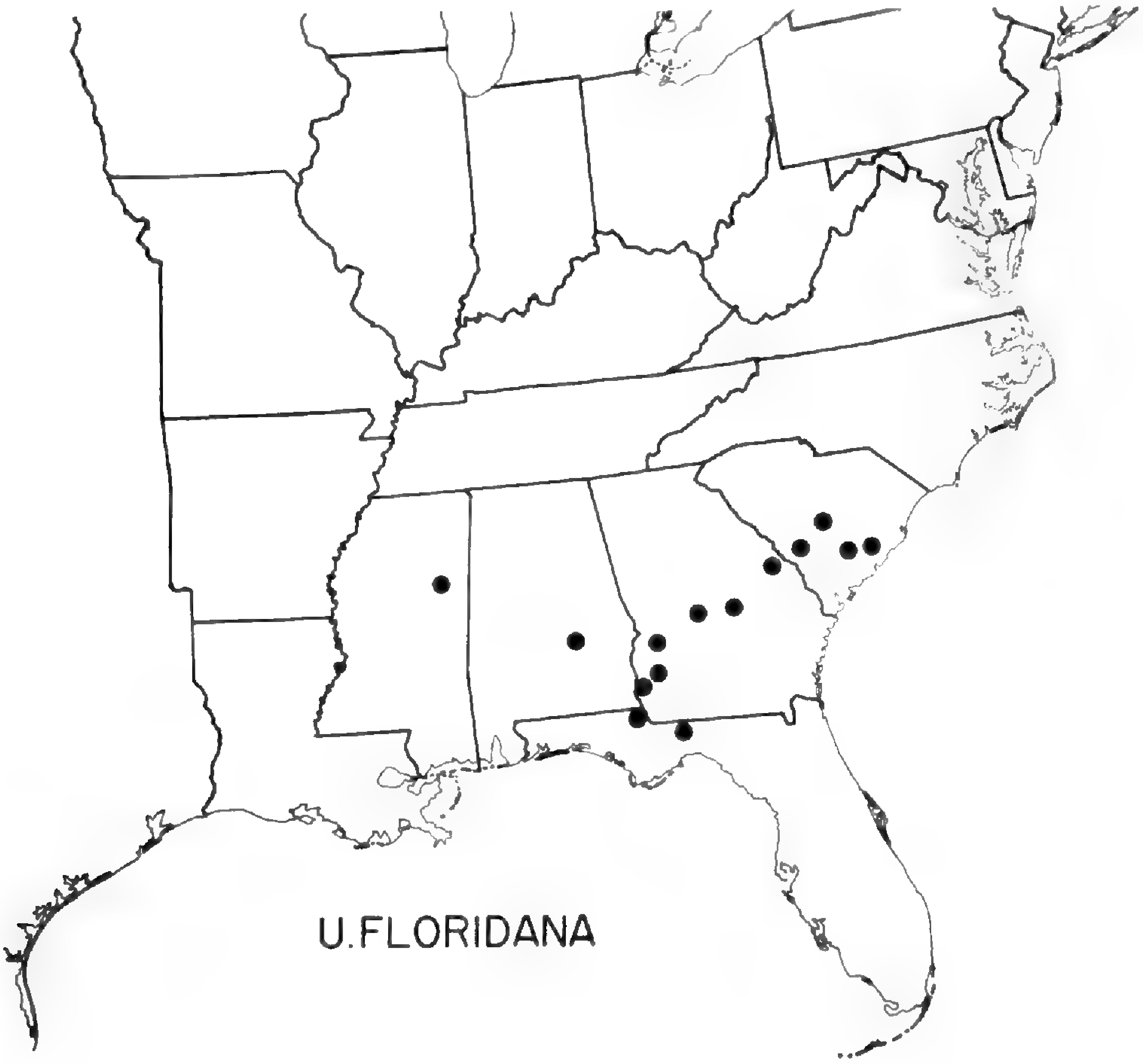

Fig. 3. Distribution of *Uvularia floridana*

one flower. Perianth-segments about (1.8-) 2.2-3.0 cm. long and about 3-4 mm. wide, tapering to an acuminate apex, perfectly smooth both internally and externally, very pale yellowish-white. Tepals narrowing basally into a thickened, somewhat fleshy, channeled base about 1.0-1.8 mm. long with a well-defined, narrow, nectariferous depression about 0.8-1.4 mm. long and 0.5-1.0 mm. wide with more or less parallel sides and thickened walls but lacking an elevated flap or ridge. Filaments smooth, white, narrowly oblong to linear and scarcely, if at all, tapering to either apex or base, about 3-5 mm. long and about 0.8-1.0 mm. wide. Connective bluntly rounded, whitish, and extending 0.5-2.0 mm. beyond the anther-sacs. Anther-sacs bright yellow, about 6-9 mm. long. Ovary conspicuously triquetrous and very indistinctly, if at all, stipitate; tapering from its widest point at the middle to both apex and base; the three sides each slightly concave and at least not noticeably medially grooved, about 3-4 (-5) mm. high and each face about 1.5-2.5 mm. wide. Style united for at least four-fifths of the distance from the ovary to the stigmatic tips which at maturity are widespreading and somewhat reflexed; style and stigmas together about 1.0-1.5 cm. long with the stigmatic lobes about 3.5-5.0 mm. long. Capsule strongly 3-winged, triquetrous and rather abruptly tapering to apex and base so that its rather concave sides appear rhombic in outline, its base sessile and the apex with a conspicuous rostrate beak about 4-7 mm. long and 2 mm. wide; the body of the fruit about 1.5-3.0 cm. long, excluding the beak, and 1.2-2.0 cm. wide. Seed (known only from one imperfect example) globose to subglobose, about 4 mm. in diameter, reddish-brown at maturity with a thickened mound-like ridge or crest extending along either side of the slit-like raphe and perhaps 1/3-(1/2?) encircling the seed. Moist and often poorly drained bottomland hardwood forests along the Coastal Plain from South Carolina into northern Florida and west into Mississippi (Fig. 3).

This little-collected species is known only from the bottomlands and floodplains of the southeastern Coastal Plain. It is readily distinguishable from its nearest relative *U. sessilifolia*, which also possesses sessile leaves and an elongated rhizome, by its long-beaked but sessile fruit and the cordate bract which subtends its flower or fruit.

It seems desirable to cite a specimen of this infrequently collected species from each county in which it is known.

REPRESENTATIVE COLLECTIONS: — SOUTH CAROLINA: BARNWELL CO.: *Batson & Kelley* 30 Mar. 1953 (UNC); BERKELEY CO.: north of Goose Creek Reservoir. *Hunt 2771* (GA); CALHOUN CO.: 4 miles southeast of Lone Star. *Radford 9366* (UNC); DORCHESTER CO.: vicinity of Four Holes Swamp. *Ahles 21906* (UNC). GEORGIA: BURKE CO.: 5 miles west of Waynesboro. *Harper 2074* (F, GH, MSC, MO, NY, US);

CALHOUN CO.: near Ichawaynochaway Creek, west of Leary. *Thorne & Muenscher 7994* (GA, GH, IA, NY); EARLY CO.: along Odum Creek, west of Blakely. *Thorne & Muenscher 8598* (GA, IA); HOUSTON CO.: between Grovania and Beech Haven. *Harper 1966* (F, GH, MO, MSC, NY, US); LAURENS CO.: Dublin. *Harper 1363* (MO, NY, US); WEBSTER CO.: 2 miles east of Preston. *Thorne & Muenscher 9339* (IA). FLORIDA: — JACKSON CO.: along the Chipola River, between Mariana and Mariana Caverns State Park. *Godfrey 56319* (DUKE, FLAS, FSU, IA, NCSC, NCU, MO, NY, TENN, USF, WVA); LEON CO.: about 6 miles west of Tallahassee. *Godfrey 61910* (DUKE). ALABAMA: MONTGOMERY CO.: wooded bottoms of Catoma Creek. *Harper 83* (GH, MO, NY, US); MISSISSIPPI: OKTIBBEHA CO.: State College. *Eckles* 7 April 1937 (MISSA).

3. **Uvularia sessilifolia** L., Sp. Pl. 304. 1753. (Type in Linnean Herbarium. Phototype seen.) *Oakesia sessilifolia* (L.) S. Wats., Proc. Am. Acad. 14: 269. 1879. *Oakesiella sessilifolia* (L.) Small, Fl. Se. U. S. 272. 1903.

Plants completely glabrous but stems and lower surfaces of the leaves glaucous; the stem about (1.7-) 2.5-4.0 (-4.5) dm. high and triquetrous at least above and arising from a branching, whitish, fleshy, subterranean rhizome about 3-5 mm. in diameter. Leaves glabrous, narrowly to broadly elliptic in general outline with a gradually tapering to broadly rounded base and an acute to even short-acuminate apex, mostly (3.7-) 4.5-6.5 (-8.2) cm. long and (1.2-) 1.7-2.7 (-4.0) cm. wide; the leaf subtending the lowest branch mostly about (3.0-) 5.0-7.0 (-7.2) cm. long and (0.8-) 1.0-1.5 (-2.5) cm. wide. Blade-bearing leaves below the lowest branch 1-2. Leaf-margin scarious and very minutely denticulate. Fertile branchlet leafless and hence consisting of no more than the terete peduncle partially fused basally to the leafy axillary stem and about (5.0-) 7.0-14.0 (-18.0) mm. long and one flower. Perianth-segments about (1.2-) 1.5-2.2 (-2.8) cm. long and about 2.0-4.5 mm. wide, gradually tapering to the more or less rounded apex; perfectly smooth both externally and internally, very pale yellow. Tepals narrowing basally into a thickened, somewhat fleshy, channeled base about 1.2-1.8 mm. long with a well-defined, narrow, nectiferous depression about 0.8-1.0 mm. long and about 0.5-0.8 mm. wide with more or less parallel sides and thickened walls but lacking an elevated flap or ridge. Filaments smooth, narrowly oblong to linear and scarcely, if at all, tapering to either apex or base, about (2.0-) 2.5-5.0 (-6.5) mm. long and 0.6-0.8 mm. wide. Connective bluntly rounded just above the anther-sacs and barely, if at all, extended beyond them. Anther-sacs about 5.0-10.0 (-13.0) mm. long. Ovary conspicuously triquetrous and clearly stipitate, tapering from the widest point at the middle to both apex and base; the three sides slightly concave and at least not conspicuously medially grooved, about 3.0-5.0 mm. high excluding the 0.8-1.2 mm. long stipe and each face about 1.5-3 mm. wide. Style united for at least four-fifths of the distance to the stigmatic tips which somewhat reflex in age; style and stigmas together about 1.0-1.5 cm. long and the stigmatic lobes about 1-2 mm. long. Capsule conspicuously three-winged, triquetrous and roundedly tapering to both apex and base; its sides somewhat concave and each face appearing broadly elliptic in outline; its base conspicuously stalked with the stalk usually about 2-4 (-6) mm. long; the fruit about (1.2-) 1.5-2.7 (-3.2) cm. long (excluding the stipe) and (0.8-) 1.0-1.5 (-1.8) cm. wide. Seed globose or nearly so, about 3-4.5 mm. in diameter, reddish-brown at maturity with a thickened mound-like ridge or crest extending along either side of the slit-like raphe which half encircles the seed. Typically found in moist hardwoods and especially in bottomlands but (particularly in the northern midwest) also encountered in more xeric sites including even jack pine woods; ranging from Nova Scotia south into northern Florida and west into North Dakota and Louisiana (Fig. 4).

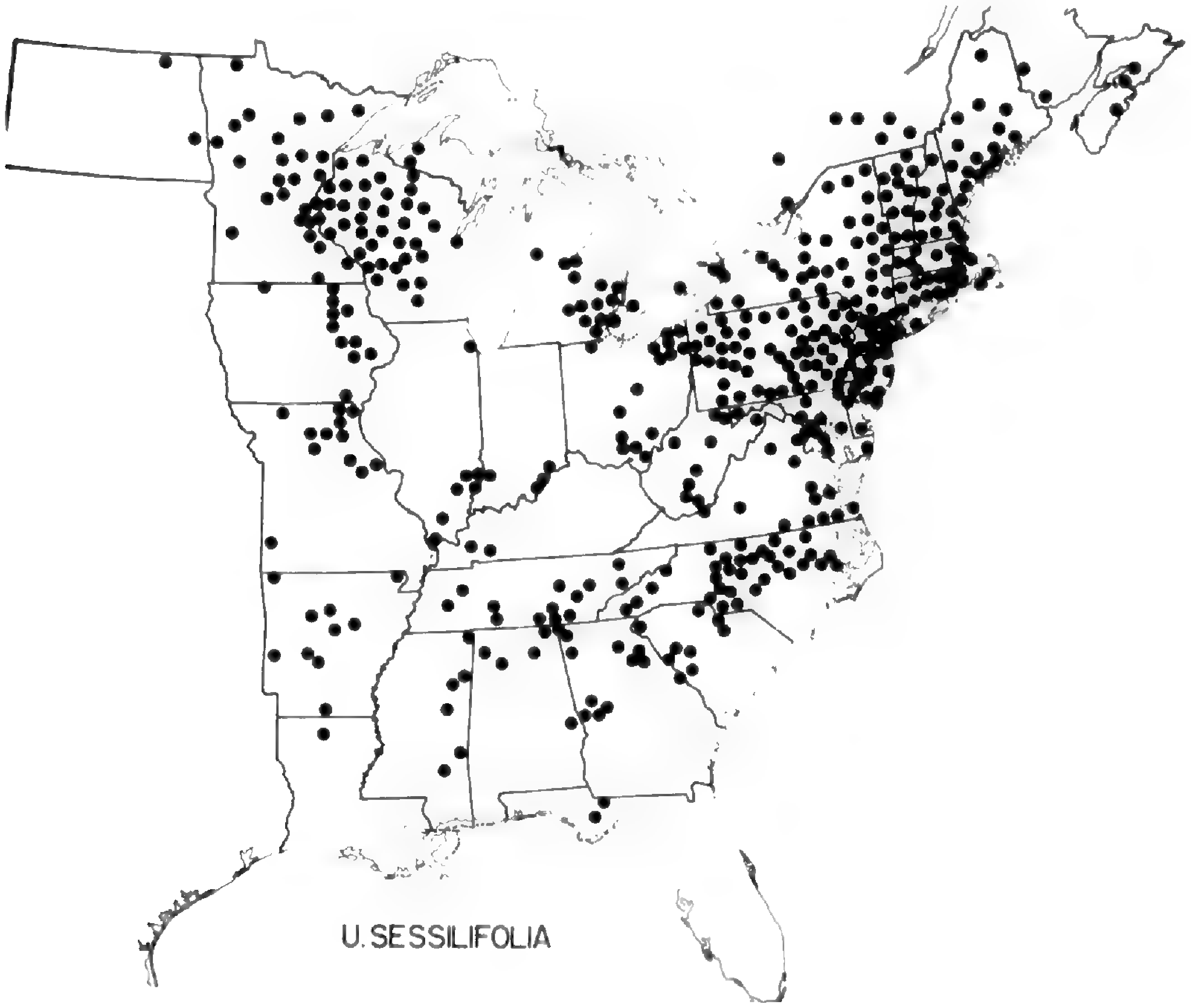

Fig. 4. Distribution of *Uvularia sessilifolia*

4. **Uvularia grandiflora** J.E. Sm., Exot. Bot. 1: 99. t. 51. 1804. (Type not seen. Description and plate seemingly conclusive.) *U. perfoliata α major* Michx., Fl. Bor.-Am. 1: 199. 1803. (Type not seen Description thought to be conclusive.) *U. grandiflora* f. *latifolia* Louis-Marie, La Revue d'Oka 14: 153. 1940. (Type not seen.) *U.*

grandiflora f. *variegata* Louis-Marie, La Revue d'Oka 14: 153. 1940. (Type not seen.)

Plant glabrous except for the lower surface of the leaves; the stem terete and about (2.0-) 4.0-7.0 (-8.0) dm. tall. Leaves sparsely to very densely pubescent beneath (or very rarely glabrous); the trichomes extremely short to rather long, ranging in length from about .05-0.5 mm. long; mostly (4.0-) 7.0-12.0 (-13.5) cm. long and (2.0-) 3.0-5.0 (-5.5) cm. wide, ovate-oblong to somewhat elliptic in general outline with a broadly rounded base and an acute to short-acuminate apex; the leaf subtending the lowest branch mostly about (6.5-) 9.0-12.0 (-13.5) cm. long and (2.0-) 2.5-3.5 (-5.5) cm. wide. Blade-bearing leaves below the lowest branch typically but one. Leaf-margin smooth and very narrowly scariously rimmed. Fertile branchlet bearing one perfoliate leaf and one flower on a peduncle about (1.0-) 1.2-2.0 (-2.5) cm. long. Perianth segments about (2.0-) 2.5-4.5 (-5.0) cm. long and about (2.5-) 3.0-7.0 (-9.0) mm. wide, acute to acuminate, perfectly smooth both externally and internally, pale yellow. Tepals fleshy-thickened at base with a shallow nectariferous depression about 2 mm. long and 1 mm. wide bordered distally by a very slightly elevated ridge or mound about 0.1 mm. high. Filaments smooth, more or less oblong but noticeably tapering towards both base and apex from a point approximately two-fifths the distance from base, about (2.0-) 3.0-6.0 (-7.0) mm. long and 0.5-1.2 (-1.6) mm. wide. Connective extending beyond the anther in an inwardly arching, obtusely conical beak about 0.2-0.7 mm. long and 0.4 mm. wide and not at all indented at apex. Anther-sacs elongate, about (8-) 12-15 (-20) mm. long. Ovary oblong-cylindric in general outline, obtusely and moderately 3-lobed with each segment slightly longitudinally grooved medially, about 2.5-4 mm. high, sessile. Style united for about one-fifth to one-third or rarely two-fifths the distance from the base towards the stigmatic tip; stigmatic tips slightly reflexing with age; style and stigmas together about 9-12 mm. long. Capsule with a rounded to nearly truncate apex and more or less obpyramidal in general outline but moderately 3-lobed and each lobe itself very slightly grooved; mostly about 0.8-1.5 cm. high and (1.0-) 1.2-1.7 (-2.2) cm. wide at its broadest point. Seed nearly globose, but often partially compressed out of shape, about 3-5 mm. in diameter, reddish-brown at maturity, about one-third to one-half enveloped by a thin membranous covering. Rich and usually moist hardwood-forested slopes and bottomlands from southern Quebec south along the mountains into Alabama (and even as far as southern Mississippi) and west into Arkansas, the eastern Dakotas and southern Ontario (Fig. 5).

The possibility that this binomial may be superceded by *U. lanceolata* Ait. is discussed under that binomial with the Doubtful and Excluded Names at the end of this paper.

Dietz (1952) has discussed introgression in both this and the following species under which I have presented a few comments. Most of the specimens that have proved difficult to identify resemble *U. grandiflora* in most particulars except that they are glabrous or very nearly so.

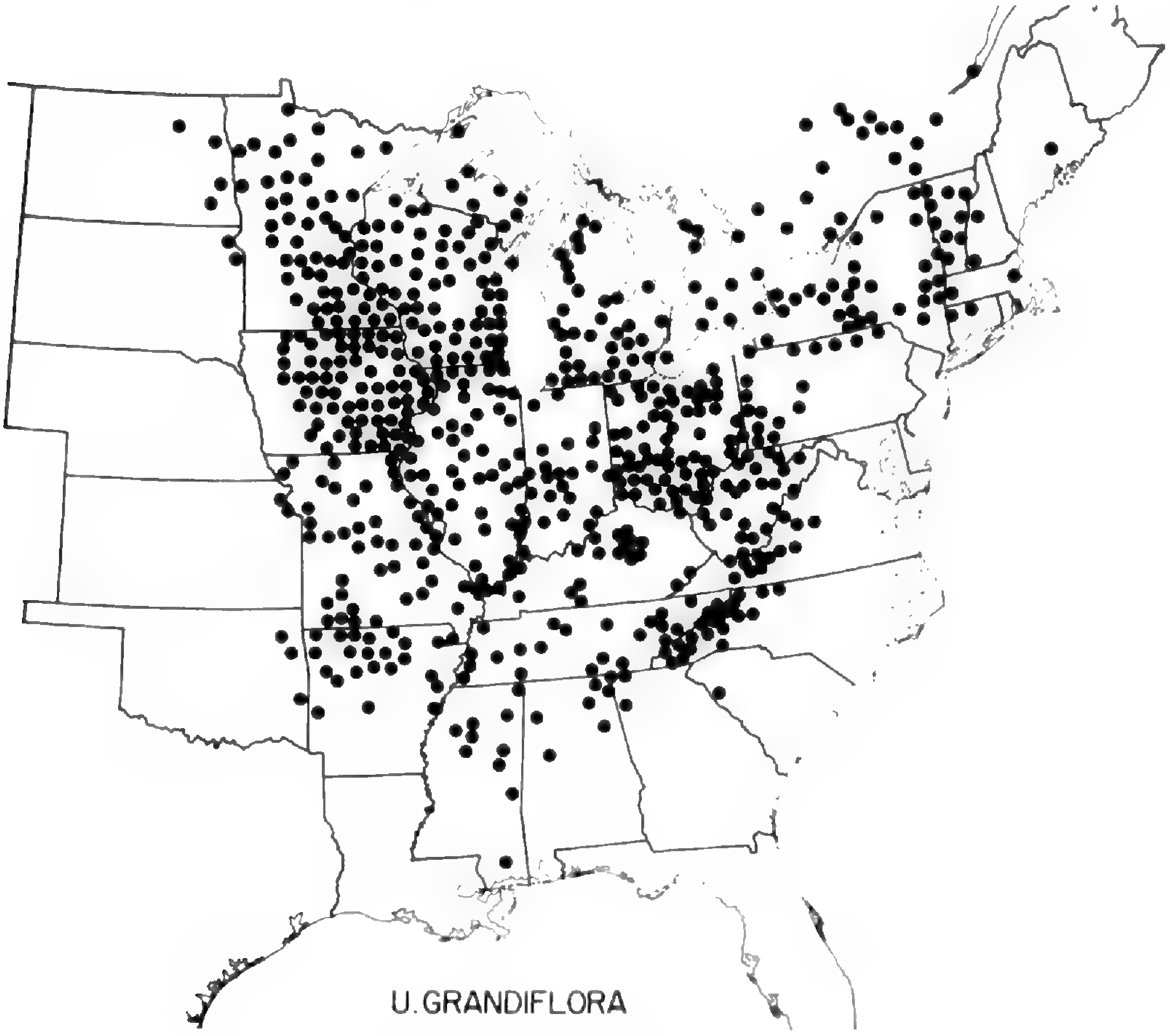

Fig. 5. Distribution of *Uvularia grandiflora*

5. **Uvularia perfoliata** L., Sp. Pl. 304. 1753. (Type in the Linnean Herbarium. Phototype seen.) *U. perfoliata β minor* Michx., Fl. Bor.-Am. 1: 199. 1803. (Type at Paris; not seen, description seemingly definite.) *Uvularia flava* J. E. Smith, Exot. Bot. 1: 97. 1804. (Type not seen. Plate and description seemingly adequate for determination.)

Plant completely glabrous; the stem slightly to heavily glaucous and about (1.5-) 2.0-3.5 (-6.0) dm. tall with (1-) 2 very slender, subterranean, slightly geniculate stolons up to 1.5 dm. long (apparently present only early in growing season). Leaves glaucous beneath, mostly

(3-) 4-8 (-12) cm. long and (1.5-) 2-4 (-6) cm. wide, ovate to ovate-oblong in general outline with a broadly rounded base and an acute to abruptly short-acuminate apex; the leaf subtending the first branch mostly about 4-8 (-10) cm. long and 2-5 cm. wide. Blade-bearing leaves below the first branch typically 3-4 but occasionally fewer. Leaf-margin smooth and very narrowly scariously rimmed. Fertile branchlet bearing one perfoliate leaf and one flower on a peduncle about (0.6-) 1.0-1.8 (-2.4) cm. long. Perianth segments (1.5-) 2.0-3.0 (-3.7) cm. long and about 3-5 (-6) mm. wide, acute, densely papillose-tuberculate within, pale yellow but typically of an orange color in the area of the rounded mound-like papillosities; the rounded, half globose to oblong papillose beads varying greatly in size on each tepal, ranging from about 0.2-0.5 (-1.0) mm. long. Tepals fleshy-thickened at base with a shallow but pronounced nectariferous depression about 1.5 mm. long and about 1 mm. wide and with an inconspicuous ridge bordering each side of the nectary. Filaments smooth, more or less oblong but noticeably tapering to both base and apex from a point about one-half the distance from base towards the apex, about 3-4 mm. long and 1.0-1.5 mm. wide, rather turgid. Connective extending beyond the anther into an inwardly arching acute beak about 1 mm. long and about 0.5 mm. wide, very slightly indented at apex. Anther-sacs about 7-10 mm. long. Ovary oblong-cylindrical to obpyriform in general outline, obtusely and deeply 3-lobed with each lobe again slightly indented medially, about 3 mm. high, very slightly elevated at base by receptacular bulge but sessile and not stipitate. Style united for about half to two-thirds the distance to the stigmatic tip; stigmatic tips reflexing with age; style and stigmas together about 8-10 mm. long. Capsule nearly truncate at apex and obpyramidal in general outline but strongly 3-lobed and each lobe itself deeply 2-lobed with the lobes appearing apically rostrate, mostly about 0.8-1.3 cm. high and 1.2-1.6 cm. wide at apex. Seed subglobose to plumply reniform, about 3-6 mm. long, reddish-brown at maturity, one-third to one-half enveloped by a thin membranous, previously balloon-like covering originating from the funiculus and outer integument. Usually in open to densely forested deciduous slopes or well-drained uplands but occasionally in floodplain or swampy forests and more rarely growing in piney woods or even in meadows or along road or railroad embankments; ranging from southern New Hampshire and southern Ontario south into northern Florida and westward into central Ohio and Louisiana (Fig. 6).

Dietz (1952, p. 243) has suggested that *U. flava* J. E. Smith was a hybrid ("probably an introgressive hybrid, or perhaps even an F_1") between *U. perfoliata* and *U. grandiflora* stating that it resembled *U. perfoliata* "but with deeper yellow flowers and perianth smooth within — floral characteristics which suggest *U. grandiflora*." Dietz also con-

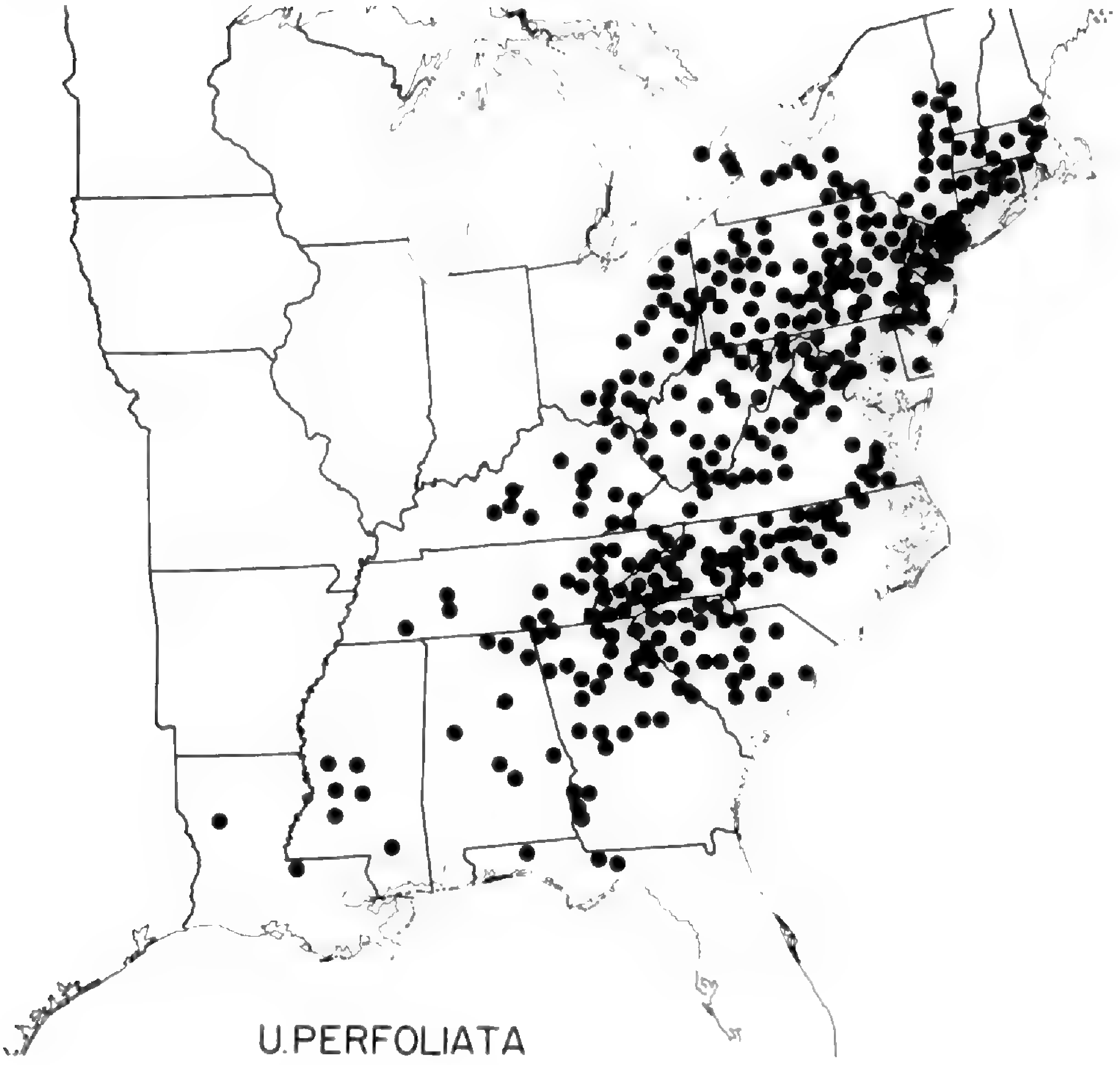

Fig. 6. Distribution of *Uvularia perfoliata*

cluded that "*U. flava* apparently disappeared gradually, for the manuals of the day reflect increasing uncertainty about it until it finally was dropped into synonymy with *U. perfoliata* and was removed entirely from the literature." Smith, however, in both the plate and the original accompanying description clearly indicated that the tepals were tuberculate-roughened within and that the anthers were pointed. He admitted that although he felt *U. flava* to be distinct from *U. perfoliata* "it is very difficult to express a specific distinction." The flower of *U. flava* was described as being "remarkably different, larger, more taper and elongated, with narrower sharper petals, an inch long, yellow, with orange-coloured tubercles on the inside" and the point of the anthers are "also longer and more conspicuous." In contrast the tepals of *U. perfoliata* were described by Smith to be "scarcely half an inch long, of a very pale greenish buff-colour", and with "their inner side rough with yellowish protuberances." There is no evidence in the original account that would indicate that *U. flava* was anything other than a more orange-tinted race of *U. perfoliata;* there certainly is nothing to indicate that Smith was describing either an F_1 or introgressant between *U. perfoliata* and *U. grandiflora.* Watson (Proc. Am. Acad. 14: 268. 1879) placed *U. flava* in the synonymy of *U. grandiflora,* a disposition which caused Gray (Am. Jour. Sci. ser. 3. 18: 313. 1879) to express surprise.

Anderson (1954) and his student Dietz (1952) have both agreed that much of the variability observed within the perfoliate species of *Uvularia* is the result of introgressive hybridization. Amazingly, Anderson, on the basis of a detailed study of only ten herbarium specimens "selected at random" of each of the two perfoliate species, was able to conclude that 1) the specimens of *U. grandiflora* formed a "coherent group", 2) those of *U. perfoliata* were "not so coherent" and 3) the variation within the last mentioned species was due to introgression from *U. grandiflora.* Dietz's (1952) more lengthy investigation convinced him that *U. grandiflora* was introgressing into *U. perfoliata* and that any introgression of *U. perfoliata* into *U. grandiflora* would be obscured by the possibility of undetected introgression from any of the sessile-leaved taxa. These sessile-leaved species, Dietz felt, were more closely related to *U. perfoliata* than that species was to *U. grandiflora.* In fact Dietz indicated that the sessile-leaved taxa would be somewhat intermediate in morphology and hence apparently in taxonomic position to the two perfoliate species but closer in their affinities to *U. perfoliata.* This conclusion as to relationship is in my opinion highly erroneous and demonstrates aptly the dangers inherent in weighing all characters and even tendencies as of equal importance in what certainly must be judged as a futile effort to achieve objectivity. Science will be advanced further by the more normal taxonomic procedure of attempting to evaluate the significance of the characters and basing classification upon the results of these considered judgments. Only a distorted picture can be expected if one treats rather ill-defined tendencies such as the number of fruit per plant and general leafiness as being equally significant in determining relationships as the unvarying characters with strong morphologic bases such as the nature of the underground parts, the manner of attachment of the medial cauline leaves, fruit shape, presence or absence of ornamentation upon the tepals and the very different raphial outgrowths of the seeds.

Anderson and Whitaker (1934) point out that taxonomists tend to "think of species in terms of the precise differences which permit their ready classification" and that "to them the really essential differences between *U. grandiflora* and *U. perfoliata* will be those few discontinuous ones which are ordinarily used in identifying the species." Anderson and Whitaker contrasted this taxonomic viewpoint with that of those whose interest was "in the biological makeup of the units which are being classified" and stated this latter group found that "the many slight overlapping differences between species are more characteristic than the few sharply discontinuous ones." A taxonomist can be expected to be biased towards the advantages of the outlook held by his own discipline and my own study of *Uvularia* certainly did not present evidence that would convince me of the validity of this so-called "biological" viewpoint.

It seems reasonable to conclude that the "variants more or less difficult to classify" found in the area of overlap between the ranges of the two perfoliate species might well be the result of introgression between those two species and my experience with the genus emphatically confirms Dietz's conclusion "of the relative rarity of introgression as a factor in the perfoliate Uvularias." The most useful character in distinguishing the two perfoliate species is the presence or absence of papillae upon the inner surface of the tepals. No specimen possessing tepals proved to be a problem in identification; those lacking them occasionally did. Dietz's study was based upon mature specimens which, of course, lack tepals. A taxonomist attempts to identify specimens in all stages of maturity but he would consider it a pointless handicap not to utilize those characters which experience has shown to be the most reliable and instead to insist upon basing the study upon specimens in those stages most difficult to distinguish.

Anderson (1953) attempted to refute those who have felt that at least part of the variability encountered within species or even variability shared between segments of two supposedly distinct taxa might be due to common ancestry (i. e., a common "store of variability" or the "genetic pool hypothesis"). It still would appear that those features, thought by Anderson or Dietz to be indications of introgression, such as the number of fruit borne on each plant, general leafiness, position of the longest internode, ratio of leaf-width to leaf-length, are all variable to the degree of overlapping between the two species. The noted variation is hence not necessarily the result of hybridization. Actually, Dietz admits the possibility of plants of "good" *U. perfoliata* with more than one fruit and leaves more numerous than nine but in spite of this both of these features are used as evidence of introgression from *U. grandiflora* when coupled with longer internodes and a higher ratio of leaf width to length since "where introgression is a factor, there is a strong tendency for the sum of the measured characters to vary together." To one who is not a student of introgression, it would seem only proper to rule out as evidence of introgression those features that normally vary sufficiently in one species to match the condition characteristic of the other species.

Characteristic of Dietz's approach are the comments made about a population of the midwestern perfoliate species from Missouri in which was noted "the complete absence of plants with more than one fruit." This was followed immediately by the statement that *U. sessilifolia*, which is found in Missouri, "is typically a single-fruited plant." A population sample from northern Minnesota "suggests strongly an introgression from *U. sessilifolia*" by the "presence of some sessile leaves on the upper portions of occasional plants", a more strongly divergent primary branch "as in *U. sessilifolia*" and "the gross appearance of the plant." Suspicion of miscegenation was so great that it was thought to be "noteworthy that a *Uvularia* cross apparently did not occur at Hawley [Pennsylvania] where two species occur together." Throughout most of the generic range two or more species grow either together or more characteristically in close proximity to one another. Evidence of hybridization between any of these species is certainly slight and between most species non-existent. Much of the published "evidence" is indeed flimsy and highly circumstantial and hence is anything but convincing. It would be of the greatest interest to know if it were possible for crosses to occur between species of the two sections recognized in this account of the genus and in spite of the considerable time and effort that might be required to attempt such experimental crosses this would seem to be the only certain way to demonstrate or even to disprove partially the possibility of intersectional crosses. Certainly evidence of the circumstantial sort previously presented cannot be accepted. The judicial Anglo-Saxon precept of "innocent until proven guilty" ought to be extended by botanists to plants. Baker's (Nature 159: 221-223. 1947) recommendation that "wherever possible, artificial crosses between the forms involved . . . should precede investigations of natural populations" has much merit in spite of Dietz's excuse that "experimental data would involve a prohibitively long investigation." These lengthy investigations appear to be the only ones that will provide the desired information.

DOUBTFUL AND EXCLUDED NAMES

Uvularia acutifolia Raf., Am. Monthly Mag. 359. 1817. *nom. nud.*

Uvularia amplexicaule Mill., Gard. Dict. ed. 8. No. 1. 1768. = *Streptopus amplexifolius* (L.) DC., Fl. Fr. 3: 174. 1805.

Uvularia amplexifolia L., Sp. Pl. 304. 1753. = *Streptopus amplexifolius* (L.) DC., Fl. Fr. 3: 174. 1805.

Uvularia Betua Buch.-Ham. ex D. Don, Trans. Linn. Soc. 18: 517. 1841. *nom. illegit.* (Art. 34.4). Published in synonymy of *Disporum Hamiltonianum* (Wall.) D. Don, *l.c.*

Uvularia calcarata Wall., Cat. n. 5087. 1831-32. = *Disporum calcaratum* (Wall.) D. Don, Trans. Linn. Soc. **18**: 516. 1841.

Uvularia caroliniana (Gmel.- Wilb., Rhodora **63**: 39. 1961. (= *Anonymos pudica* Walt., Fl. Car. 123. 1788. *nom. illegit.* Art. 43. *Erythronium carolinianum* Gmel., Syst. Nat. 2(1): 546. 1791. *U. pudica* (Walt.) Fern., Rhodora **41**: 536. 1939. *nom. illegit.* Art. 43.)

I now belatedly concur with Dietz's conclusions (1952, p. 226), if not completely with his reasoning, that Walter's account, the basis for all the above-mentioned synonyms, is too uncertain as to the species (or species) described to warrant the abandonment of Michaux's clearly-defined and certain binomial, *U. puberula.* It now would appear that both Fernald and I relied too heavily upon the note made by Asa Gray after examining the specimens in Walter's herbarium in 1839 that "*Anonymos* (Erythronio aff.) *pudica!* = *Uvularia puberula.*" Even though Gray may well have seen a specimen of what is here called *U. puberula* in Walter's herbarium, it does not follow that the specimen seen by Gray should be accepted as the type of *Anonymos pudica* in view of the conflicting statements in the original account in Walter's Flora. The fruit and seed were described by Walter in the generic description as follows:

> Per. *capsula* turbinato-triangularis, angulis bifidis, trilocularis, trivalvis.
>
> Sem. *bina* in singulo loculamento depresso-globosa, ab uno latere cincta membrana vesiculari.

The distinguishing features mentioned here are "*capsula* turbinato-triangularis, angulis bifidis . . ." and ". . . ab uno latere cincta membrana vesiculari". This best describes *U. perfoliata* which possesses an inversely pyramidal capsule deeply lobed at each of the three apical angles and a bladdery membrane half-encompassing the seed. These features certainly exclude from consideration any member of section *Oakesiella*, all of which possess hornless, triquetrous capsules tapering to both apex and base and seeds with a hardened, double ridge extending half-way around each in a manner resembling the crest on a Roman helmet.

In the diagnosis of Walter's species, the only even vaguely delimiting term is "foliis amplexicaulibus". Michaux described the leaves of *U. puberula* as sub-amplexicaul, and, although any such term seems to be an overemphasis of the sessile leaves of this species, it still would appear to be a better description of it than of the perfoliate leaves of *U. perfoliata.* And of course Gray, as reported by Fernald (Rhodora **41**: 537. 1939), did identify a specimen that he took to be *Anonymos pudica* as *U. puberula* in Walter's collection.

In view of the certainty of the identity of the plant included in Walter's generic description as being other than the species to which the name has been applied and the inconclusiveness of the one word in the original diagnosis for the species, which might be considered at all diagnostic, it would seem best to treat Gmelin's binomial, based completely as it was upon Walter's account, as a *nomen dubium* and to take up again Michaux's unequivocal *U. puberula.*

Uvularia chinensis Ker-Gawl., Curtis Bot. Mag. t. 916. 1806. = *Disporum cantoniensis* (Lour.) Merr., Phil. Jour. Sci. 15: 229. 1919.

Uvularia cirrhosa Thunb., Fl. Jap. 136. t. 2. 1784. = *Fritillaria.*

Uvularia distorta (Michx.) Pers., Syn. Pl. 1: 360. 1805. = *Streptopus amplexifolius* (L.) DC. var. *americanus* Schultes, Syst. Veg. 7: 311. 1829. (= *Streptopus distortus* Michx., Fl. Bor.-Am. 1: 200. 1803). It is very doubtful if Persoon actually should be charged with having published this combination for it appears under the genus *Uvularia* merely as "7. *amplexifolia (distorta)*, . . ."

Uvularia grandifolia Pursh, Fl. Am. Sept. 1: 231. 1814. [typographical error for *U. grandiflora* J. E. Sm.]

Uvularia Hamiltoniana Wall., Cat. n. 5088. 1831-32. = *Disporum calcaratum* (Wall.) D. Don var. *Hamiltonianum* (Wall.) Baker, Jour. Linn. Soc. Bot. **14**: 589. 1875.

Uvularia hirta Thunb., Fl. Jap. 136. 1784. = *Tricyrtis hirta* (Thunb.) Hook., Bot. Mag. t. 5355. 1863.

Uvularia lanceolata Soland. in Ait., Hort Kew. 1: 434. 1789. A strong suspicion exists that Solander here for the first time provided a binomial for the plant that is now called *U. grandiflora.*

Aiton's account is presented below in full.

lanceolata. 2. U. foliis perfoliatis ovato-lanceolatis acuminatis.
Polygonatum ramosum flore luteo minus *Corn.* canad. 40. tab. 41.
Spear-leav'd Uvularia.
Nat. of North America.
Introd. 1785, by Mr. Archibald Menzies.
Fl. July H. 4.

Cornut's plate is anything but diagnostic but there is a slight hint of *U. grandiflora* in the leaves depicted as there is also in the diagnostic phrase of Aiton and the suggested common name. Pursh (Fl. Am. Sept. 1: 231. 1814) equated Aiton's name to *U. grandiflora* "according to specimens in the Herbarium of A. B. Lambert, Esq." while Baker (Jour. Linn. Soc. Bot. Lond. 17: 462. 1879) includes *U. lanceolata* in the synonymy of *U. perfoliata* noting that it "est forma mera angustifolia". The name obviously should remain unassigned until authentic specimens are discovered.

Uvularia lanuginosa (Michx.) Pers., Syn. Pl. 1: 360. 1805. = *Disporum lanuginosum* (Michx.) Nicholson, Dict. Gard. 2: 485. 1884.

Uvularia lanuginosa β major Hook., Fl. Bor.-Am. 2: 174. 1838. = *Disporum trachycarpum* (S. Wats.) Benth. & Hook. f., Gen. Pl. 3: 832. 1883.

Uvularia Leschenaultiana Wall., Cat. n. 5089. 1831-32. = *Disporum Leschenaultianum* (Wall.) D. Don, Trans. Linn. Soc. 18: 518. 1841.

Uvularia multiflora Reinw. ex Kunth, Enum, Pl. 4: 207. 1843. *nom. illegit.* (Art. 34.4). Published by Kunth in the synonymy of *Disporum multiflorum* Don, *l.c.*

Uvularia oppositifolia Schlecht. ex Kunth, Enum. Pl. 4: 254. 1843. *nom. illegit.* (Art. 34.4). Published by Kunth in the synonymy of *Fritillaria camtschatcensis* (L.) Ker., Bot. Mag. sub t. 1216. 1809.

Uvularia parviflora Wall., Asiatic Res. 13: 378. 1820. = *Disporum parviflorum* (Wall.) D. Don, Prodr. Nep. 50. 1825.

Uvularia Pitsutu Buch.-Ham. ex D. Don, Prodr. Fl. Nep. 50. 1825. *nom. illegit.* (Art. 34.4). Published by Don in the synonymy of *Disporum Pitsutu* Buch.-Ham. ex D. Don, *l.c.*, = *Disporum cantoniensis* (Lour.) Merr., Phil. Jour. Sci. 15: 229. 1919.

Uvularia puberula J. E. Sm., Rees. Cycl. 37: No. 5. 1818. = *Disporum Smithii* (Hook.) Piper, Contr. U. S. Nat. Herb. 11: 201. 1906.

Uvularia pudica (Walt.) Fern., *nom. illegit.* see discussion under *U. caroliniana.*

Uvularia rosea (Michx.) Pers., Syn. Pl. 1: 360. 1805. = *Streptopus roseus* Michx., Fl. Bor.-Am. 1: 201. 1803.

Uvularia sessiliflora J. F. Gmel. Syst. Nat. ed. 13.2: 1642. 1792.

Uvularia sessilis Thunb., Fl. Jap. 135. 1748. = *Disporum.* The combination *D. sessile* has been attributed to D. Don (Fl. Nep. 50. 1825) but it was not made there according to the strictures of Art. 33. The only reference there by Don is made following the generic description and is as follows: "Obs. Huc *Uvularia chinensis Bot. Mag. et Uvularia sessilis Thunb. Jap.* cui folia, sessilia, et flores subsolitarii albi." But since Thunberg included the binomial *U. sessilifolia* L. as a synonym, it would appear that the legitimacy of the name itself ought to be investigated thoroughly.

Uvularia Smithii Hook., Fl. Bor. Am. 2: 174. t. 189. 1838. = *Disporum Smithii* (Hook.) Piper, Contr. U. S. Nat. Herb. 11: 201. 1906.

Uvularia umbellata Wall., Asiatic Res. 13: 379. 1820. = *Disporum cantoniensis* (Lour.) Merr., Phil. Jour. Sci. **15**: 229. 1919.

Uvularia ? viridescens Maxim., Prim. Fl. Amur. 273. 1859. = *Disporum smilacinum* A. Gray, Perry Jap. Exped. 2: 321. 1856.

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THE NEW YORK BOTANICAL GARDEN WILD FLOWER BOOKS

The New York Botanical Garden has undertaken the preparation of a series of illustrated books on the wild flowers of the United States (excluding Alaska and Hawaii). The books will be directed to the amateur with little or no botanical training, as well as to the professional scientist in non-botanical fields, and will present wild flowers without the embellishment of technical descriptive terms found in manuals and floras. At the same time the descriptions will be scientifically accurate and the coverage complete within the usual concept of "wild flowers" (excluding grasses, sedges, and unattractive weeds, and, of course, all woody plants). Most species will be illustrated in color, and the very best available color photographs are now being sought. Line drawings will be used to distinguish related species whenever color is inadequate for the purpose. Means of tracing the plant to its family, genus, and species will be included. But the dichotomous keys so useful to the taxonomist and so terrifying to the layman will be conspicuously absent.

It is planned to treat the United States in five regions, a volume being devoted to each: the northeastern states, the southeastern states, the central plains and mountains (including the Rocky Mountains and the Great Basin), the Southwest, and the Pacific Northwest.

A committee headed by Mrs. David Rockefeller has undertaken to obtain the subsidy necessary to ensure publication. The work will be centered at The New York Botanical Garden, under the direction of Harold William Rickett, Senior Botanist. An artist, a photographer, and a secretary will devote all or part of their time to the work. William C. Steere will serve as General Editor. For outstanding illustrations in color the cooperation is sought of amateur and professional photographers of wild flowers in all parts of the country. The first volume will deal with the northeastern states, and color photographs (transparencies) of the wild flowers of this region are now required. Amateurs are urged to send their best "shots" at once to Dr. Rickett.

H. W. Rickett, The New York Botanical Garden.

PHORADENDRON RUBRUM IN FLORIDA

Dr. Frank C. Craighead, on low-flying flights over the northern keys of Monroe County, Florida, observed on mahogany trees, *Swietenia Mahagoni* Jacq., a parasite which appeared to kill gradually the over-mature hosts. In the company of Doctors John Popenoe and Carl W. Campbell, of the Subtropical Agricultural Experiment Station, Homestead, Dr. Craighead, searching on North Key Largo, found a tree on which the parasite was growing low enough to be reached. The plant proved to be *Phoradendron rubrum* (L.) Grisebach, a species known from Cuba and the Bahamas, where it has been found only on *Pithecellobium* and *Bursera,* according to labels on specimens in the Gray Herbarium.

The mahogany trees on which Dr. Craighead has observed *Phoradendron rubrum* have been practically always large specimens, two to four feet in diameter and twenty or more feet to the lowest limbs. On the higher branches the mistletoe forms large masses two to three feet in diameter, very conspicuous in winter when the hosts shed their leaves. Dr. Craighead reports that recently-dead trees, seen from a plane fifty feet above them, were covered with dead or dying mistletoe, indicating that the parasite may play a part in killing the trees. He writes, "There are very few of these big mahoganies left on Key Largo. Some occur on Rhodes and Sand Keys just to the north. The mistletoe is here also from what I could make out in flying over. These mahoganies are the remnants of a fine stand that has been depleted over the past thirty to fifty years. Most of them are defective and for that reason were left. They occur in the hammocks of these keys and on a narrow coastal strip from Flamingo to US highway 1 on the tip of the peninsula. On the keys the mahoganies grow on coral rock; on the mainland on marl soil or oölitic limestone, the largest trees on the latter."

Specimens of *Phoradendron serotinum* (Raf.) M. C. Johnston *(P. flavescens)* in the Gray Herbarium indicate Lee County, Florida, as the southern limit of its range, a location one hundred miles northwest of Key Largo. It can be distinguished quickly from *P. rubrum* by its whitish berries and terete internodes and, upon more critical examination, by the lack of cataphylls.

Phoradendron rubrum (L.) Grisebach, Fl. Br. W. Ind. 314. 1864. *Viscum rubrum* L., Sp. Pl. 1023. 1753.

Parasitic, evergreen shrub; stems and branches ligneous, furrowed in drying; sections of the branches with pairs of basal, broad and spreading, often connate cataphylls, and rarely with one or two additional pairs upward, particularly on new growth; these sections 8 to 32 mm., furrowed when dried, terete at base, two-edged and flattened upward with a 90° tortion from base to apex; leaves elliptical, spatulate to obovate, mostly cuneate at the base, short-petioled, caducous on drying and at death of plant; veins few, prominent, pinnate, branching; inflorescence axillary, spicate; spikes elongating through a series of cup-like bracts, monoecious, with trimerous flowers, the staminate flowers above, berries globose, glabrous, about 4 mm. in diameter, lemon to light orange in color.

Specimens cited: FLORIDA. Key Largo, Monroe County, growing on mahagoni in hammocks, berries orange, 19 April 1941, *J. M. Crevasse* (FLAS); South end of Key Largo, Monroe County, on large Swietenia Mahagoni in hammock, berries orange, 6 February 1944, *S. J. Lynch* (FLAS); Key Largo, Monroe County, on Swietenia, berries pink to orange, March 1953, *Ray Garrett* (FLAS, GH); North Key Largo, Monroe County, on Swietenia Mahagoni, 2 February 1963, *Frank C. Craighead, Carl W. Campbell* and *John Popenoe* (GH, USF).

GEORGE R. COOLEY, GRAY HERBARIUM,HARVARD UNIVERSITY.

EDITOR'S NOTE

Two scientific articles of considerable length on South American plants have appeared recently in Rhodora. This does not represent a new departure since Rhodora in the past has had papers dealing with the continent south of us. At this time we would like to define in a general way the geographical coverage of our journal in order to assist our contributors and facilitate the flow of good manuscripts in our direction. We would like to emphasize the fact that suitable papers on South American botany will be welcome insofar as space will permit their printing. We feel that it is important for Rhodora to be in the main stream of taxonomic research. As indicated by Dr. Schultes in his accompanying article in this number, South America is unusually rich in numbers of species of Angiosperms. In our hemisphere inevitably most of the descriptive taxonomy of the future will relate to the American tropics. In our opinion Rhodora should play a part in this great pioneering venture. Also, many members of the New England Botanical Club and some of the editorial board of Rhodora are very active in South American Taxonomy, and Rhodora certainly should make its pages available for their contributions.

As has been customary, in order to maintain some geographical identity, we shall continue not to accept papers dealing chiefly with plants of the Old World.

A. R. HODGDON.

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THE GENUS REVERCHONIA (EUPHORBIACEAE)[1] [2]

GRADY L. WEBSTER AND KIM I. MILLER

Reverchonia, a monotypic genus of the subfamily Phyllanthoideae, has been placed in the subtribe Phyllanthinae adjacent to *Phyllanthus* (Pax and Hoffmann, 1931). The single species, *R. arenaria* A. Gray, is a highly specialized desert annual (fig. 2) found in disjunct sand-dune areas in the southwestern United States and northeastern Mexico. Gray, in the original description (1880), noted that "the relationship of this plant to *Phyllanthus* is so close, that, were it not for a combination of characters, it might be taken for an aberrant *Phyllanthus.*" This character-complex, which has sufficiently impressed subsequent authors so that all have followed Gray's lead and maintained *Reverchonia* as distinct, includes features of both habit and reproductive organs. The aspect of the fruit-bearing plant, due

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[1] Research was supported by a grant from the National Science Foundation (G23604). The authors are indebted to Barbara Webster and Lillian Miller for assistance, and to Mr. Chester M. Rowell for his diligence in obtaining materials.

[2] We would like to express our thanks to the curators of the following herbaria for loaning specimens or furnishing locality data:

University of Arizona (ARIZ); Chicago Natural History Museum (F); Gray Herbarium (GH); Missouri Botanical Garden (MO); University of New Mexico (UNM); Oklahoma State University (OKLA); University of Oklahoma (OKL); Southern Methodist University (SMU); University of Texas (TEX); Texas Technological College (TTC); United States National Museum (US); Utah State Agricultural College (UTC); and University of Utah (UT).

Voucher specimens for research described in this paper are deposited at the Kriebel Herbarium, Purdue University (PUL).

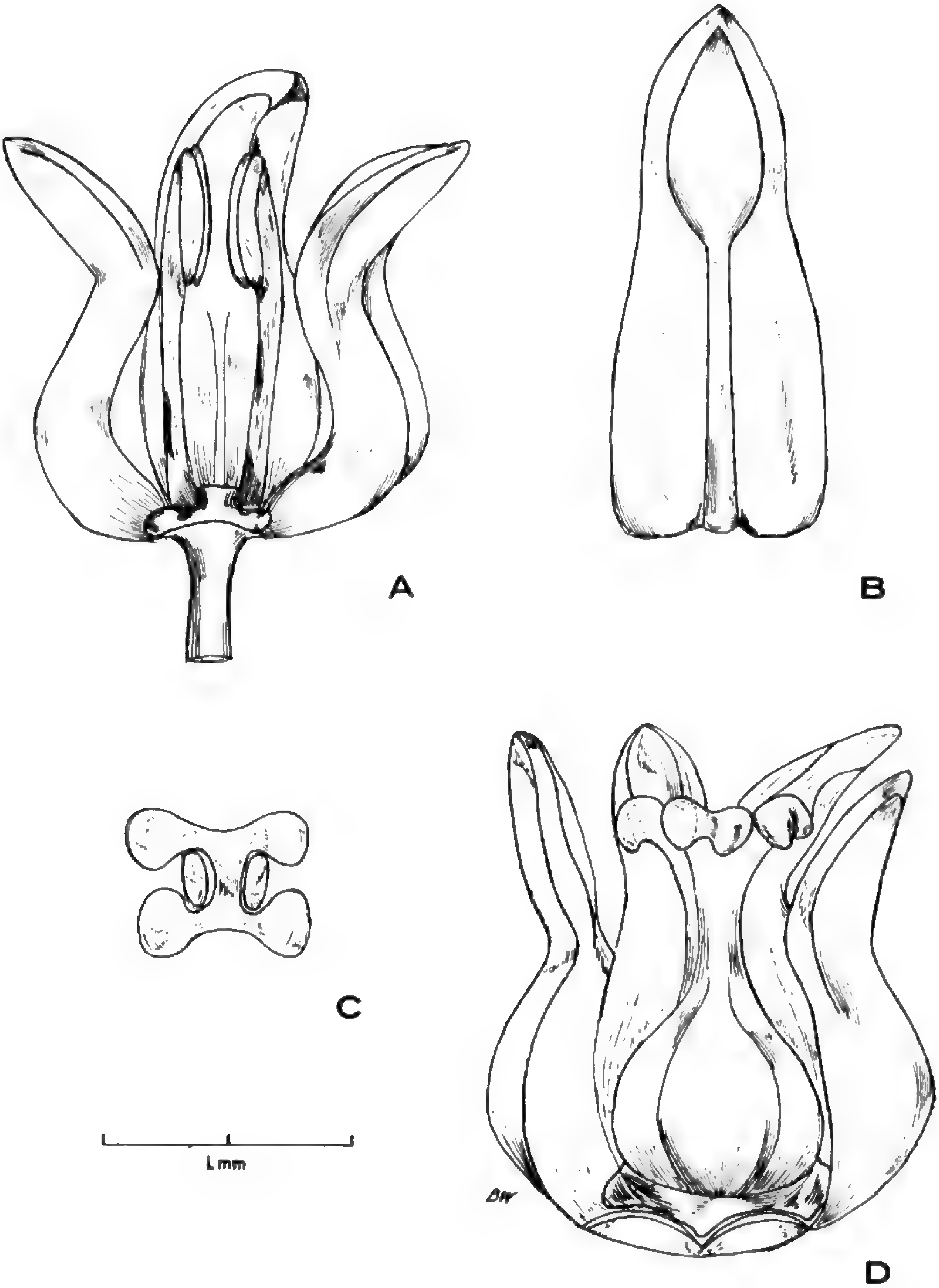

Fig. 1. Flowers of *Reverchonia (Warnock 10723)*. A. Male flower, with one calyx-lobe removed. B. Male calyx-lobe, adaxial view. C. Disk of male flower (as seen from above, partially enclosing the filament bases). D. Female flower, with 2 calyx-lobes removed.

to the disproportionately large capsules hanging from slender lateral branches, is distinctive and unlike any other taxon of American Phyllanthoideae. Especially prominent reproductive features (fig. 1) include the dark reddish flowers with unusually shaped calyces (the male vaguely suggesting the flowers of certain Fumariaceae), the introrse stamens and central disk of the male flower, the large seeds with a subchalazal invagination, and the embryo with linear cotyledons.

As duly noted by Gray, the most anomalous character of *Reverchonia* is the narrow cotyledon shape, which would technically place the genus in the "series" Stenolobeae as conceived by Mueller Argoviensis (1866). The Stenolobeae, as delimited by Mueller and later by Pax (1890) and Gruening (1913), comprise a number of genera with more or less ericoid habit which are restricted to Australia and New Zealand. Except for the narrow cotyledons, however, most of these taxa seem to have little in common with *Reverchonia. Micrantheum,* which would probably key out the nearest, differs in having foliate stipules, extrorse anthers, a pistillode in the male flower, and (like most other Stenolobeae) carunculate seeds.

A search has been made among genera of American Phyllanthoideae other than *Phyllanthus* for any which might show similarities to *Reverchonia.* The only group in which any degree of resemblance can be detected is *Tetracoccus.* As recently revised by Dressler (1954), it comprises 4 taxa of desert shrubs which grow in southwestern desert areas adjacent to the range of *Reverchonia.* Although the species of *Tetracoccus* are completely dissimilar in overall habit (being intricately branched bushes), the leaves (when entire) have an aspect suggesting those of *Reverchonia.* The flowers show a considerable superficial resemblance, especially in the central male disk and the dilated style-tips. The likeness of the male disk is especially striking, since it is in this particular character that *Reverchonia* diverges most strongly from *Phyllanthus.*

In order to evaluate possible relationships of *Reverchonia* with *Phyllanthus, Tetracoccus,* and other Phyllanthoideae, we have carried out palynological, cytological, and anatomical studies. Punt (1962), in a valuable detailed study of Euphorbiaceous pollen, has described the microspores of most of the taxa in question. He shows that in most of the taxa of Stenolobeae, together with certain other Australasian taxa possessing broad cotyledons, the pollen grains are of a very characteristic echinate, non-colporate type ("*Aristogeitonia* configuration"). The microspores of *Tetracoccus ilicifolius,* with their 6-7 small colpi and prominent spines 3.5 μ long, definitely belong in this grouping. In contrast, the pollen grains of *Reverchonia* are prolate, tricolporate with a small colpus transversalis, and psilate (the tectate exine essentially smooth). Punt's illustration (his Plate II, fig. 7) and that of Erdtman (1952: fig. 97D) agree well with our own observations (on microspores from *Miller & Miller 1322, Webster 4615*) except that the exine reticulation is much fainter than indicated in Erdtman's drawing. Punt classified the grains of *Reverchonia* in his *Phyllanthus pentaphyllus* subtype along with those of several herbaceous species of *Phyllanthus* and *Savia erythroxyloides.* In the species of *Phyllanthus* sect. *Phyllanthus* examined by us the tectate exine is distinctly finely pitted (Punt describes the exine of *P. niruri* as "intra-reticulate"). and *Reverchonia* differs only in its somewhat more obscure ornamentation. However, despite the palynological similarity, the herbaceous species of *Phyllanthus* sect. *Phyllanthus* do not appear very similar to *Reverchonia*, as they are highly specialized vegetatively (i. e., with phyllanthoid branching) and dissimilar in floral details (e. g., male disk of distinct segments, anthers extrorse, seeds differently ornamented). *Reverchonia* shows a certain approach to the condition of phyllanthoid branching (as defined by Webster, 1956: 104) in that flowers are borne only on the lateral determinate axes; however, it differs in the lack of reduction of leaf-blades on the main axis and in the spiral rather than distichous phyllotaxy of the lateral branchlets.

Chromosome counts have been made by the junior author from aceto-carmine squashes of root-tips and immature leaves. The chromosome complement of *Reverchonia* proves to be 2n = 16 (fig. 3). This is a very striking result, in view of the fact that within the subfamily Phyllanthoideae this

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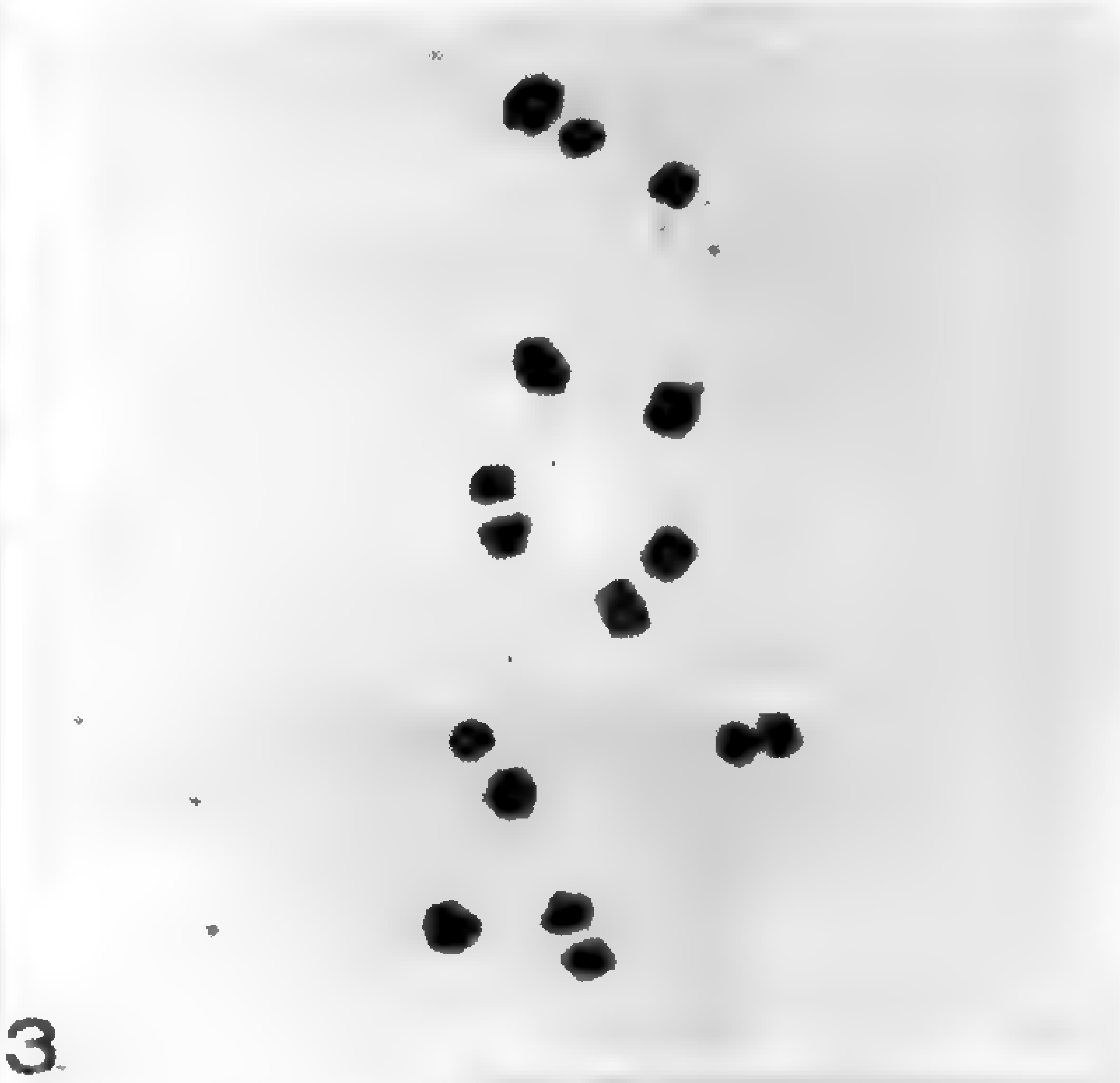

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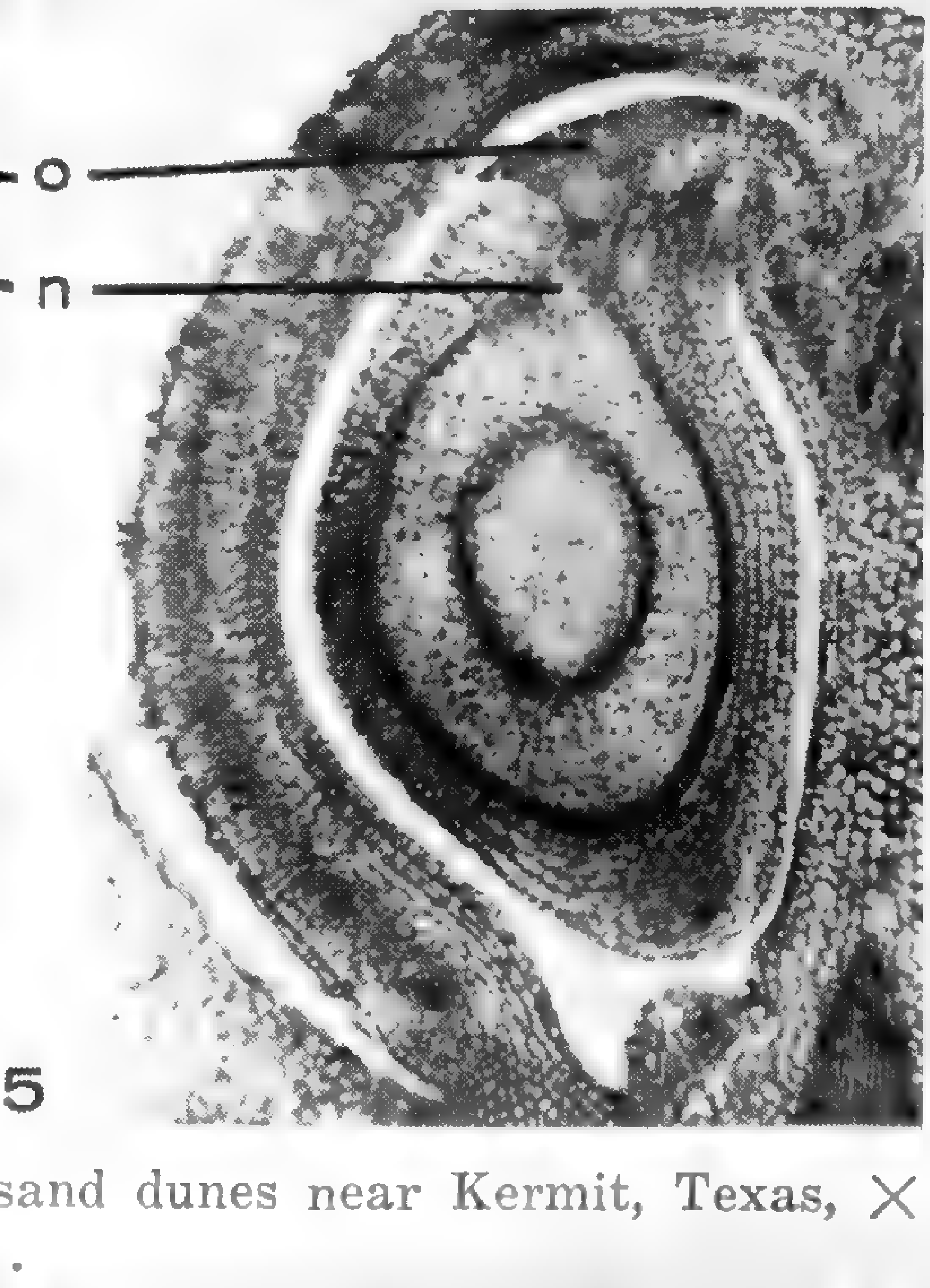

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Fig. 2. Habit of *Reverchonia*, sand dunes near Kermit, Texas, × 1/10 (photograph by C. M. Rowell).

Fig. 3. Mitotic chromosomes of *Reverchonia*, showing 2n = 16, × 2000 *(K. and L. Miller 1322)*.

Fig. 4. Longitudinal section of ovary, *Reverchonia*, showing ovule and associated parts (O, obturator; N, tip of nucellus), × 60 *(K. and L. Miller 1322)*.

Fig. 5. Longitudinal section of ovary, *Argithamnia mercurialina*, × 60 *(K. and L. Miller 1174)*.

Plate 1286

number has been found only in *Phyllanthus polygonoides*, belonging to sect. *Isocladus* (Webster & Ellis, 1962). In most of the other Phyllanthoideae studied, the base number is 13; and in *Tetracoccus* it appears to be 12 (Perry, 1943). The cytological evidence, therefore, strongly supports a closer relationship between *Reverchonia* and sect. *Isocladus*. The pollen grains of taxa in this section certainly would not negate such a relationship, since they show considerable similarity to *Reverchonia*. As observed in *P. platylepis* and *P. polygonoides*, they differ mainly in being less prolate and in having a less elongated colpus transversalis. However, all known species of sect. *Isocladus* are strongly dissimilar in certain floral details, including extrorse anthers, male and female disks of separate segments, stamens united by the filaments, female calyx-lobes herbaceous, stigmas subcapitate, columella persistent, and seeds small with verruculose ornamentation and lacking a hilar invagination.

Studies on the gynoecium in taxa of Phyllanthoideae have yielded most interesting results which suggest particular relationships between *Reverchonia* and other putatively related genera. Gray (1880) had noted that *Reverchonia* was unusual in having amphitropous ovules. Since Pax and Hoffmann (1931) flatly categorize the ovules of the Euphorbiaceae as anatropous, the situation in *Reverchonia* might seem unusual indeed. However, anatomical researches in progress indicate that amphitropous ovules occur in a considerable number of Phyllanthoideae, as was clearly pointed out long ago by Baillon (1858: 164). The ovule of *Reverchonia*, as seen in longitudinal section (fig. 4), resembles that in *Phyllanthus* and allied genera in having 2 well-developed integuments, a nucellar beak extending through the micropyle and in contact with the obturator, and a funicle which departs from the placenta below the middle of the locule. The funicle is definitely attached to the ovule toward its base. In the sense of Goebel (1933: 2003), the ovule of *Reverchonia* would be classed as "hemitropous." In contrast, the ovule in most other Euphorbiaceae is definitely anatropous (fig. 5), with the funiculus departing from the upper half of the locule and adnate to the ovule for most of its length (cf. Schweiger, 1905).

These ovular differences are usually also apparent in the seed, despite various ontogenetic changes in proportion. In the usual anatropous Euphorbiaceous seed the hilum is near the micropylar end and the raphe (funicle scar) traverses the length of the seed before ending at a chalazal area often marked by a depression. In the seed of *Reverchonia* and certain other Phyllanthoideae, the hilum is below the middle of the seed (subchalazal) and there is no definite raphe. In such seeds, as well as some anatropous ones, the chalazal pit may be the most conspicuous external mark on the seedcoat, and it has been described as the hilum by some investigators. Vindt (1953), for example, refers to the submicropylar attachment of the funicle as the "hile apparent" and its chalazal ending as the "hile vrai."

A survey of ovular configurations in the Euphorbiaceae, although not yet complete, indicates that the two kinds of ovules are correlated with definite systematic groups. Amphitropous ovules are found in *Reverchonia, Phyllanthus,* and a number of other genera in the Phyllanthoideae, while anatropous ovules occur in other Phyllanthoideae and in all of the Crotonoideae and Stenolobeae. *Tetracoccus* has carunculate anatropous seeds which, as pointed out by Croizat (1942), resemble those of *Petalostigma* and certain other Phyllanthoideae of Australasia. Thus the palynological, cytological, and anatomical data all speak strongly against any close relationship of *Tetracoccus* with *Reverchonia;* any similarities must be due to convergent evolution. For the same reasons *Tetracoccus* cannot be related to *Securinega* (in the usual sense) either, as suggested by Croizat. *Securinega* (including the closely related *Fluggea*) has tricolporate reticulate pollen grains, amphitropous ovules, and (at least in *Fluggea virosa*) a haploid chromosome number of 13 (Webster and Ellis, 1962). Certain species of *Securinega,* in fact, show a definite resemblance to *Reverchonia;* in the mediterranean *S. buxifolia* the male disk-segments are fused in a manner suggestive of the disk in *Reverchonia.* On the other hand, all the species of *Securinega* have a definite pistillode in the male flower, and all are shrubby plants dissimilar in habit. Furthermore, as shown above, the base chromosome number in *Securinega* is 13 rather than 8 as in *Reverchonia* and *Phyllanthus* sect. *Isocladus.*

On the basis of the evidence in hand, it appears that *Reverchonia* definitely belongs in the subtribe Phyllanthinae, where it has much in common with both *Securinega* and *Phyllanthus* sect. *Isocladus.* Although the chromosomal evidence suggests a closer relationship to *Isocladus,* the chromosome numbers in subtribe Phyllanthinae are too poorly sampled for this to be considered conclusive. It is possible that the closest affinity of *Reverchonia* may turn out to be with some Old World taxon of Phyllanthinae rather than with any of the American groups considered in this paper. *Tetracoccus,* which should be excluded from the Phyllanthinae, may share with *Reverchonia* a similar migrational history; both genera appear to be relict groups surviving from an ancient dispersal of Phyllanthoideae through tropical or subtropical desert regions.

Johnston and Warnock (1963) have questioned the status of *Reverchonia* as a genus distinct from *Phyllanthus,* on the grounds of its lack of diagnostic morphological characters. It is true that except for the male disk there are no diagnostic features which would immediately separate the two genera. Gray's recognition of *Reverchonia* on the basis of its particular ensemble of characters still seems the most reasonable solution. Because of the isolated position of *Reverchonia,* its inclusion in *Phyllanthus* would extend further the boundaries of that already vastly diversified genus. For those who still prefer to base classification on phylogeny, inclusion in *Phyllanthus* would seem unwise in view of the possibility that *Reverchonia* may be more closely related to *Securinega.*

SYSTEMATIC TREATMENT

REVERCHONIA A. Gray, Proc. Amer. Acad. Arts and Sci. 16:107. 1880.

Annual herbs; phyllotaxy spiral on all axes, branches persistent; leaves entire, stipulate, petiolate. Monoecious; flowers pedicellate, in dense axillary clusters (cymules) on lateral branches; cymules typically androgynous, with one central female and several lateral male flowers. Male flower: calyx-lobes 4, biseriate, inflated, constricted above the middle, the distal portion flaring abaxially; disk central, deeply 4-lobed, partially surrounding the bases of the stamens; stamens 2, opposite the outer calyx-lobes; filaments free; anthers introrse, dehiscing longitudinally and vertically; pollen grains prolate, tricolporate, tectate. Female flower: calyx-lobes 6, not inflated as in the male; disk subentire or angular; carpels 3, styles fused below, stigmas bilobed; ovules two in each cell, collateral, amphitropous. Fruit capsular, dehiscent, 6-seeded; columella usually deciduous; seeds trigonous, with a conspicuous subchalazal invagination; embryo slightly curved, cotyledons very narrow.

Type species: *Reverchonia arenaria* A. Gray.

Reverchonia arenaria A. Gray, Proc. Amer. Acad. **16:** 107. 1880

Glabrous annual herb becoming 2-5 dm. high, with sparsely branching taproot; main stem subterete, smooth, glaucous-white; lower lateral branchlets 2-3 dm. long (upper ones shorter), mostly 1.5-2 mm. thick. Leaves: stipules reddish, papery, lanceolate, acuminate, persistent, entire or irregularly toothed, (0.7-) 0.9-1.7 (-2.3) mm. long; leaf-blades elliptic to narrowly oblong-elliptic or nearly linear, thickish, c. (15-) 20-40 (-45) mm. long, (1.8-) 2.5-8 (-9) mm. broad, apiculate at the tip, narrowed at the base, veins more or less obscure; petiole 1-3 mm. long.

Flowers in reduced bracteolate cymules axillary to the leaves on lateral branchlets (never on main stem), each cymule typically producing 1 central female and 4-6 lateral male flowers. Male flower: pedicel slender, 1.5-2.5 mm. long; calyx-lobes 4, ovate-oblong, submedianly constricted, 1-veined, obtuse, purplish or pinkish with a narrow central stomatiferous greenish strip, c. 1.5-2.5 mm. long, 0.7-1.5 mm. broad; disk of 4 roundish lobes continuous across the center of the flower (between the stamens), with the outline of an I-beam; stamens 2, opposite the outer calyx-lobes; filaments free, subterete, 0.7-1.2 mm. long; anthers erect, oblong, c. 0.5-0.75 mm. long, dehiscing vertically; pollen grains very finely tectate-reticulate, with prominent colpus transversalis. Female flower: pedicel stout, c. 1.5-2 mm. long at anthesis, becoming (2.5-) 3.2-6.5 (-8.7) mm. long in fruit; calyx-lobes 6 (rarely 5), oblong, colored and distally constricted as in the male but not especially inflated, becoming (1.3-) 1.5-2.5 (-2.9) mm. long; disk flat, rather thin, 1.1-1.8 mm. in diameter, roundish or 6-angled in outline; ovary oblate-spheroidal, smooth, grooved; styles erect, 0.5-0.8 mm. high, united halfway or less, stigmas somewhat dilated, emarginate or slightly bilobed.

Capsule oblate-spheroidal, smooth, stramineous, 7-9.8 mm. in diameter; columella usually deciduous. Seeds trigonous, dark- or reddish-brown, smooth on the back (tangential face), papillate on the lateral (radial) faces, (4.4-) 4.7-6.2 (-6.6) mm. long; hilum subchalazal, deeply invaginated, with a raised thickened rim. Cotyledons (measured on seedlings) linear, c. 20-30 mm. long, 1.2-1.6 mm. broad.

Type: Texas, Baylor Co., sandy island in the Brazos River near Seymour, September 1879, *Reverchon* (GH, lectotype; F, MO, isolectotypes). Gray did not cite a collection number, but the duplicate sheets at Chicago and St. Louis bear the number 876. Gray also cited the collection made by Bigelow in 1853; this was apparently the first discovery of the genus. Judging from the map and itinerary of Whipple's exploring party (Gorman, 1941) Bigelow collected the plant along the bed of the Canadian River in northeastern Hutchinson County, Texas, between Spring Creek and the Roberts County line.

DISTRIBUTION:

OKLAHOMA. COTTON CO.: along Red River, Burkburnette Bridge, *Wood 15* (OKL, OKLA). ELLIS CO.: shinnery sand hills, *Engleman* (OKL, TEX). HARMON CO.: drifting sand along Buck Creek, 4 mi. W and 6.5 mi. S of Hollis, *Waterfall 8340* (OKL, OKLA, TEX). WOODS CO.: dunes along Cimarron River near Waynoka, *Goodman 4942* (OKL), *Goodman and Waterfall 4520* (GH, OKL, TEX), *Hansen* (US), *Rice* (OKL), *Waterfall 8169* (OKL, OKLA, PUL, SMU, TEX), *10372* (OKLA, SMU), *12317* (GH, TEX).

TEXAS. ANDREWS CO.: 17 mi. SE of Andrews, *McVaugh 10767* (MO, US). BAYLOR CO.: island in Brazos River near Seymour, *Reverchon 876* (F, GH, MO). CHILDRESS CO.: dunes along Red River 9 mi. N of Childress, *Gould and Thomas 7726* (SMU). COCHRAN CO.: 2 mi. W of Bledsoe, *Cory 16524* (GH). CRANE CO.: 13 mi. N of Imperial, *Warnock 15505* (TEX). EL PASO CO.: El Paso to Monument 53, *Wagner 994* (US); dunes E of El Paso, *Hershey* (SMU); deep sand c. 20 mi. E of El Paso, *Hinckley 4795* (US); 15 mi. E of El Paso, *Warnock 10901* (SMU); Hueco Mts., 17 mi. E of El Paso, *Waterfall 3899* (GH, MO). HARDEMAN CO.: 4.3 mi. N of Romero, *York and Rodgers 309* (SMU, TEX). HOCKLEY CO.: sand-dunes north of Anton [possibly in LAMB CO.], *Reed 3446* (US). HUTCHINSON CO.: Canadian River bottoms, N side of Borger, *Shinners 8091* (SMU); Bugbee Creek, dunes in floodplain, 9 mi. E of Stinnett, *Thornton 52-435* (TEX). LOVING CO.: between Mentone and Wink, *Warnock 10723* (PUL, SMU). OLDHAM CO.: 13 Aug. 1891, *Carleton 415* (US). WARD CO.: dunes 3-5 mi. E of Monahans, *Muller 8515* (SMU), *Miller and Miller 1308* (PUL), *Rowell 60-064* (PUL, SMU), *Warnock 7877* (PUL, SMU, TEX), *Webster 4615* (F, PUL, SMU). WHEELER CO.: S side of N fork of Red River, 3.5 mi. N of Shamrock, *Cory 50247* (GH, SMU, US, UT). WILBARGER CO.: dunes S of Red River, Round Timbers Ranch, *Tharp and Miller 51-156* (TEX). WINKLER CO.: dunes c. 9 mi. E of Kermit, *Correll 15183* (US); dunes 6-11 mi. N and E of Kermit, *Lewis and Rowell 8234*, *Miller and Miller 1322* (PUL), *Rowell 8263*, *60-047* (PUL, TTC), *60-074* (PUL, SMU, TTC). WICHITA CO.: Red River above Burkburnett, *Tharp 606* (TEX).

NEW MEXICO. CHAVES CO.: Arroyo Ranch, near Roswell, *Griffiths 5694* (MO, US); shinneries E of Roswell, *Goodding 6541* (ARIZ); sandy soil near Acme (c. 25 mi. NE of Roswell), *Williams 9588* (UNM). DOÑA ANA CO.: Jornada Range Reserve, *Hurtt 49* (US): between Strauss and Anapra, *Stearns 396* (US). OTERO CO.: dunes S of Alamagordo, *Hershey 3653* (UNM); 18 mi. S of Alamagordo, *Johnston 2727* (SMU). QUAY CO.: sandy roadside, 4.8 mi. W of Glenrio, *Shinners 21077* (SMU). SOCORRO CO.: 7 mi. W of the atom bomb crater, *Dunn 4851* (UNM); 12.5 mi. S of junction W of Carthage, red sand dune area, *Dunn and Lint 5011* (UNM); north of Lava, *Wooton* (TEX, US); W of Bingham, *Shinners 9589* (UNM).

ARIZONA. COCONINO CO.: Leupp Indian Reservation, with *Hilaria* and Sacaton, *Casteter* (UNM), *Oakley 373* (ARIZ). NAVAJO CO.: Moki (=Moenkopi?) Reservation, and Little Colorado River, *Hough 39* (US); Second Mesa, Hopi Reservation, *Whiting 756* (ARIZ).

UTAH. KANE CO.: dunes WSW of Kanab, *Harrison 11080* (US); 10 mi. N of Kanab, *Hinckley* (ARIZ); dunes 6 mi. N of Kanab, *Hitchcock, Rethke, and van Raadshooven 4536* (GH, UTC); dunes N of Kanab, *Milner 8949* (UT).

MEXICO. CHIHUAHUA: dunes, *LeSueur Mex-287* (F, GH, SMU, TEX), *765* (F, TEX); 38 mi. S of Juarez, sandhills in mesquite desert, *Gentry 8207* (GH, US); 40 mi. S of Juarez, dunes, *Gentry 17900* (US); sand hills near Samalayuca, *Pringle 3044* (F); dunes 6 mi. S of Samalayuca, *Waterfall 12475* (US); sandhills near Paso del Norte, *Pringle 792* (F, GH, US).

A very dubious collection — Texas, Tarrant Co., Fort Worth, Mar. 1890, *Bodin* (US) — has not been mapped, as the plant has not been recollected within 100 miles of Ft. Worth, and it never flowers as early as indicated on Bodin's label.

Shinners (1952) has noted that in Texas and Oklahoma the distribution of *Reverchonia* is remarkably parallel to that of *Euphorbia carunculata*, which was originally described by Waterfall from the Waynoka sand dunes in northern Oklahoma. Shinners also records *Reverchonia* from the state of Durango, Mexico, but we have not been able to confirm this and suspect that the mention of Durango was a slip for Chihuahua. All of the Mexican records of *Reverchonia* seem to come from the same area of dunes south of Samalayuca; and judging from the map of Chihuahuan vegetation presented by LeSueur (1945), dune habitats suitable for *Reverchonia* occur only in the northeastern corner of the state, adjacent to El Paso and Hudspeth counties in Texas. It seems unlikely, therefore, that *Reverchonia* will be found much further south in Mexico. The spotty records from Arizona and western New Mexico are more difficult to interpret; it is possible that the apparent rarity of the plant there is an artifact of the inadequate collection records.

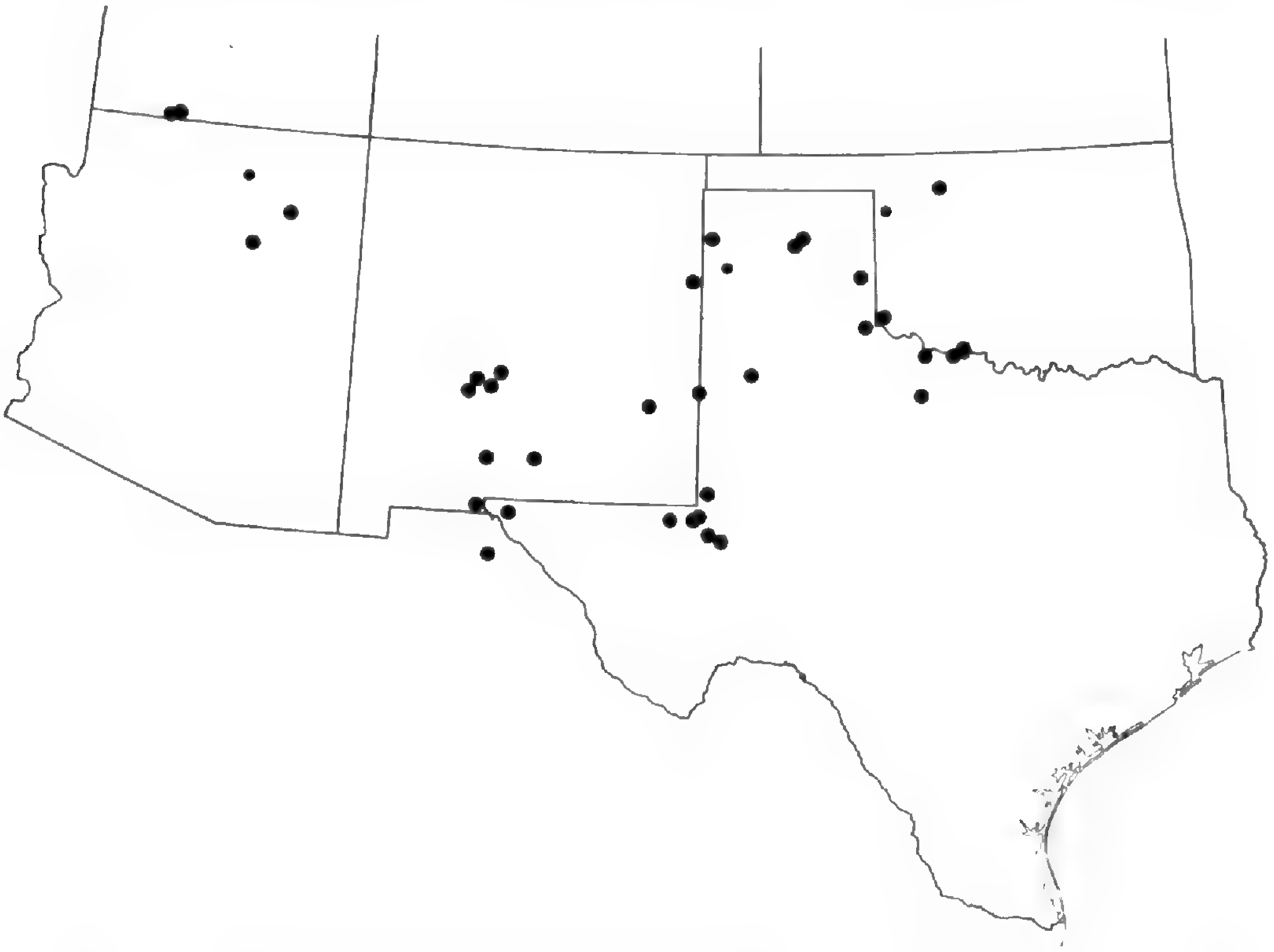

Fig. 6. Distribution map of *Reverchonia*. Large dots, exact localities; small dots, county records or inexact localities.

The area occupied by *Reverchonia* is fundamentally discontinuous due to its very strong preference for (or restriction to) dune habitats. It covers a considerable spread of altitudes, from around 1000 ft. along the Red River in Texas-Oklahoma to between 5500 and 6000 ft. in northern Arizona and Utah. According to Dr. Robert Vickery (in litt.) the plant in Utah grows on brilliant red dunes surrounded by pine forest (north of Kanab); this suggests very different conditions from the dunes of pale sand with shinnery oak *(Quercus havardii)* and *Prosopis* where *Reverchonia* occurs in west Texas (in Crane and Ward counties). The differences in altitude and precipitation (varying from 25 to less than 10 inches per year) which occur within the range suggest that *Reverchonia* possesses some degree of adaptability.

In its flowering pattern, *Reverchonia* behaves as a long-day plant. The earliest flowering specimen seen was collected on May 28 (*McVaugh 10707*) and the latest on September 25 *(Gould and Childress 7726);* fruiting begins by mid-July (at least in Texas and Oklahoma) and continues into October. Germination of the large seeds is rapid and the first internodes elongate greatly; the conspicuous narrow cotyledons may persist on certain plants until they begin to flower. It seems possible that the failure of *Reverchonia* to extend westward into the Californian and Sonoran deserts might be correlated with the different seasonal distribution of precipitation there (i. e., very few summer rains). Along the other boundaries of the species range it is impossible to suggest correlations with any one climatic

Table 1. MORPHOLOGICAL VARIATION IN REVERCHONIA[1]

Character	N	Range (mm.)	$\bar{X}$	s (mm.)	C. V.
seed length	60	4.4-6.6	5.34	0.48	8.98
	8	4.8-5.9	5.43	0.38	6.94
length fruiting pedicel	77	2.5-8.7	4.49	1.08	23.99
	21	2.5-5.3	4.11	0.65	15.82
capsule diameter	16	7.0-9.8	8.43	0.91	10.81
	8	7.8-9.3	8.8	0.52	5.95
stipule length	107	0.7-2.3	1.27	0.27	21.5
	22	1.2-2.1	1.43	0.35	24.47
leaf length	97	16-44	27.4	6.1	22.25
	21	22-42	29.05	5.2	17.9
leaf width	96	1.7-9.1	4.78	1.58	33.14
	21	2.5-8.8	5.12	1.45	28.28

[1] Parameters are based on one measurement of each character per specimen. The upper row for each character gives data based on measurements of specimens throughout the range of the species; the lower row is based on a single population sample from Winkler Co., Texas *(Miller and Miller 1322)*, except that for seed and pedicel length and fruit diameter specimens were added from a nearby collection *(Rowell 60-074)*.

factor, which indicates that a complex of interrelationships is probably involved.

Comparison of specimens from all portions of the range indicates that there is relatively little geographic variation. A population sample from Winkler Co., Texas, shows a range of variation quite close to that of the species as a whole (Table 1). The only character with some suggestion of geographical differentiation is the length of fruiting pedicel, which tends to be somewhat longer in some of the Chihuahuan specimens than from other localities. However, although the pedicels are over 8 mm. long in Gentry's collection, they are within the usual range of variation in plants collected by Pringle and Waterfall in the same general area. The seeds of the Chihuahuan specimens may average somewhat longer than those of most populations, but the available samples are not large enough to be decisive. In any event, it is fair to say that on the whole *Reverchonia arenaria* is a rather homogeneous species, even though there is considerable random — i. e., non-geographic — variability (as indicated by the high coefficients of variability for the characters in Table 1). We suspect that this lack of geographic differentiation may be related to the fact that the plant is sufficiently well adapted for cross-country dispersal (perhaps by travelling along sandy stream-beds) so that the populations do not remain isolated.

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AN ANNOTATED LIST OF VASCULAR PLANTS FROM CAPE SABINE, ALASKA

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INTRODUCTION

While making field studies of *Campanula* (Campanulaceae) in western North America during the summer of 1959, Mr. Karl Stone and I had an opportunity to spend several days (July 11-14) in the vicinity of Cape Sabine, a small cape on the Arctic Coast of northwest Alaska (ca. 68° 55′ N. lat., 164° 30′ W. long.). At this cape, located about 65 km. east of Cape Lisburne, the westernmost land-point of the Arctic Slope, the Pitmegea River enters the Arctic Ocean. This small river flows off the North Slope of the Brooks Range, and its drainage basin lies, physiographically, very near the western limits of the Arctic Slope as defined by Spetzman (Fig. 4).

The Arctic Slope of Alaska was rather poorly collected prior to 1941 when Hultén's monumental Flora of Alaska and Yukon began appearing, and the many large gaps on his range maps have undoubtedly been responsible in part for stimulating the intensive floristic research conducted in Arctic Alaska in recent years. Many new areas have been visited and collected with the result that a reasonably accurate picture of distribution patterns on the Arctic Slope is emerging. No small part of the stimulus for this research has come from the Arctic Research Laboratory at Point Barrow. Through its facilities field work that hitherto was impossible has become routine. Now, virtually no spot on the Arctic Slope is inaccessible. The floristic research of the last two decades was summarized in 1962 in the much-needed volume by Wiggins and Thomas, A Flora of the Alaskan Arctic Slope. What is at once evident from this work is that despite all the collecting on the Arctic Slope in recent years many areas still remain relatively unknown. Collections from certain areas, such as Cape Lisburne and Point Barrow, are very extensive and must be virtually complete, whereas many other areas have been little collected. Continuing publication of floristic contributions from the Arctic Slope of Alaska seems, therefore, amply justified.

Cape Sabine is not far from Cape Lisburne, but it has been passed over by many collecting parties for the more alluring Cape Lisburne. From a phytogeographic standpoint, however, Cape Sabine should be interesting, because this general area combines physiographically features of both the coastal plain and the foothills of the Brooks Range (cf. Spetzman). Although several previous parties have made recent collections in this area, their results have not been made known and their records have not, regrettably, been reported by Wiggins and Thomas. I think it worthwhile, therefore, to bring our collection to the attention of other arctic botanists, despite its incompleteness. In the very short time available to us, the equivalent perhaps of two full days of collecting, we were able to collect 143 species. This number surely must represent at least half and possibly as much as two-thirds of the local vascular flora (cf. Spetzman, p. 52). Even so, one new record for North America and several new ones for the Arctic Slope were established (cf. later discussion). Publication of this list was first suggested by Dr. Henry Childs, my camping partner, at that time working under the direction of Dr. Frank Pitelka, University of California, studying mammal populations in the Pitmegea valley as a part of a longterm ecological study supported by the Arctic Institute of North America. Dr. Childs felt that they very much needed specific information on the vegetation of the Pitmegea valley for their study.

EXPLANATORY NOTES

We collected at two locations in the Pitmegea valley. Mr. Karl Stone, with a camping partner, collected in the immediate vicinity of the Cape, while I collected inland about 11 km. (7 mi). Henceforth, the two sites will be called the "Coastal" and "Sevenmile" sites, respectively. Few if any vascular plant collections have been made previously at Sevenmile. All numbers given in the catalog, following the Latin names and synonyms, are joint Shetler-Stone collection numbers. Those in italics represent Coastal collections, while all others are Sevenmile collections. An asterisk (*) following a number indicates a unicate collection. The first and only complete set of specimens is deposited at the University of Michigan Herbarium. Partial sets can be found at the following institutions: Arctic Research Laboratory (Point Barrow), Komarov Botanical Institute (Leningrad), National Museum of Canada (Ottawa), Riksmuseum (Stockholm), U. S. National Museum, and the University of Alaska.

The genera are arranged as in Hultén's Flora of Alaska and Yukon, and the species are arranged alphabetically. Certain critical groups were sent to A. E. Porsild (Nat. Mus. Canada), who kindly determined or verified their identities for me. He is credited accordingly in the catalog. All determinations not otherwise credited were made by me. In June 1962, after the collections had all been determined, E. Hultén kindly looked at our specimens while examining all arctic collections at the University of Michigan, and his opinions have been duly incorporated and credited in the catalog. Unless otherwise noted, he concurred with my determinations.

Hultén's Flora of Alaska and Yukon has served as the point of reference throughout, and all unmodified page citations to Hultén are to this work. Where I have used a name other than that used by him, I have given his name in parenthesis. Few other synonyms are given. A wide range of publications was consulted, including the Flora of the USSR, and where for compelling reasons I have departed from Hultén's interpretations the appropriate citations and explanatory notes are given. Insofar as our material permitted, I have attempted to indicate, by Latin epithets or critical comment, the nature of the infraspecific variation exhibited.

I regret that Wiggins' and Thomas' flora appeared too late for me to consider it in the original preparation of this paper. In a cursory way, however, I have checked my manuscript against their nomenclature, descriptions, and records, and wherever possible I have taken their point of view into consideration.

PHYTOGEOGRAPHICAL COMMENTS

The Cape Sabine region is really in the foothills of the Brooks Range (cf. Spetzman, fig. 4), and, as already noted, physiographically this area has certain features of both the foothills and the coastal plain. There are many low ridges and domes which give the terrain the gently rolling aspect of the lower foothills, but the extensive flat meadows, some very poorly drained, and numerous small lakes in the Sevenmile area suggest typical coastal plain. Certainly the climate is more coastal than montane, because of the proximity of the sea, although the amount of relief is atypical for coastal plain. Between the Cape and Sevenmile the land rises from sea level to nearly 350 m. This is a rather sharp rise for a distance of only about 11 km. Thus, more habitats than are typical for coastal plain are afforded in this area, and the flora might be expected to be more diverse than at other coastal stations eastward.

The following list of 16 species collected by us which are rare or unknown on the Arctic Coast of Alaska suggests a strong montane element in the Cape Sabine flora: *Bromus inermis pumpellianus, Carex atrofusca, C. lugens, Juncus albescens, Luzula wahlenbergii, Anemone narcissiflora, Smelowskia calycina, Chrysosplenium wrightii, Saxifraga davurica, S. eschscholtzii, Potentilla biflora, P. ledebouriana, Primula tschuktschorum, Pedicularis oederi, Senecio hyperborealis, Taraxacum phymatocarpum.*

Comparisons with the published record (cf. Hultén, Fl. Al. & Yuk; Spetzman; Wiggins and Thomas) suggest that at least 19 of our collections are significant contributions to present knowledge of plant distribution on the Arctic Slope of Alaska. These 19 significant records have been indicated in the catalog by prefixing the name of the species with an asterisk. Further comment and explanation can be found under each. It should be noted here, however, that of these 19 species *Braya siliquosa* apparently is a new record for North America, and the following four seem to be new to the Arctic Slope, although in several cases taxonomic opinion is involved, and the records prove less significant if a different taxonomic interpretation is espoused: *Draba bellii, Erigeron compositus, Primula sibirica, Salix stolonifera.*

ANNOTATED LIST

Equisetum variegatum Schleich. in Weber et Mohr ssp. **variegatum.** 3230*.

Alopecurus alpinus Sm. var. **alpinus.** 3156.

Arctagrostis latifolia (R. Br.) Griseb. s.l. 3237-A*, 3237-B, 3237-C*.

Tussocks of this grass were very abundant in a niggerhead meadow about 1 km. west of Sevenmile camp. Nine pieces from several tussocks were collected, and examination of these pieces revealed two rather distinct types and one more or less intermediate type. The first, 3237-A, represented by two pieces, has a relatively short culm, quite purple spikelets that are 4-6 mm long, and purple anthers averaging 2.5 mm long. These pieces would seem to match Hultén's typical *A. latifolia* (p. 144). The second, 3237-B, represented by six pieces, has a taller culm than A, spikelets that are less purple and 3.5-4.5 mm long, and yellow anthers mostly 1.5-2.0 mm long. Some of these anthers have purple tips, and on one piece they are distinctly longer than 2.0 mm. Perhaps these specimens belong to var. *arundinacea* (Trin.) Griseb., but the yellow anthers apparently are not typical for this variety. Porsild (1951, p. 82, under *A. arundinacea*) commented, "The anthers that in early anthesis are purple become yellow in age. . . ." Our specimens vary from preanthesis to immature fruit, but I find no evidence that anther color varies with age. Rather, the color difference seems constant with age, suggesting that it is genetic. The third, 3237-C, represented by one piece, is quite similar to A, but differs by having some yellow suffused in the purple anthers and by having less purple spikelets that are about 4 mm. long. In these latter characters it is more similar to B. All three types have rather congested and strict panicles and quite variable scabrosity on the pedicels. In general, the pedicels are sparsely if at all scabrous.

As Hultén commented (p. 147), this seems to be an extremely variable species in Alaska. Careful field study is needed to determine the validity of segregating several varieties within it. At Sevenmile, two rather distinct types are growing side-by-side, along with some apparent intermediates, suggesting hybridization.

Deschampsia caespitosa (L.) Beauv. ssp. **caespitosa** var. **glauca** (Hartm.) Sam. 3252.

Trisetum spicatum (L.) Richt. 3285.

Poa arctica R. Br. 3234*, 3269; verified by Porsild.

No. 3234 comprises one immature specimen, and the racial relationship could not be determined. No. 3269 represents ssp. *arctica.*

P. glauca Vahl. *3178*; verified by Porsild.

***P. komarovii** Roshew. *3325.*

Our specimens are not altogether typical of this species and suggest *P. lanata* Scribn. et Merr. somewhat. Both Porsild and Hultén have seen these specimens. Porsild expressed some doubt about my determination but without suggesting any other identity, while Hultén concluded that my determination is probably correct. In favor of *P. komarovii* are the low habit (cf. Anderson, p. 77), general resemblance to *P. alpina* L., presence of many dried basal sheaths, and the short (less than 2 mm.) anthers. In favor of *P. lanata* are the very greenish-purple spikelets, relatively narrow leaves, and prominent lanatum on the lower part of the lemmas and on the keel and lateral nerves to above the middle. Possibly our specimens belong to some other Asiatic species, but for the present it seems best to refer them here.

Poa komarovii is an Amphi-beringian species, which in Alaska is distributed primarily in the Aleutians and on the islands in the Bering Sea. It is, in Hultén's opinion (1937, p. 39), a radiant from so-called "Southern Beringia." Previous records from the Arctic Slope are all from the general area of Point Barrow (Hultén, p. 212; Wiggins and Thomas, p. 364). Our specimens were collected very near the shore. It might be added here that more typical specimens of this species were collected by us also at Atkasuk along the Meade River southwest of Point Barrow. Porsild concurred fully with my determination of those specimens.

Apparently, this typically more southern species has invaded the Arctic Coastal Plain and migrated at least as far east as Point Barrow.

Arctophila fulva (Trin.) Anders. 3260.

Dupontia fischeri R. Br. ssp. **psilosantha** (Rupr.) Hult. 3290.

Festuca rubra L. s.l. 3214.

Bromus inermis Leyss. ssp. **pumpellianus** (Scribn.) Wagnon var. **arcticus** (Shear) Wagnon. (*B. pumpellianus* Scribn., incl. vars. *arcticus* (Shear) Porsild and *villosissimus* Hult.) 3215.

Our specimens, all collected on the same gravel bar, are extremely variable with respect to pubescence and seem to fit best the views of Wagnon (1950), regarding taxonomic treatment of plants of this affinity.

Eriophorum angustifolium Honck. ssp. **angustifolium.** 3265.

***E. brachyantherum** Trautv. 3199; det. by Hultén.

Apparently this is the second record for the Arctic Slope. Hultén (p. 279) did not report it, and Wiggins and Thomas (p. 91) assign only one collection to this species and "with some reluctance." They report a Spetzman collection from Lake Noluck, in the foothills of the Brooks Range about 200 km east of Cape Sabine, as this species.

E. scheuchzeri Hoppe. 3300.

E. vaginatum L. ssp. **vaginatum.** 3301.

The anthers of our specimens are 2.0-2.5 mm. long, most of the scales are not conspicuously darker in the center, and the spikes are more or less oblong (cf. Hultén's key, p. 275). This subspecies is unreported from the Arctic Slope, but is not unexpected in western Alaska. Subspecies *spissum* is the common North American race, whereas ssp. *vaginatum* is Eurasian.

Carex aquatilis Wahlenb. s.l. 3289.

Our specimens are intermediate between *C. aquatilis* and *C. stans* Drej., but approach *C. aquatilis* more closely (cf. key of Krechetovich, Fl. SSSR 3: 201-202, 1935). Hultén (pp. 339-340) included *C. stans* in *C. aquatilis*, but generalized that all specimens of the Arctic Coast belong to the *C. stans* type. The records of Wiggins and Thomas (p. 104) are in agreement with this generalization, but our collection would seem to be an exception.

C. atrofusca Schk. *3341.*

***C. krausei** Boeckeler ssp. **krausei.** 3250.

The strictly gynoecandrous condition of the terminal spikes immediately places this collection in *C. krausei,* according to Hultén (p. 348). But, according to the recent cytotaxonomic revision of *Carex Section Capillares* by Löve, Löve, and Raymond (pp. 744-745), the identity of our specimens is not so clearcut. Interesting as their study is from a biosystematic point of view, it also indicates the difficulties of achieving a practical taxonomic treatment that faithfully reflects underlying cytological differences. If one accepts the taxa that they have recognized in this group on cytological grounds, one is hard-pressed to distinguish them morphologically with their key. All characters used are highly variable, and the key is replete with numerous overlaps and relative distinctions. Despite what I would call "clavate-linear" terminal spikes that do overtop the lower ones and despite culms up to 20 cm. high, I think our specimens can only belong to *C. krausei* ssp. *krausei* as delimited by them. On the whole our plants are rather low — mostly 15 cm. or less.

Our record appears to extend the known range of this species considerably westward on the Arctic Slope (cf. Wiggins and Thomas, p. 112).

***C. lugens Holm.** 3238-A, 3238-B, 3238-C*, 3238-D*.

This species is unreported from the western sector of the Slope (cf. Wiggins and Thomas, p. 106).

C. membranacea Hook. *3155*, 3287.

C. physocarpa Presl. 3288.

Our specimens are not entirely typical. They have predominantly just one staminate spike, the perigynia are almost black, only some of the scales have hyaline tips, and the leaves are narrow, mostly 3 mm. wide or less.

C. rariflora (Wahlenb.) Smith. 3268.

C. scirpoidea Michx. 3249.

Juncus albescens (Lge.) Fern. (*J. triglumis* sensu Hultén, in part). 3204*.

J. balticus Willd. var. **alaskanus** (Hult.) Porsild. (*J. arcticus* Willd. ssp. *alaskanus* Hult.) 3209.

J. castaneus Smith s.l. *3157*, 3208.

Luzula confusa Lindb. 3224-A*.

L. tundricola Gorodk. (*L. nivalis* var. *latifolia* sensu Hult. Fl. Al. & Yuk., Wiggins and Thomas; cf. Hult., 1962, p. 10). *3179*, 3224-B; det. by Hultén.

***L. wahlenbergii** Rupr. 3267.

This essentially circumpolar species has been reported previously for the Arctic Slope only from Umiat (Spetzman, p. 43) and Chandler Lake (Wiggins and Thomas, p. 128).

Lloydia serotina (L.) Rchb. 3257.

Salix alaxensis (Anders.) Cov. var. **alaxensis**. *3340*; det. by Argus and Raup.

S. arctica Pall. 3282, *3330*; det. by Argus and Raup.

S. brachycarpa Nutt. ssp. **niphoclada** (Rydb.) Argus. (*S. niphoclada* Rydb.) 3302*; det. by Argus.

S. farrae Ball ssp. **walpolei** (Cov. et Ball) Hult. 3296; det. by Argus and Raup.

S. glauca L. s.l. 3256*, 3278, 3298; det. by Argus.

I have deferred here entirely to Dr. George Argus, who has just completed a revision of the *S. glauca* complex, and have made no attempt to evaluate our specimens according to Hultén's treatment. Argus believes that infraspecific taxa cannot be maintained meaningfully in this extremely variable species. He recognizes instead several "phases." He determined our collections as his so-called "Beringian Phase." (Personal conversation, Dec. 1960).

S. glauca × **S. brachycarpa** ssp. **niphoclada**. 3256-A*, det. by Argus.

S. phlebophylla Anders. 3223.

***S. polaris** Wahl. ssp. **pseudopolaris** (Flod.) Hult. 3222, 3276*, *3328*; det. by Hultén.

In my opinion these plants approach ssp. *polaris* more closely than ssp. *pseudopolaris*. Our collections extend the known range of *S. polaris* considerably westward on the Slope (cf. Wiggins and Thomas, p. 149).

S. reticulata L. 3275, *3329*.

S. richardsonii Hook. 3299*; det. by Raup.

***S. stolonifera** Cov. *3332*; det. by Argus and Raup.

This would appear to be a most significant record, since *S. stolonifera* is a species of the Pacific Coast of Alaska (Hultén, p. 523). The one previous record for the Arctic Slope (Raup, 1959, p. 52) is also from Cape Sabine, based on a specimen collected by Cantlon and Gillis and determined by Raup. Several other species of the *Ovalifolia* group are known from the Slope, however, and, since this group is much in need of study, I am inclined to doubt the significance of our record. I suspect that what Raup has here designated *S. stolonifera* may prove to be only a variant of some other species of the group common to the Arctic Slope.

Betula glandulosa Michx. var. **sibirica** (Ledeb.) Blake. (*B. nana* L. ssp. *exilis* (Sukatch.) Hult.) 3281.

American opinion (Porsild, 1951, p. 152; Wiggins and Thomas, p. 152) seems to favor regarding this taxon as a variety of *B. glandulosa*, while Hultén is convinced that it represents a race of the Eurasian *B. nana*. This question clearly needs careful study. Our specimens fit *B. exilis* quite well (cf. Kuzeneva, Fl. SSSR. 5: 271, 1936), and I find Hultén's view not without merit.

Rumex arcticus Trautv. 3196.

Polygonum bistorta L. ssp. **plumosum** (Small) Hult. 3244.

P. viviparum L. 3277*.

Stellaria longipes Goldie. 3236; det. by Hultén.

Cerastium beeringianum Cham. et Schlecht. 3286.

Arenaria arctica Stev. (*Minuartia arctica* (Stev.) Aschers. et Graebn.) *3175*, 3251, *3338*.

No. 3175 and 3338 approach *A. obtusiloba* (Rydb.) Fern. in habit and in length and ciliation of leaves. Unfortunately, none of the collections has seeds present, and this rather important character could not be checked.

A. rossii R. Br. (includ. *Minuartia elegans* sensu Hultén); *3180**, 3225, *3337*.

No. 3180 has the closely tufted habit and short pedicels of typical *A. rossii*, while nos. 3225 and 3337 have a much more diffuse habit and longer pedicels, resembling *M. elegans*, sensu Hultén (p. 681).

Silene acaulis L. var. **exscapa** (All.) DC. *3183*, 3233.

Melandrium apetalum (L.) Fenzl ssp. **arcticum** (Fr.) Hult. 3203, *3321*.

One specimen of 3203 has corolla limbs considerably exceeding the calyx and less emarginate than on the specimens with short limbs, but otherwise this specimen is similar to the others.

Caltha palustris L. var. **arctica** (R. Br.) Hutch. 3284.

Tolmatchev (1955, p. 149) regards this race as a good species, but the differences separating it from *C. palustris* are quantitative and tenuous. It is not clear to me why both Hultén (pp. 712-713) and Porsild (cf. 1955, pp. 113-114, and 1957, p. 180, map 157) treat this taxon as a variety nomenclaturally when they seem to be of the firm opinion that it is a geographic race.

Delphinium brachycentrum Ledeb. 3187*.

Aconitum delphinifolium DC. ssp. **paradoxum** (Rchb.) Hult. *3169*.

Anemone narcissiflora L. s.l. 3226.

Hultén (pp. 732-736) and Wiggins and Thomas (pp. 186-187) distinguish subspecies in this species, but I incline to the position of Porsild (1951, pp. 177-178) and Raup (1947, p. 178) that this variable species is best regarded in the broad sense. Our plants fit ssp. *sibirica* (L.) Hult., as would be expected on geographic grounds, but I find, as Porsild does, that the distinction between this subspecies and ssp. *interior* Hult. is indeed tenuous.

A. parviflora Michx. 3229*, 3242.

Ranunculus nivalis L. 3228.

R. pallasii Schlecht. 3259.

R. sulphureus Sol. *3313**.

Papaver macounii Greene. 3291, *3316-B**.

P. radicatum Rottb. s.l. (includ. *P. alaskanum* Hult.) *3316-A*.

These specimens seem to fit Hultén's segregate species *P. alaskanum*.

Corydalis pauciflora (Steph.) Pers. *3168*.

Cochlearia officinalis L. ssp. **arctica** (Schlecht.) Hult. *3173*.

Cardamine digitata Richards. (*C. richardsonii* Hult.) 3254.

Contrary to Hultén (p. 838), there is no earlier homonym of this binomial (cf. Shetler, 1961).

***Draba bellii** Holm. (possibly *D. macrocarpa* sensu Hultén — cf. his remarks regarding *D. bellii*, p. 868) ; 3202; det. by Porsild.

Neither Spetzman nor Wiggins and Thomas reports this species from the Arctic Slope, but the systematics of arctic *Draba* are so complex that one hesitates to attribute any great phytogeographical significance to this segregate species of the *D. alpina* L. complex. I have deferred here to Porsild, however, whose wide experience with this genus in the Arctic convinces him that plants exhibiting the characteristics of our specimens should be distinguished as the separate species *D. bellii*. If our plants are placed in *D. alpina* s.l., then our record loses significance.

D. lactea Adams. *3172-A*; verif. by Porsild.

D. longipes Raup. *3170*, *3172-B**; verif. by Porsild.

D. nivalis Liljebl. var. **nivalis**. 3327*; verif. by Porsild.

D. pilosa Adams ex DC. 3191*; det. by Porsild.

Smelowskia calycina (Steph.) C. A. Mey. ssp. **integrifolia** (Seemann) Hult. *3150*, *3326*.

Erysimum pallasii (Pursh) Fern. *3148*.

***Braya siliquosa** Bunge. 3201; det. by Porsild.

Although the taxonomic situation in this genus is very complex, Porsild believes (letter, Dec. 1960) that our plants can only belong to *B. siliquosa*, a small Asiatic species which apparently is unknown to North America. This species is distinguished from other Eurasian species by its narrow linear siliques, 10-15 mm. long by about 1 mm. wide (cf. Vassilczenko, Fl. SSSR 8: 70-71, 1939). The siliques of our specimens have a maximum length of 10 mm. and a width of about 1 mm. These dimensions fit *B. siliquosa*, although the siliques are on the short side. The Cape Sabine record represents a most remarkable range extension. According to Vassilczenko, this species is widespread in Asia from western Siberia (Altai) to eastern Siberia and Okhotsk in the Far East, and it inhabits alpine meadows and slopes. He also reported that it is found in North America from 52°-57° N. lat., but I have found no American confirmation of this. Popov (*1*: 545-546) called it an alpine zone species of certain parts of the Sayan Mountain forest region and considered that it radiated westward from alpine areas of the Okhotsk region. Hultén (1937, pp. 16-17, pl. 3) regarded it as a boreal Eurasiatic species that has radiated from the Amur region and is widely distributed in central and eastern Asia, but has not reached either Europe or extreme northeastern Siberia. That *B. siliquosa* is a *boreal*, not arctic, species in Asia makes the Cape Sabine record all the more significant. Our plants were collected on a sandflat along the Pitmegea River at Sevenmile, the site more definitely in foothills topography, and quite possibly this species has only recently "washed down" from alpine areas in the Brooks Range. It should also be noted, however, that Cape Sabine lies in a general area that has not been glaciated and presumably, therefore, has served as an important refugium for plants during the Pleistocene. Perhaps prior to Pleistocene glaciation, *B. siliquosa* was more widespread in Alaska.

Parrya nudicaulis (L.) Regel s.l. 3255, *3320*.

No. 3320 fits Hultén's ssp. *interior*, but 3255 is so variable in the width and toothing of the leaves as to defy racial identity. My own limited experience with this variable species leads me to question Hultén's races.

Saxifraga bronchialis L. ssp. **funstoni** (Small) Hult. *3160*.

S. cernua L. 3195*, 3263.

S. davurica Willd. ssp. **grandipetala** (Engler et Irmscher) Hult. 3280, *3310*.

S. eschscholtzii Sternb. *3182*.

S. flagellaris Willd. ex Sternb. ssp. **flagellaris.** 3219, *3323*.

Phytogeographically, our plants should belong to this subspecies, although morphologically they tend toward ssp. *platysepala* (Trautv.) Pors. (cf. Porsild, 1955, pp. 136-138).

S. foliolosa R. Br. 3264.

S. hieracifolia Waldst. et Kit. var. **rufopilosa** Hult. 3270.

S. hirculus L. 3189.

S. oppositifolia L. 3198, *3307**, *3336**.

S. punctata L. ssp. **nelsoniana** (D. Don) Hult. 3193, *3311*.

Chrysosplenium tetrandrum (Lund) Th. Fries. 3194*.

C. wrightii Franch. et Sav. *3342*.

Parnassia kotzebuei Cham. et Schlecht. 3211.

Rubus chamaemorus L. 3190.

Potentilla biflora Willd. ex Schlecht. 3186, 3232.

P. hyparctica Malte. (*P. emarginata* Pursh s.l.); 3231*; verif. by Porsild.

P. ledebouriana Porsild. (*P. uniflora* Ledeb.); *3319*; det. by Porsild.

P. palustris (L.) Scop. 3266.

Dryas integrifolia M. Vahl. *3177**, 3253, *3331**; det. by Porsild.

D. octopetala L. *3176*, 3221; det. by Porsild.

No. 3176 is a very silvery canescent form designated by Porsild as "f. *canescens-argentea*."

D. integrifolia × **octopetala.** 3283-A*; det. by Porsild.

Lupinus arcticus S. Wats. 3218, *3317**.

Astragalus alpinus L. s.l. 3279, *3335*.

Our plants seem to fit what Hultén (pp. 1081-1085) called the "main type," but the question of races in this species needs further study.

***A. polaris** Seemann in Benth. 3274, *3339*; det. by Porsild.

This attractive little *Astragalus* species is an Alaskan endemic of gravel bars, known only from a few widely scattered localities. Wiggins and Thomas cite only one specimen from the Arctic Slope (Utukok R., cf. W. and T., p. 263).

A. umbellatus Bunge. 3206, *3312*.

Oxytropis leucantha sensu Hultén. 3239; det. by Porsild.

Porsild annotated this collection as follows: "This is *Oxytropis leucantha* sensu Hult. Fl. Al. & Yuk. not Pall. It is close to *O. glutinosa* Pors. but differs in several characters nor is it *O. viscida* or *O. viscidula.* It is probably an undescribed species of which I have other collections from W. Alaska [Dec. 1960]."

O. nigrescens (Pall.) Fisch. *3184*, *3185*, 3205*, *3324*; det. by Porsild.

Our collections exhibit several rather distinct types. Nos. 3184 and 3205 are very pulvinate and gray-pilose and seem to fit Hultén's ssp. *pygmaea* (cf. Hultén, pp. 1102-1105) fairly well, whereas no. 3185 is not particularly pulvinate and is less gray-pilose. No. 3324 includes plants of both types. The less pulvinate plants approach ssp. *bryophila* (Greene) Hult.

Hedysarum alpinum L. ssp. **americanum** (Michx.) Fedtsch. 3294.

H. mackenzii Richards. 3295, *3334*.

Epilobium latifolium L. 3304.

Hippuris vulgaris L. 3258

Bupleurum americanum Coult. et Rose. *3146*.

These plants are very low, in some cases almost acaulescent, and have relatively few rays (3-6) per umbel. Leaf-width however is quite variable. The cauline leaves mostly are narrowly lanceolate or linear, but they range up to nearly a centimeter in width and in some cases are distinctly clasping at the base. Thus in general habit they are strikingly different from the large plants of Interior Alaska, and there is no doubt that they are closely related to the Asiatic *B. triradiatum* Adams ex Hoffm. Quite possibly they should be referred to ssp. *arcticum* (Regel et Tiling) Hult. of the latter species, but until a comprehensive study of the Alaskan forms is available, including extensive comparisons with Asiatic material, it seems best to follow Hultén (pp. 1166-1168) in relegating this dwarf arctic form to the endemic American species, *B. americanum* (cf. also, Hult. Fl. Kamtch., pp. 157-158; Lincheviskii, Fl. SSSR *16:* 301-303, 1950).

Conioselinum cnidiifolium (Trucz.) Pors. *3143*.

The relationship of this species to the Asiatic *C. vaginatum* (Spreng.) Thell. s.l. needs careful scrutiny. Although *C. cnidiifolium* is reported to occur in eastern Asia (Hultén, p. 1177; Polunin, 1959, p. 328), Schischkin makes no mention of it in *Flora SSSR* (*17:* 1-10, 1951). Apparently, he referred all material of this affinity to *C. vaginatum.*

Pyrola grandiflora Radius. 3271*.

Ledum palustre L. ssp. **decumbens** (Ait.) Hult. 3273.

Cassiope tetragona (L.) D. Don. 3217, *3322**.

***Primula borealis** Duby var. **borealis.** 3171.

This Amphi-beringian species, apparently restricted to the Arctic seashores (cf. Wiggins and Thomas, p. 295), was collected on a moist turfy slope right on shore at Cape Sabine. Although rare on the Arctic Slope, its occurrence here is not unexpected, since it has been collected before on the coastal plain northeast of Cape Sabine and at Cape Lisburne to the west.

***P. egaliksensis** Wormskj. 3200.

According to Wiggins and Thomas (p. 296), this species is "rare in the foothills of the Brooks Range and on the Coastal Plain."

***P. sibirica** Jacq. 3207*.

This Eurasian species has a very disjunct range in Alaska and Yukon, and is previously unreported north of the Brooks Range. According to Hultén (1937, p. 92), it is an "Arctic-montane" radiant from eastern Asia.

***P. tschuktschorum** Kjellm. *3152.*

Although known from a widespread group of localities south of the Brooks Range, the only previously known locality north of the Range was Cape Lisburne (cf. Wiggins and Thomas, p. 295).

Androsace chamaejasme Host. ssp. **lehmanniana** (Spreng.) Hult. 3241, *3315.*

Dodecatheon frigidum Cham. et Schlecht. *3153*, 3305.

Phlox sibirica L. ssp. **borealis** *(Wherry) stat. et comb. nov. (P. borealis* Wherry, *The Genus Phlox*, p. 126, 1955; P. sibirica sensu Hult.) *3149.*

In Wherry's opinion (op. cit.), Alaskan plants of the affinity of *P. sibirica* L. should be segregated into a separate taxon because they differ consistently from Asiatic plants of this species in being "smaller in stature and in sizes of parts." He proposed to call the Alaskan taxon a distinct species, *P. borealis* Wherry. While he seems to have a good case for segregating the Alaskan plants, the differences he cites are all variable and quantitative, and it seems best to regard these plants as nothing more than a geographical race of *P. sibirica* L.

Polemonium acutiflorum Willd. in Roem. et Schult. 3235.

Myosotis alpestris F. W. Schmidt ssp. **asiatica** Vestergr. in Hult. *3147.*

Lagotis glauca Gaertn. s.l. 3188*.

In the absence of a convincing statistical demonstration of the validity of var. *stelleri* (Cham. et Schlecht.) Trautv. (cf. Hultén, Fl. Kamtch. *4:* 103-105, 1930), I am inclined to consider *L. glauca* broadly, even though both Hultén (pp. 1384-1385) and Wiggins and Thomas (p. 307) refer all Arctic Slope plants to this variety. The question is further complicated by the problem of *L. minor* (Willd.) Standley (cf. Vikulova, Fl. SSSR *22:* 501, 1955). Whether it is still a third closely related taxon or simply the oldest name for var. *stelleri*, as suggested by Vikulova's synonymy, can only be resolved by comparing Eurasian and American specimens statistically.

Castilleja pallida (L.) Spreng. s.l. 3216, *3333*.

According to Pennell's key (p. 522), our specimens belong to the typical subspecies, ssp. *pallida* (ssp. *typica* of Pennell). Phytogeographically, however, they should belong to ssp. *caudata* Pennell, and Hultén has determined our 3216 as this subspecies. In point of fact, the distinctions drawn by Pennell between these two subspecies are questionable (cf. Hultén, pp. 1391-1392), and I refrain for the present from recognizing them.

Pedicularis capitata Adams. *3181**, 3306.

P. **langsdorfii** Fisch. ex Steven. s.s. (exclud. *P. arctica* R. Br.) 3220*, *3318**.

***P. oederi** Vahl. 3240*.

This species appears to be very rare on the Arctic Slope, although south of the Brooks Range it is rather widespread and reasonably common (cf. Hultén, map 1056, p. 1472). Spetzman (p. 49) records it only from Anaktuvuk Pass. Wiggins and Thomas (pp. 309-314), curiously, make no mention of this species, although the specimen on which they based the presence of *P. flammea* L. on the Slope was Spetzman's no. 1747, which he determined as *P. oederi.* This is undoubtedly the specimen on which Spetzman based his Arctic Slope record, because it is from Anaktuvuk Pass. I have examined this collection (1747) at the U. S. National Herbarium and have compared it with both *P. flammea* and *P. oederi.* It does fall somewhat on the low side of the size range for *P. oederi*, giving some room for doubt perhaps, but there is no question but that it is this species and not *P. flammea*, as Wiggins and Thomas decided (p. 314), albeit with some doubt. This means that *P. flammea* should be removed from their list of species for the Arctic Slope, and *P. oederi* should be added.

***P. pennellii** Hult. 3261.

Not previously recorded this far west on the Arctic Slope (cf. Wiggins and Thomas, p. 311).

P. sudetica Willd. ssp. **albolabiata** Hult. (cf. Hultén, 1961); *3164*; det. by Hultén.

P. sudetica ssp. **pacifica** Hult. (cf. Hultén, 1961); 3212; det. by Hultén.

P. verticillata L. 3262*.

Valeriana capitata Pall. ex Link. *3166*, 3192.

Campanula uniflora L. *3154*, *3158**, *3167*, *3174*.

Blue and white-flowered forms seemed to be equally common and to occur intermixed in the populations.

Solidago multiradiata Ait. 3308*.

Aster sibiricus L. s.l. (includ. *A. subintegerrimus* (Trautv.) Ostenf. et

Resvoll, and *A. richardsonii* Spreng.; cf. Tamamshan, Fl. SSSR *25:* 77-110, 1959, and Hultén, pp. 1493-1496). 3210.

***Erigeron compositus** Pursh var. **glabratus** Macoun. *3144.*

This is the first record of the species for the Arctic Slope and represents a very significant range extension northwestward.

Chrysanthemum integrifolium Richards. 3293.

Artemisia arctica Less. (*A. norvegica* ssp. *saxatilis* (Bess.) Hall et Clements, Wiggins and Thomas, p. 341). *3165*, 3303.

***A. richardsoniana** Bess. (*A. borealis* sensu Hultén, in part: cf. Fl. Al. & Yuk., p. 1556, under *A. aleutica* Hult.; cf. also, Porsild, 1955, pp. 185-186;? *A. trifurcata* Steph. ex Spreng., Wiggins and Thomas, p. 340.) 3297; det. by Porsild.

Porsild (loc. cit) segregates this species from the circumpolar *A. borealis* Pall. as an endemic of the Canadian Arctic Archipelago, while Hultén (loc. cit.) and Polunin (1959, p. 430) unite these two species under *A. borealis.* Our collection represents a significant range extension only if the interpretation of Porsild is accepted. Owing to the absence of discussions and to the minimal synonymy in Wiggins' and Thomas' treatment, I am hard-pressed to relate it to the treatments of Porsild and Hultén.

Petasites frigidus (L.) Fries. 3227.

Arnica louiseana Farr ssp. **frigida** (Meyer ex Iljin) Maguire. *3162*, 3247.

Senecio atropurpureus (Ledeb.) Fedtsch. ssp. **frigidus** (Richards.) Hult. *3161*, 3197*, 3272, *3309.*

No. 3309 approaches ssp. *atropurpureus.*

S. fuscatus (Jord. et Fourr.) Hayek. *3159*.*

S. hyperborealis Greenm. *3145.*

It seems to me highly doubtful that this species is really distinct from *S. conterminus* Greenm. and/or *S. resedifolius* Less. Polunin (1959), p 460) unites it with the latter species, a relatively widespread species on the Arctic Slope, although Hultén, Porsild, and Wiggins and Thomas maintain it.

S. lugens Richards. *3163*, 3245.

S. resedifolius Less. 3246.

Saussurea angustifolia (Willd.) DC. 3292*.

***Taraxacum phymatocarpum** J. Vahl. (*T. lyratum* (Led.) DC., in part, Wiggins and Thomas, p. 353); *3151**, 3243; det. by Porsild.

From the specimen citations it appears that Wiggins and Thomas referred all specimens of this species to *T. lyratum,* although this is made clear neither by discussion nor synonymy. I am not able to compare our specimens against their key at present and think it best to accept Porsild's determination. Whether or not our record from Cape Sabine is phytogeographically significant depends entirely upon one's taxonomic view of the complex of forms relegated to *T. lyratum.* If one segregates the apparently New World *T. phymatocarpum* from it, then our record is reasonably significant. Only one previously published report for the Arctic Slope appears to exist (Spetzman, p. 51).

Crepis nana Richards. 3213*.

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CHROMOSOME STUDIES IN MEXICAN COMPOSITAE[1]

D. C. D. DE JONG AND E. K. LONGPRE

The chromosome numbers reported in this paper are, for the greater part, based upon specimens collected during the summer of 1961 along with material for the authors' separate monographic studies of the genera *Astranthium* (Compositae-Astereae) and *Sabazia* (Compositae-Heliantheae). Bud collections were obtained from plants growing in their native habitats and were placed in vials containing a freshly mixed Carnoy solution of 6 parts 95% ethyl alcohol, 3 parts chloroform, and 1 part glacial acetic acid. The vials were subsequently placed in a foam-plastic cooler with bulk ice and kept refrigerated during the entire field trip; upon return to East Lansing they were stored at 1° C until used. Slides were made by the aceto-carmine smear technique. Chromosomes were drawn with the aid of a Zeiss drawing apparatus at an initial magnification of ca. 4000X and are here reduced to ca. 1300X.

A complete list of the taxa studied is contained in Table 1; the tribal sequence is that of Hoffmann (1897), whereas the genera and species have been placed in alphabetical order. All counts are documented by voucher specimens in the Herbarium of Michigan State University. We are indebted to Dr. J. H. Beaman for aid in the identification of certain specimens and in the preparation of the manuscript, and to Dr. Rogers McVaugh for the use of herbarium facilities at the University of Michigan, Ann Arbor. Dr. Arthur Cronquist kindly identified some species of *Erigeron* and *Conyza;* Drs. B. L. Turner and M. C. Johnston determined the species of *Aphanostephus, Dyssodia,* and *Schkuhria.* All other determinations are our own.

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TABLE 1.

SUMMARY OF THE COLLECTIONS STUDIED.

TAXON	LOCALITY	GAMETIC CHROMOSOME NUMBER
EUPATORIEAE		
Eupatorium greggii Gray	DURANGO: 1 mi. s. of La Zarca. *De Jong & Longpre 951.*	10 (Fig. 1)
Kuhnia chlorolepis Woot. & Standl.	CHIHUAHUA: 11 mi. e. of Majalca. *De Jong & Longpre 924.*	9 (Fig. 2)
ASTEREAE		
Achaetogeron forreri Greene	DURANGO: at railroad crossing near Hacienda Coyotes. *De Jong & Longpre 1003.*	27 (Fig. 3)
A. griseus Greenman	DURANGO: 30 mi. w. of Ciudad Durango, along Hwy 40. *De Jong & Longpre 974.*	9
A. griseus	DURANGO: 31 mi. w. of Ciudad Durango, along Hwy 40. *De Jong & Longpre 978.*	9 (Fig. 4)
Aphanostephus ramosissimus DC.	CHIHUAHUA: along Hwy to Buenaventura, 7 mi. w. of Hwy 45 turnoff. *De Jong & Longpre 904.*	4 (Fig. 5)
A. ramosissimus	CHIHUAHUA: 15 mi. w. of Buenaventura. *De Jong & Longpre 916.*	4
A. ramosissimus	DURANGO: 1 mi. s. of La Zarca. *De Jong & Longpre 961.*	4
A. ramosus (DC.) Gray	PUEBLA: 1.5 mi. w. of Chachapa. *Beaman 3614.*	4
A. ramosus	MICHOACAN: meadow along road to Cerro San Andres, 2815 m. alt. *De Jong 758.*	4
A. ramosus	MICHOACAN: At Km. 43.5, Hwy 120 to Uruapan. *De Jong 762.*	4
A. ramosus	PUEBLA: 3.4 mi. s. of Tlachichupa on road to Zuapam. *Beaman 3621.*	4
Aster pauciflorus Nutt.	DURANGO: *ca.* 12 mi. n. of Donato Guerra. *De Jong & Longpre 964.*	9 (Fig. 6)
A. exilis Ell. var. *australis* Gray	JALISCO: 13 mi. s. of Guadalajara. *De Jong & Longpre 1018.*	5
Astranthium mexicanum (Gray) Larsen	STATE OF MEXICO: At Km. 75, Amecameca—Popocatépetl road, 3235 m. alt. *De Jong 566.*	18

A. mexicanum	FEDERAL DISTRICT: near railroad overpass at La Cima. *De Jong 647.*	18	
A. mexicanum	FEDERAL DISTRICT: on slope along road to La Cima. *De Jong 653.*	18	
A. mexicanum	MICHOACAN: Cerro San Andres, *ca.* 3100 m. alt. *De Jong 757.*	18	
A. mexicanum	MICHOACAN: East slope of Cerro Tancitaro, 3080 m. alt. *De Jong 1068.*	18	
A. orthopodum (Robins. & Fern.) Larsen	DURANGO: 38 mi. w. of Ciudad Durango, along Hwy 40. *De Jong 984.*	3	(Fig. 7)
A. purpurascens (Robins.) Larsen	HIDALGO: at village limit of Cobrecito. *De Jong 1227.*	8	
A. xanthocomoides (Less.) Larsen	PUEBLA: 5.3 mi. sw. of San Salvador El Seco. *De Jong 630.*	8	(Fig. 8)
A. xanthocomoides	TLAXCALA: 2.2 mi. s. of Puebla State Line, just n. of Tlaxco. *De Jong 1195.*	8	
A. xylopodum Larsen	JALISCO: Sierra del Halo, s. of Tecalitlan. *De Jong 1028.*	5	(Fig. 9)
Baccharis glutinosa Pers.	CHIHUAHUA: 11 mi. e. of Majalca. *De Jong & Longpre 925.*	9	
Conyza canadensis (L.) Cronq.	CHIHUAHUA: along Hwy to Buenaventura, 7 mi. w. of Hwy 45 turnoff. *De Jong & Longpre 903.*	9	
C. aff. *confusa* Cronq.	DURANGO: 1 mi. e. of La Ciudad. *De Jong & Longpre 1011.*	9	(Fig. 10)
Erigeron coronarius Greene	DURANGO: 38 mi. w. of Ciudad Durango, along Hwy 40. *De Jong & Longpre 994.*	9	
E. aff. *coronarius*	DURANGO: 14 mi. w. of Ciudad Durango, along Hwy 40. *De Jong & Longpre 973.*	9	
E. delphinifolius Willd.	STATE OF MEXICO: 4.5 kms. s. of Tlalmanalco. *Beaman 4525.*	9	(Fig. 11)
E. delphinifolius Willd. aff. subsp. *neomexicanus* (Gray) Cronq.	DURANGO: *ca.* 12 mi. n. of Donato Guerra. *De Jong & Longpre 967.*	9	
E. delphinifolius Willd. subsp. *neomexicanus* var. *neomexicanus*	DURANGO: 14 mi. w. of Ciudad Durango, along Hwy 40. *De Jong & Longpre 972.*	9	

E. delphinifolius Willd. subsp. *neomexicanus* var. *oreophilus* (Greenman) Cronq.	CHIHUAHUA: 1 mi. e. of Majalca. *De Jong & Longpre 934.*	9
E. divergens T. & G.	CHIHUAHUA: 11 mi. e. of Majalca. *De Jong & Longpre 922.*	9 (Fig. 12)
E. pubescens HBK.	HIDALGO: 3 mi. s. of Cuyamaloya. *De Jong & Longpre 1226.*	35 (Fig. 13) univalents
Grindelia oxylepis Greene	CHIHUAHUA: 6 mi. w. of Cuaohtemoc. *De Jong & Longpre 940.*	6
G. oxylepis	CHIHUAHUA: 22 mi. s. of Hidalgo del Parral. *De Jong & Longpre 948.*	6
G. oxylepis	DURANGO: 1 mi. s. of La Zarca. *De Jong & Longpre 956.*	6
G. sublanuginosa Steyermark	JALISCO: Lago Chapala, 49 mi. s. of Guadalajara. *De Jong & Longpre 1026.*	6 (Fig. 14)
Haplopappus spinulosus (Pursh) DC. subsp. *scabrellus* (Greene) Hall	CHIHUAHUA: along Hwy to Buenaventura, 7 mi. w. of Hwy 45 turnoff. *De Jong & Longpre 901.*	4
H. spinulosus (Pursh) DC. subsp. *scabrellus*	CHIHUAHUA: 17 mi. n. of Ciudad Camargo. *De Jong & Longpre 919.*	6
Leucelene ericoides (Torr.) Greene	CHIHUAHUA: 17 mi. n. of Ciudad Camargo. *De Jong & Longpre 920.*	8 (Fig. 15)
Machaeranthera tanacetifolia (HBK.) Nees	CHIHUAHUA: along Hwy to Buenaventura, 7 mi. w. of Hwy 45 turnoff. *De Jong & Longpre 900.*	4
M. gymnocephala (DC.) Shinners	DURANGO: 1 mi. s. of La Zarca. *De Jong & Longpre 955.*	4 (Fig. 16)
Psilactis asteroides Gray	CHIHUAHUA: 6 mi. w. of Cuaohtemoc. *De Jong & Longpre 944.*	4
Xanthocephalum gymnospermoides (Gray) Benth. & Hook. ex Rothrock in Wheeler	CHIHUAHUA: meadows at Majalca. *De Jong & Longpre 930.*	6 (Fig. 17)
X. gymnospermoides	CHIHUAHUA: 6 mi. w. of Cuaohtemoc. *De Jong & Longpre 943.*	6
X. sericocarpum Gray	CHIHUAHUA: 9 mi. s. of V. Matamoros. *De Jong & Longpre 950.*	4 (Fig. 18)

INULEAE			
Gnaphalium lavandulifolium (HBK.) Blake	STATE OF MEXICO: Nevado de Toluca, *ca.* 4090 m. alt. *De Jong & Longpre 1116.*	14	(Fig. 19)
HELIANTHEAE			
Berlandiera lyrata Benth.	CHIHUAHUA: along Hwy to Buenaventura, 3.6 mi. e. of Ricardo Flores Magon. *De Jong & Longpre 910.*	15	
Calea palmeri Gray	MICHOACAN: 12 mi. e. of Zacapu. *Longpre 113.*	16	
C. scabra (Lag.) Robins.	JALISCO: Sierra del Halo, s. of Tecalitlan. *De Jong 1033.*	16	(Fig. 20)
Cosmos palmeri Robins. var. *palmeri*	DURANGO: 33 mi. w. of Ciudad Durango, along Hwy 40. *De Jong & Longpre 983.*	17	(Fig. 21)
Chrysanthellum mexicanum Greenman	JALISCO: 13 mi. s. of Guadalajara. *De Jong & Longpre 1020.*	8	(Fig. 22)
Parthenium hysterophorus L.	DURANGO: *ca.* 12 mi. n. of Donato Guerra. *De Jong & Longpre 965.*	17	
P. hysterophorus	JALISCO: 13 mi. s. of Guadalajara. *De Jong & Longpre 1021.*	17	
Sabazia humilis (HBK.) Cass.	PUEBLA: between Kms. 65 and 66, Hwy 190, se. of Mexico City. *Longpre 350A.*	4	(Fig. 23)
Sanvitalia procumbens Lam.	DURANGO: *ca.* 12 mi. n. of Donato Guerra. *De Jong & Longpre 966.*	8	(Fig. 24)
Verbesina tetraptera Gray	MICHOACAN: 12 mi. e. of Zacapu. *Longpre 127.*	*ca.* 18	
V. callilepis Blake	DURANGO: 1 mi. w. of La Ciudad. *De Jong & Longpre 1012.*	18	(Fig. 25)
Ximenesia encelioides Cav.	CHIHUAHUA: along Hwy to Buenaventura, 9.2 mi. w. of Ricardo Flores Magon. *De Jong & Longpre 911.*	17	(Fig. 26)
Zexmenia palmeri Greenman in Jones	MICHOACAN: 12 mi. e. of Zacapu. *Longpre 128.*	*ca.* 17	
HELENIEAE			
Dyssodia cancellata (Cass.) Gray	CHIHUAHUA: 9 mi. s. of V. Matamoros. *De Jong & Longpre 949.*	13	(Fig. 27)
D. hartwegii (Gray) Robins	DURANGO: 1 mi. s. of La Zarca. *De Jong & Longpre 957.*	26	(Fig. 28)


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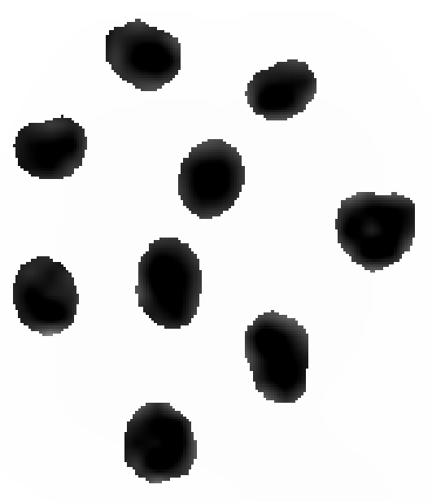
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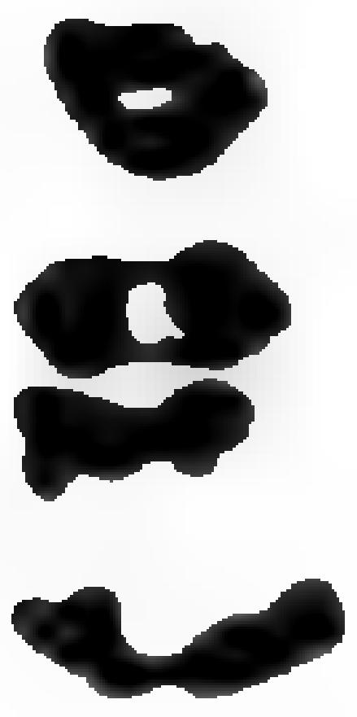
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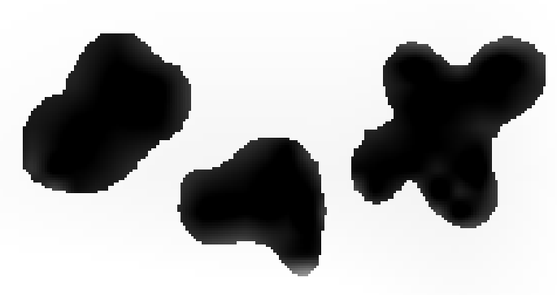
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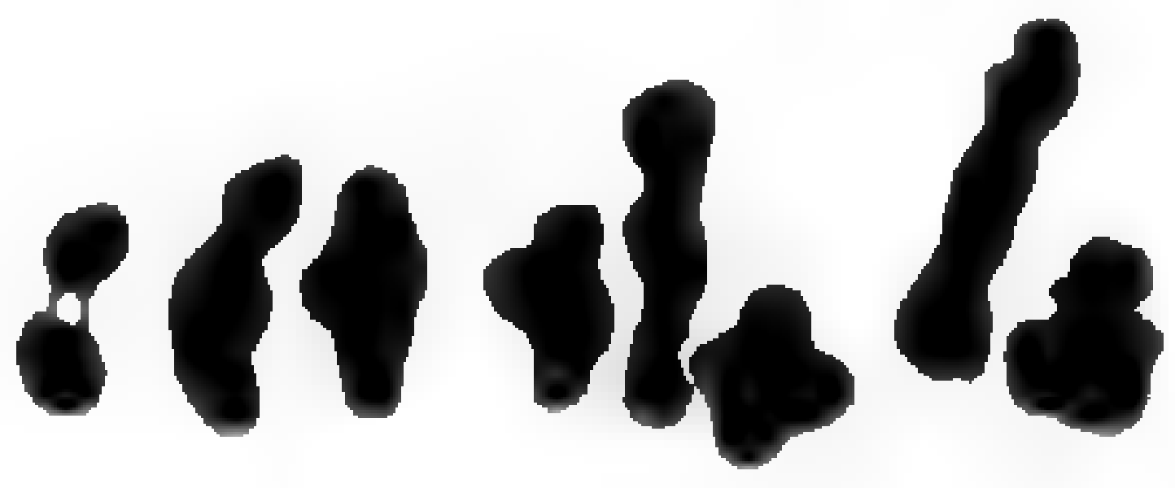
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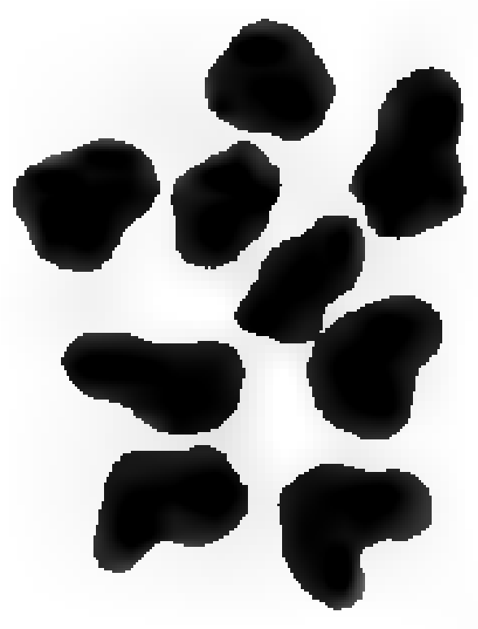
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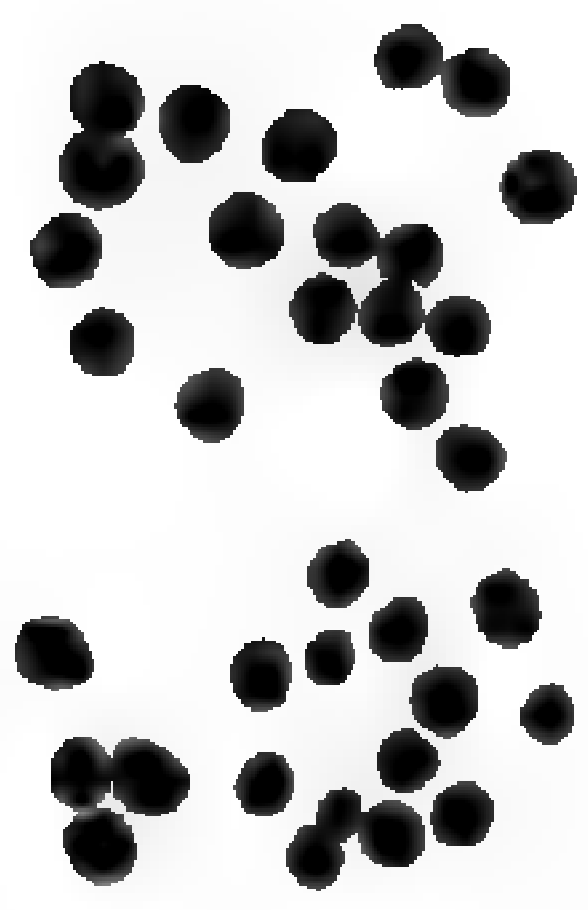
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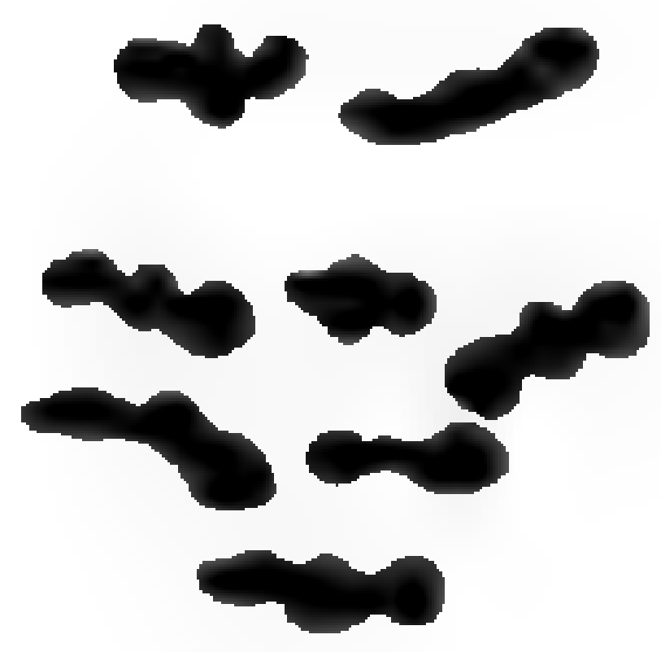
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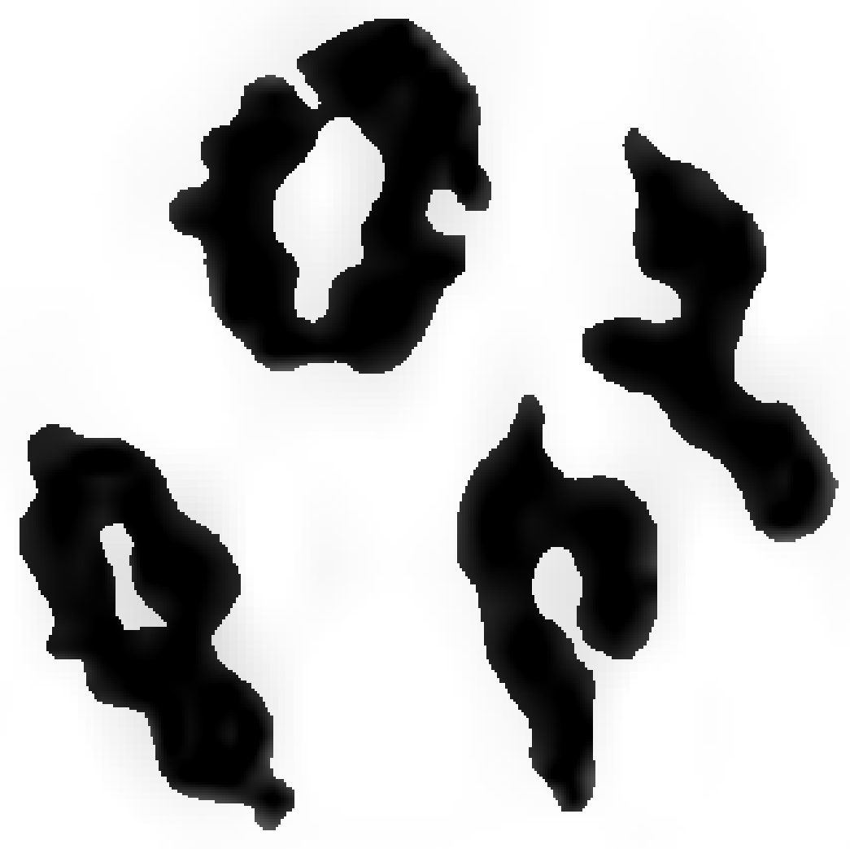
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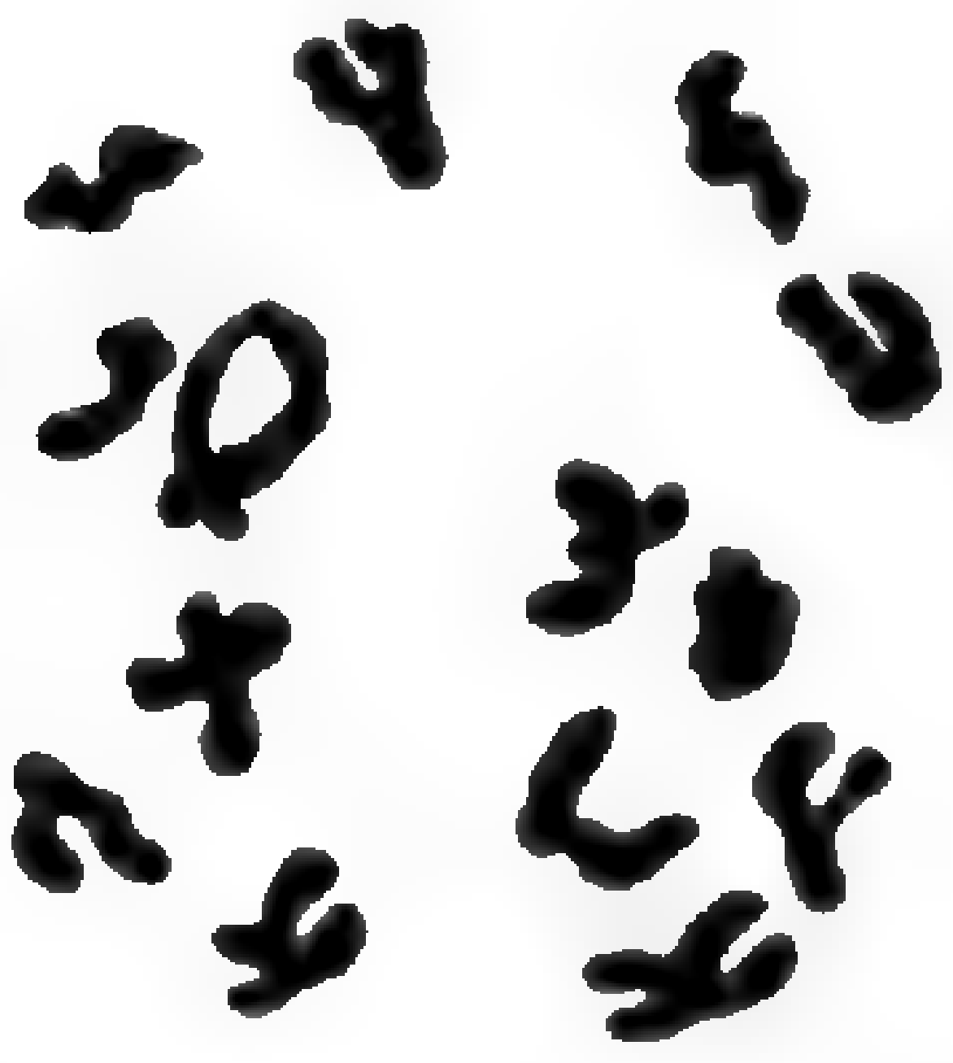
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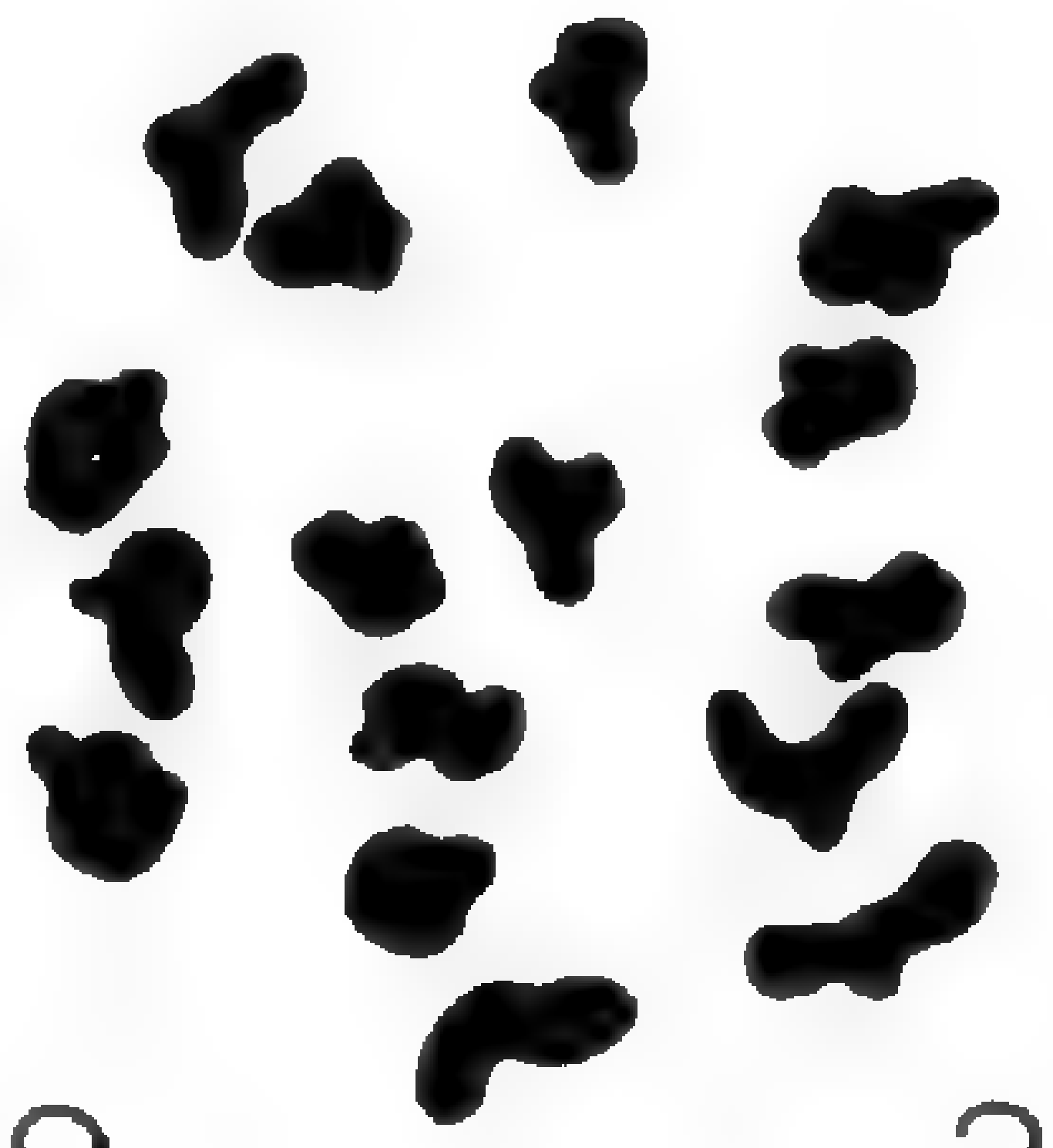
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Gaillardia pinnatifida Torr.	CHIHUAHUA: 17 mi. n. of Ciudad Camargo. *De Jong & Longpre 914.*	17	
Psilostrophe gnaphalodes DC.	DURANGO: 1 mi. s. of La Zarca. *De Jong & Longpre 954.*	32	(Fig. 29)
P. tagetina (Nutt.) Greene	CHIHUAHUA: along Hwy to Buenaventura, 7 mi. w. of Hwy 45 turnoff. *De Jong & Longpre 905.*	16	(Fig. 30)
Schkuhria anthemoidea (DC.) Coult. var. *wislizeni* (Gray) Heiser	JALISCO: Lago de Chapala, 49 mi. s. of Guadalajara. *De Jong & Longpre 1024.*	10	(Fig. 31)
Tagetes lucida Cav.	CHIHUAHUA: 3 mi. w. of Guerrero. *De Jong & Longpre 947.*	11	(Fig. 32)
ANTHEMIDEAE			
Achillea lanulosa Nutt.	CHIHUAHUA: meadows at Majalca. *De Jong & Longpre 932.*	18	
SENECIONEAE			
Cacalia sinuata Llav. & Lex.	DURANGO: 33 mi. w. of Ciudad Durango, along Hwy 40. *De Jong & Longpre 982.*	30	
MUTISIEAE			
Chaptalia dentata (L.) Cass.	DURANGO: 14.5 mi. w. of Hacienda Coyotes. *De Jong & Longpre 1008.*	16	(Fig. 33)
CICHORIEAE			
Stephanomeria pauciflora (Torr.) A. Nels.	CHIHUAHUA: 17 mi. n. of Ciudad Camargo. *De Jong & Longpre 915.*	8	(Fig. 34)
S. tenuifolia (Torr.) Hall	CHIHUAHUA: 11 mi. e. of Majalca. *De Jong & Longpre 927.*	8	(Fig. 35)

Fig. 1-20. Meiotic chromosomes of Mexican Compositae, × *ca.* 1300. Fig. 1. *Eupatorium greggii* ($n = 10$) — Fig. 2. *Kuhnia chlorolepis* ($n = 9$) — Fig. 3. *Achaetogeron forreri* ($n = 27$) — Fig. 4. *Achaetogeron griseus* ($n = 9$) — Fig. 5. *Aphanostephus ramosissimus* ($n = 4$) — Fig. 6. *Aster pauciflorus* ($n = 9$) — Fig. 7. *Astranthium orthopodum* ($n = 3$) — Fig. 8. *Astranthium xanthocomoides* ($n = 8$) — Fig. 9. *Astranthium xylopodum* ($n = 5$) — Fig. 10. *Conyza* aff. *confusa* ($n = 9$) — Fig. 11. *Erigeron delphinifolius* ($n = 9$) — Fig. 12. *Erigeron divergens* ($n = 9$) — Fig. 13. *Erigeron pubescens* ($n = 35$ univalents) — Fig. 14. *Grindelia sublanuginosa* ($n = 6$) — Fig. 15. *Leucelene ericoides* ($n = 8$) — Fig. 16. *Machaeranthera gymnocephala* ($n = 4$) — Fig. 17. *Xanthocephalum gymnospermoides* ($n = 6$) — Fig. 18. *Xanthocephalum sericocarpum* ($n = 4$) — Fig. 19. *Gnaphalium lavandulifolium* ($n = 14$) — Fig. 20. *Calea scabra* ($n = 16$).


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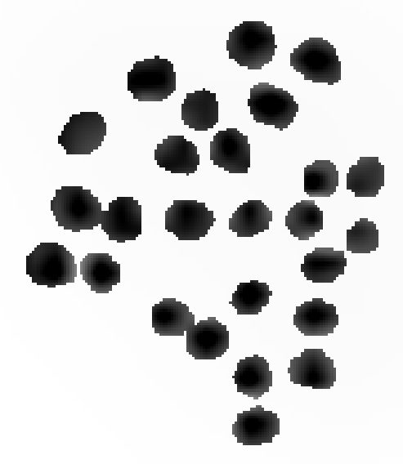
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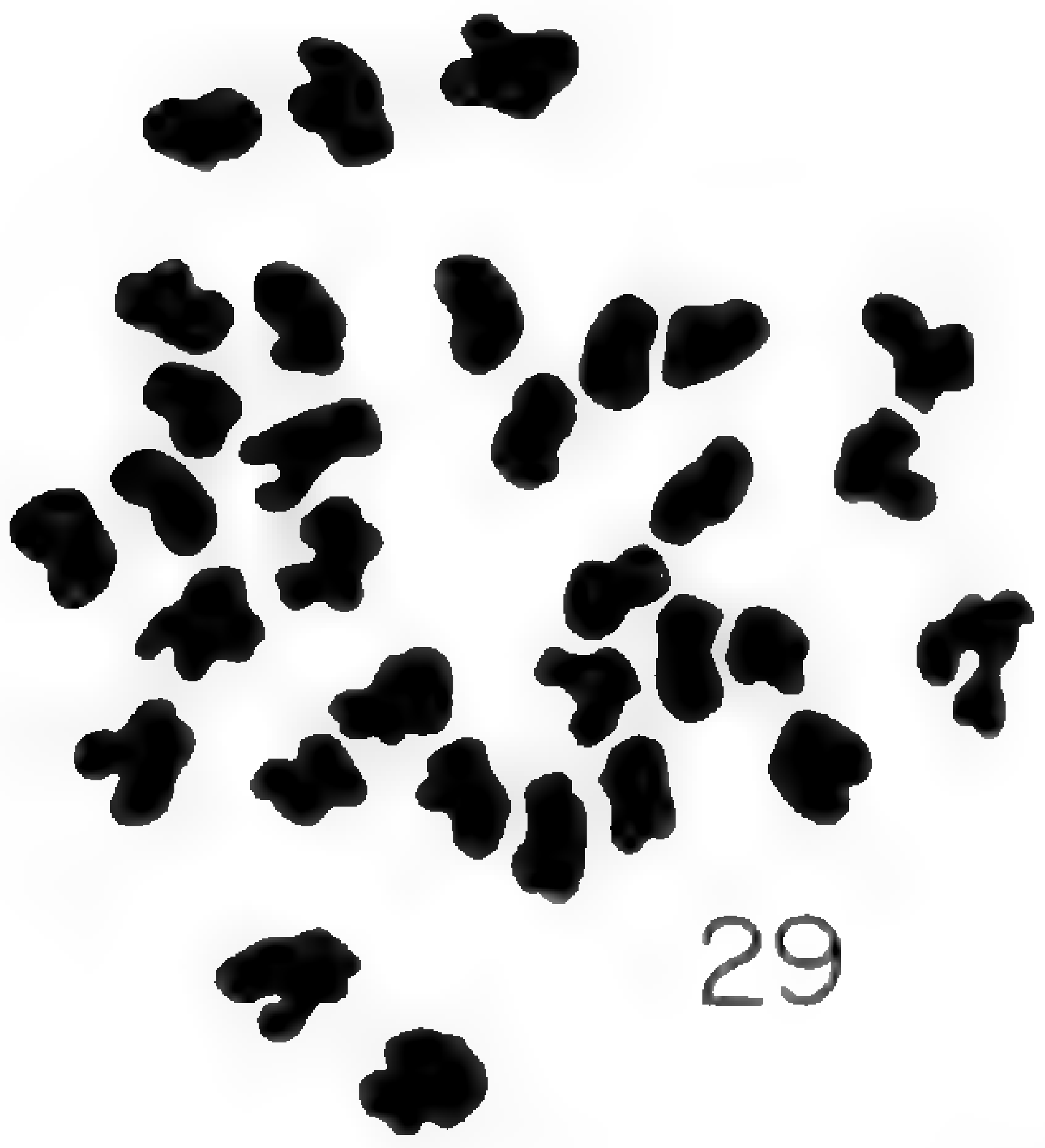
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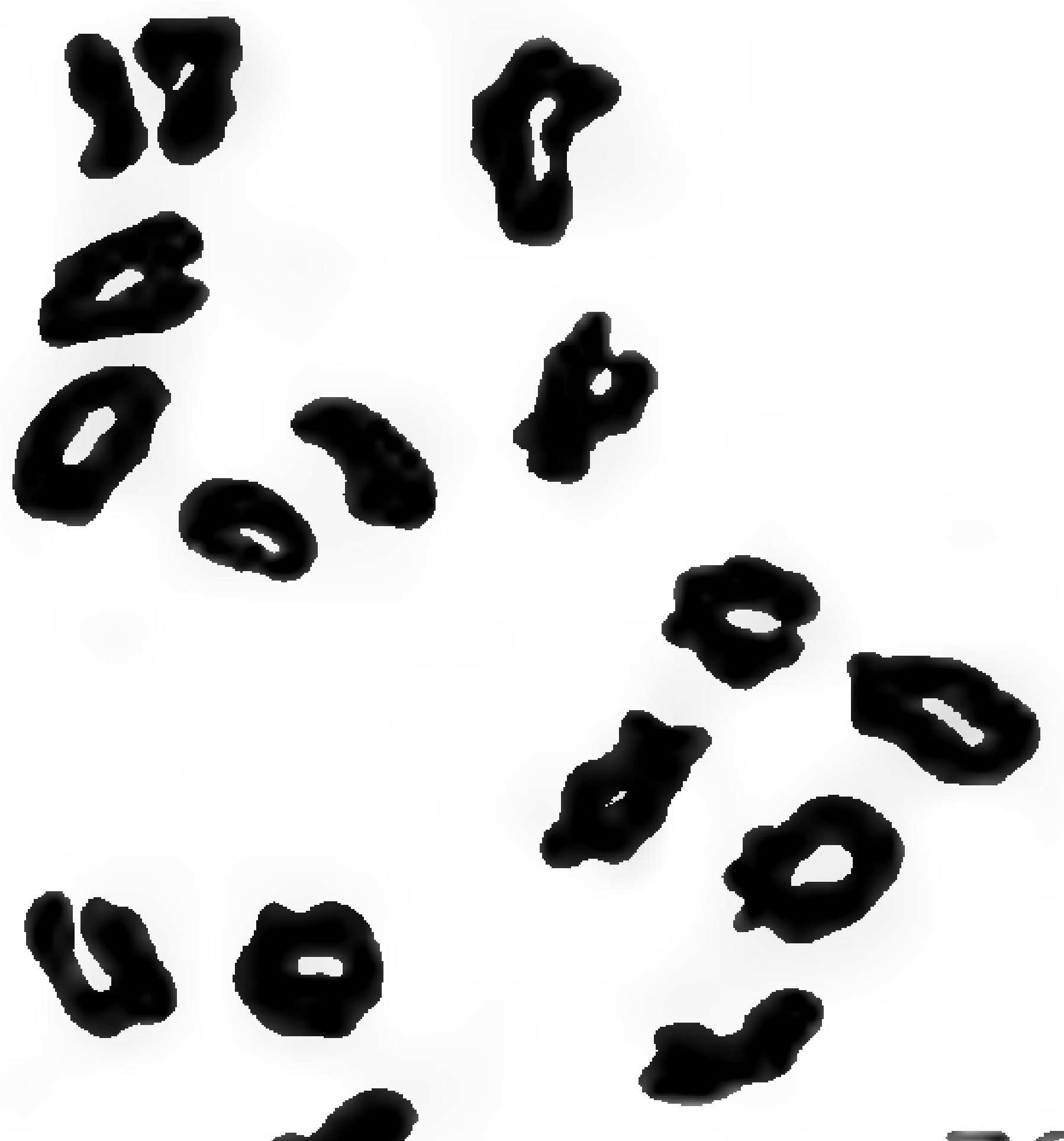
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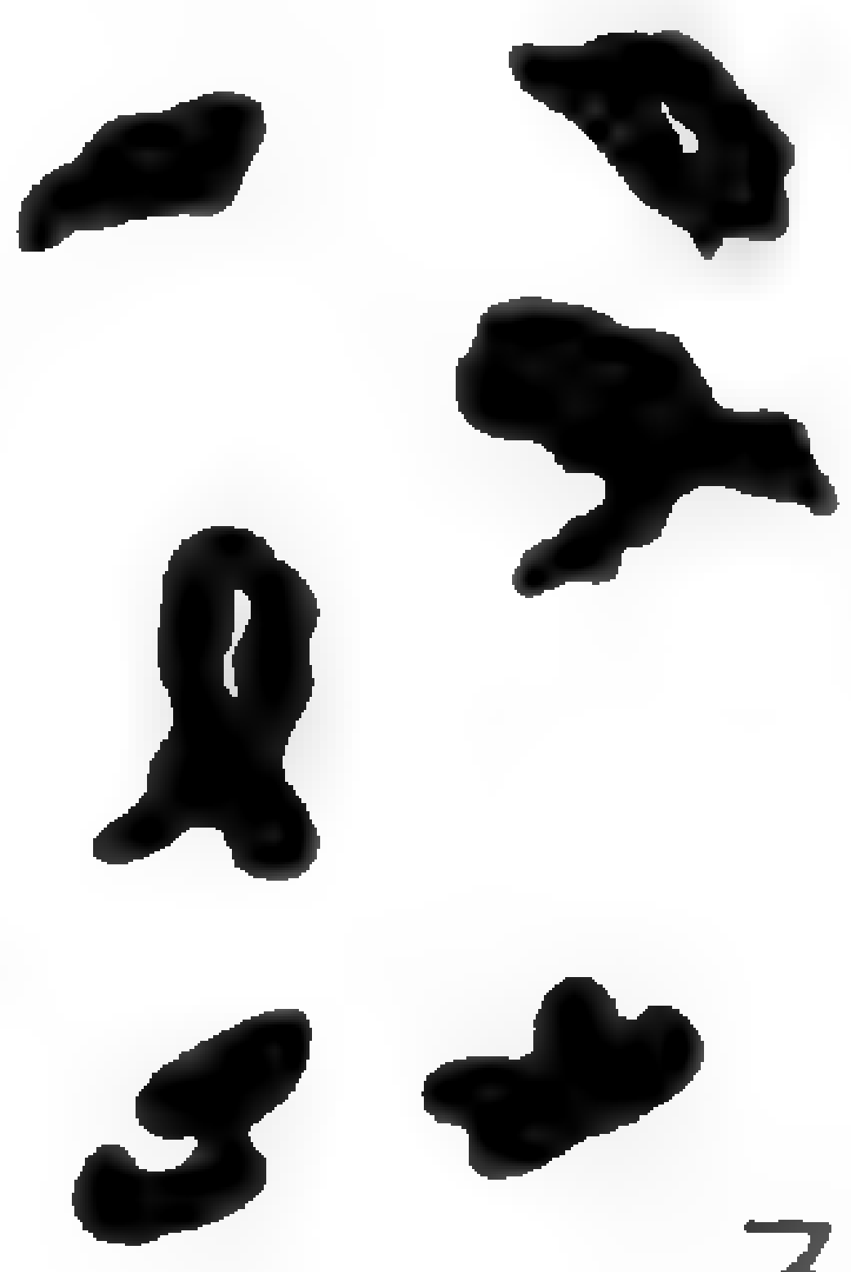
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DISCUSSION

EUPATORIEAE — *Eupatorium.* Most species counted to date are members of sect. Eximbricata. *E. greggii* ($n = 10$) is a member of sect. Conoclinium, in which another species, *E. betonicum,* has also been counted as $n = 10$ by Turner, Powell, and King (1962). *Eupatorium* sect. Conoclinium has close affinities with *Ageratum* which is unibasic on $x = 10$.

Kuhnia chlorolepis ($n = 9$). This species was also reported as $n = 9$ by Turner (1959).

ASTEREAE — *Achaetogeron* ($x = 9$). The chromosome numbers reported for *A. forreri* ($n = 27$) and *A. griseus* ($n = 9$) are the first counts for this primarily Mexican genus.

In the description of *A. wislizeni,* the species upon which *Achaetogeron* was based, Gray (1849) noted it to be ". . . entirely like a true Erigeron . . . except as to the pappus which refers it to the Bellideae . . ." Thus *Achaetogeron* was established by Gray to accommodate a species characterized by a simple pappus of small setae and without the inner pappus bristles found in *Erigeron.* In addition to *A. wislizeni,* 20 species have been described in *Achaetogeron* by subsequent authors.

In *Achaetogeron* we can distinguish three groups of species on the basis of pappus characters. One group, including the type species of the genus, has a simple pappus of short setae or squamellae. The second is epappose; the third has a double pappus of inner bristles and an outer crown of setae

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Fig. 21-35. Meiotic chromosomes of Mexican Compositae, × *ca.* 1300. Fig. 21. *Cosmos palmeri* var. *palmeri* ($n = 17$) — Fig. 22. *Chrysanthellum mexicanum* ($n = 8$) — Fig. 23. *Sabazia humilis* ($n = 4$) — Fig. 24. *Sanvitalia procumbens* ($n = 8$) — Fig. 25. *Verbesina callilepis* ($n = 18$) — Fig. 26. *Ximenesia encelioides* ($n = 17$) — Fig. 27. *Dyssodia cancellata* ($n = 13$) — Fig. 28. *Dyssodia hartwegii* ($n = 26$) — Fig. 29. *Psilostrophe gnaphalodes* ($n = 32$) — Fig. 30. *Psilostrophe tagetina* ($n = 16$) — Fig. 31. *Schkuhria anthemoidea* var. *wislizeni* ($n = 10$) — Fig. 32. *Tagetes lucida* ($n = 11$) — Fig. 33. *Chaptalia dentata* ($n = 16$) — Fig. 34. *Stephanomeria pauciflora* ($n = 8$) — *Fig.* 35. *Stephanomeria tenuifolia* ($n = 8$).

or squamellae. Most of the species of this third group were described by Larsen (1948). Since the double pappus is also found in the majority of species of *Erigeron* and since this third group of species is like *Erigeron* in all other characters, there seems to be no reason to retain these species in *Achaetogeron.* To this effect it should be noted that we have found *Achaetogeron fisheri* Larsen to be conspecific with *Erigeron delphinifolius.* On this basis we hesitate at present to effect the transfers of these species without a careful study of the Mexican species of *Erigeron.*

With respect to the remaining species of *Achaetogeron,* their generic status has been questioned by several workers. In fact, Greene (1891) considered the genus to be artificial and transferred the species then known to *Erigeron.* Our studies have so far indicated that *Achaetogeron* is somewhat heterogeneous and that some species have such close relatives in *Erigeron,* that they may be placed with these species in *Erigeron,* without affecting the naturalness of that genus. The basic chromosome number of *Achaetogeron* ($x = 9$) further supports the close relationship with *Erigeron* which has also $x = 9$; further morphological and cytological studies will be carried out on the Mexican species of both genera.

The chromosome numbers listed for *Aphanostephus* and *Aster* agree with the basic numbers reported for these genera by other workers. The count for *Aster pauciflorus* ($n = 9$), a member of sect. *Orthomeris,* is a first report.

Astranthium ($x = 3, 4, 5$). The counts for *A. orthopodum* ($n = 3$), *A. xylopodum* ($n = 5$), and that reported by Baldwin (1941) for *A. integrifolium* ($n = 4$) establish $x =$ 3, 4, and 5 as the basic chromosome numbers of this predominantly Mexican genus which is a member of the subtribe Bellidinae. Of the eleven genera placed in this subtribe by Hoffmann (1897), five (excluding *Keerlia* which is now in *Chaetopappa*) are not yet known chromosomally. Of the remaining genera, *Achaetogeron, Bellis,* and *Lagenophora* have $x = 9$; the Australian *Brachycome* likewise has $x = 9$ (De Jong, unpublished). The genus *Aphanostephus,* like

Astranthium, is tribasic with $x = 3$, 4, and 5 (Turner in Raven *et al.,* 1960).

A. mexicanum ($n = 18$). Diploid and tetraploid counts were published previously for this species by Beaman, De Jong, and Stoutamire (1962). *A. mexicanum* is found at alpine and subalpine elevations in the transvolcanic belt of South-Central Mexico and extends southward into the State of Oaxaca. The species is anomalous in the genus in that it has morphological characters commonly found in *Achaetogeron,* while, cytologically, it agrees with the basic number of that genus.

A. xanthocomoides ($n = 8$). A count of $n = 8$ was also obtained for this species by Turner, Beaman, and Rock (1961). These authors likewise reported a second collection from Nuevo Leon to have $n = 8$, but this collection, *Beaman 2697,* should be regarded as an undescribed species of *Achaetogeron.* In view of the basic chromosome number of this genus, $x = 9$, it seems that a recount is in order for collection *2697. A. xanthocomoides,* as understood at present, has its northern limit in the Sierra de Pachuca in the State of Hidalgo (De Jong, unpublished).

Erigeron ($x = 9$). The chromosome numbers of the species listed in Table 1 are consistent with the basic chromosome number of the genus (cf. Montgomery and Yang, 1960).

E. delphinifolius ($n = 9$). This collection *(Beaman 4525)* was obtained from near the type locality of *Achaetogeron fisheri* (cf. discussion of *Achaetogeron*).

E. pubescens. We found 35 univalents in most cells examined, whereas cells in which a few bivalents were formed were rare. Pollen was found to be extremely variable in size, with a high percentage of the grains aborted. Turner, Beaman, and Rock (1961) reported another collection of this species with 36 univalents.

E. divergens ($n = 9$). We have found this species to be diploid, whereas *E. divergens* var. *cinereus* was reported by Montgomery and Yang (1960) to have $2n = 27$.

The counts listed for *Grindelia* are consistent with the basic number of the genus. The chromosome number of *G. sublanuginosa* ($n = 6$) has not been reported before.

Haplopappus. Raven *et al.* (1960) indicated a collection of *H. spinulosis* subsp. *scabrellus* from Arizona to have $n = 4$. We have found $n = 4$ and $n = 6$ in two Chihuahuan collections of this subspecies. Jackson (1957a) likewise obtained $n = 4$ and $n = 6$ in *H. spinulosis* subsp. *cotula.*

Leucelene ($x = 8$). *L. ericoides* ($n = 8$); a count of $n = 16$ was published (cited as *Aster hirtifolius*) by Raven *et al.* (1960). This widespread, weedy perennial apparently has diploid and tetraploid races, which may account for the polymorphic nature of the species. We have followed Shinners (1946) in recognizing this monotypic genus which seems to have closer affinities with *Chaetopappa* than with *Aster.*

Xanthocephalum ($x = 4, 6$). The count here reported for *X. sericocarpum* ($n = 4$) brings to 4 the number of species in the genus that have this chromosome number. On the other hand, *X. gymnospermoides* has $n = 6$, as reported by various authors (Raven *et al.,* 1960; Turner, Powell, and King, 1962; see also Table 1). Three of the 8 species recognized by Solbrig (1961) are not yet known cytologically.

The chromosome numbers listed for species of *Baccharis, Conyza, Machaeranthera,* and *Psilactis* are consistent with the basic numbers reported for these genera (cf. Raven *et al.,* 1960; Turner, Powell, and King, 1962).

INULEAE — *Gnaphalium* ($x = 7$). The count ($n = 14$) for *G. lavandulifolium,* a suffrutescent alpine species, has not been previously reported. Another alpine species, *G. vulcanicum,* was also found to be tetraploid by Beaman, De Jong, and Stoutamire (1962).

HELIANTHEAE — *Berlandiera lyrata* ($n = 15$). Our count agrees with that published by Turner, Powell, and King (1962).

Calea ($x = 16, 18$). We have found both *C. palmeri* and *C. scabra* to have $n = 16$. Previous counts in the genus were reported by Turner, Powell, and King (1962), but an unequivocal count was only obtained for *C. trichotoma* ($n =$

18) by these authors. Bentham (1873) observed that some species of *Calea* were difficult to distinguish from species of *Sabazia*. Indeed, the herbaceous *C. palmeri* closely resembles *Sabazia* in floral and vegetative characters and may well be a member of that genus. Our count for *C. scabra* ($n = 16$) adds a second basic number to *Calea*.

Cosmos ($x = 12, 17$). Of the 27 species recognized in the genus by Sherff (1955), only 4 species have so far been counted. From all reported chromosome numbers, the genus has appeared to be unibasic with $x = 12$. We have found *C. palmeri* var. *palmeri* to have $n = 17$ and are considering it to be diploid on a base of $x = 17$.

Chrysanthellum ($x = 8$). The chromosome number of *C. mexicanum* ($n = 8$) is the first report for this genus of 2 or 3 small annual species which Hoffmann (1897) placed in the subtribe Coreopsidinae. A species of *Heterospermum*, a genus which Bentham (1873) considered to be closely related to *Chrysanthellum*, was counted as $n = 25$ by Turner, Beaman, and Rock (1961).

Parthenium. Our counts for two collections of *P. hysterophorus* ($n = 17$) agree with those reported by Rollins (1950) for the same species. On the other hand, Thombre (1959) found *P. hysterophorus* to have $n = 18$. Since some other species in the genus have been reported as $n = 18$, the problem here appears to be taxonomic rather than cytological.

Sabazia ($x = 4$). Our count for *S. humilis* ($n = 4$) is consistent with that of Turner and Johnston (1961). *S. humilis* is an annual species and has the lowest chromosome number so far found in the genus (Longpre, unpublished). Although Hoffmann (1897) considered *Sabazia* to be a member of the subtribe Verbesininae, we agree with Turner and Johnston (1961) that the genus is better placed in the subtribe Galinsoginae. Turner and Johnston thought the genus to have affinities with *Tridax;* we are of the opinion that *Sabazia* is also close to *Galinsoga*, morphologically as well as chromosomally.

Verbesina. The chromosome number of *V. callilepis*, $n =$

18, has not been previously reported. The species is a member of sect. *Pterophyton*.

Ximenesia ($x = 17$). *X. encelioides* ($n = 17$). Previous counts of $n = 17$ were reported by Carlquist (1954, as *Verbesina encelioides*) and Turner and Ellison (1960). *X. encelioides* is the only species so far counted in this small genus which Hoffmann (1897) considered to be a section of *Verbesina*.

Zexmenia. Jones (1905) recognized 42 species in this genus, the greater number of which is found in Mexico and Central America. Turner, Powell, and King (1962) considered the genus to be multibasic with $x = 10$, 11, and 14. Since our count for *Z. palmeri* is an approximation, ($n =$ *ca.* 17), no conclusion is warranted concerning its bearing on the basic chromosome numbers of the genus.

HELENIEAE — *Psilostrophe* ($x = 16$). *P. gnaphalodes* ($n = 32$) seems to have diploid and tetraploid races, since Turner, Beaman, and Rock (1961) counted the species as $n = 16$. Our count for *P. tagetina* ($n = 16$) agrees with that reported for the same species by Jackson (1957b), and Raven and Kyhos (1961).

Schkuhria ($x = 10$, 11). *S. anthemoidea* var. *wislizeni* ($n = 10$). Turner, Powell, and King (1962) reported this variety as tetraploid.

The chromosome numbers listed in Table 1 for species of *Dyssodia, Gaillardia,* and *Tagetes* are consistent with those previously obtained for the same species (cf. Johnston and Turner, 1962; Raven and Kyhos, 1961).

MUTISIEAE — *Chaptalia dentata* ($n = 16$). Chromosome numbers of $2n = 48$ have been reported by Baldwin and Speese (1947) for *C. nutans* var. *nutans* and *C. integrifolia,* and Turner (1959) obtained $n = 24$ for *C. nutans* var. *texana*. These authors considered $x = 12$ to be the basic number of the genus. Although the few genera studied in the Mutisieae have high basic chromosome numbers, our count for *C. dentata* suggests that $x = 8$, rather than 12, is the basic number of *Chaptalia*.

CICHORIEAE — *Stephanomeria* ($x = 8$). Our counts for *S. pauciflora* and *S. tenuifolia,* both with $n = 8$, agree with the counts obtained by Stebbins, Jenkins, and Walters (1953) for the same species.

SUMMARY

This paper reports chromosome numbers in 74 collections, representing 57 taxa of Mexican Compositae; the chromosome numbers of 21 of these are reported for the first time including first counts for the genera *Achaetogeron* and *Chrysanthellum*. The generic status of *Achaetogeron* is discussed on the basis of morphological and cytological evidence; the genus is considered as provisionally distinct.

Basic chromosome numbers in addition to those previously obtained by other authors are reported for the genera *Astranthium, Calea,* and *Cosmos;* the basic number of *Chaptalia* is thought to be $x = 8$ rather than 12 as previously reported. Chromosome counts of *Haplopappus spinulosis* subsp. *scabrellus* ($n = 6$), *Leucelene ericoides* ($n = 8$), *Psilostrophe gnaphalodes* ($n = 32$), and *Schkuhria anthemoidea* var. *wislizeni* ($n = 10$) differ from those published earlier for these taxa.

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HABENARIA CONOPSEA IN NORTH AMERICA

Among some miscellaneous collections of orchids that were recently sent to me for determination from the Herbarium of the University of North Carolina is a sheet that contains a solitary flowering plant collected by W. C. Coker (s.n.) "In damp peaty soil, Abisco, Labrador, July 19, 1921."

Although the inflorescence of this plant was unfortunately embedded in a generous amount of glue, it was possible to extricate enough of two flowers to make a dissection for study. This plant belongs to the *Habenaria conopsea* (L.) Benth. — *H. odoratissima* (L.) Franchet complex of Eurasia. Although the plant is unquestionably dwarfed, and the solitary linear leaf is more like those attributed to typical *H. odoratissima*, in my opinion the floral characters place this plant in *H. conopsea.*

In 1913, Britton and Brown included this species (as *Gymnadenia conopsea* (L.) R. Br.) in their *Illustrated Flora of the Northeastern United States and Adjacent Canada* (p. 553) with the following note: ". . . otherwise known only from the Old World, [it] has been collected at Litchfield, Connecticut [in 1887]. The flower has a broad 3-lobed lip and a slender spur much longer than the ovary." I have been unable to locate in any herbarium a specimen from the above locality.

In 1952, in *Native Orchids of North America, North of Mexico* (p. 116), I considered the report by Britton and Brown to represent non-persistent waifs in Connecticut since the species, in the meantime, had not been observed again in Connecticut or anywhere else in this hemisphere. It now appears, however, that this orchid should be considered as an element of the flora of North America, whether it be indigenous or as a naturalized species introduced from Europe. It is most likely that the species occurs elsewhere in eastern North America and it has just been overlooked, possibly because it is either most uncommon or is to be found only in relatively isolated or inaccessible areas.

A description of the solitary plant found in Labrador is as follows:

Plant 12 cm. tall, rigidly erect, glabrous; rootstock thick, palmately divided (in our area similarly to that of *Habenaria viridis* (L.) R. Br. var. *bracteata* (Willd.) A. Gray); stem with several tubular sheaths at the base and two narrow somewhat foliaceous bracts above; only one leaf present that arises from within the sheaths at base of stem, linear, narrowly obtuse, apparently conduplicate, 6.5 cm. long and 3 mm. wide; inflorescence with about 15 densely placed flowers that are not all open, 2 cm. long; floral bracts ovate-lanceolate, long-acuminate, up to at least 8 mm. long; flowers small; dorsal sepal broadly elliptic, obtuse, about 4 mm. long and 2 mm. wide; lateral sepals similar to the dorsal one but slightly oblique; petals elliptic, obtuse, about 3.5 mm. long and 2 mm. wide; lip suborbicular-flabellate in outline, broadly cuneate below the middle, shallowly 3-lobed above with the lobes bluntly rounded, about 4 mm. long; disc with 5 veins, with only the central vein unbranched and extending to the apex of the mid-lobe; spur cylindric, curved, 8-10 mm. long, nearly twice as long as the pedicellate ovary.

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A COMPANION VOLUME TO THE NEW BRITTON AND BROWN ILLUSTRATED FLORA.[1]

The northeastern part of North America is fortunate to have a newly prepared manual condensed from the large three volume Illustrated Flora by H. A. Gleason. The book under review was prepared by Arthur Cronquist and is based squarely on Gleason's revision of the earlier Britton and Brown Illustrated Flora, first published in three volumes in 1896, 1897 and 1898. A second Britton and Brown edition came in 1913 and the Gleason edition was published in 1952. Much of the material in the present volume goes back to the Gleason edition and in this respect it is not new. On the other hand, Cronquist has incorporated some of the results of more recent studies and has modified the descriptive matter and nomenclature accordingly.

In relation to the area covered by Gleason's Illustrated Flora this manual pertains to an area reduced in the extreme northeast to exclude the Gaspé Peninsula and in the southwest to exclude the area south of the Missouri River in the state of Missouri. Thus, the area covered is somewhat less than that accounted for by Gray's Manual, ed. 8, and an otherwise obvious direct comparison of these two manuals for their included numbers of taxa cannot readily be made. However, it is satisfying to note that the nomenclature of these two manuals is closer to being the same than in earlier editions. This offers the hope that a high degree of stability of nomenclature is in sight for the plants found in northeastern North America, at least.

Some botanists perhaps will find the treatments of such difficult genera as *Rubus* and *Crataegus* to be over simplified and unsatisfactory for identifying their plants. But I am personally glad to see that the complications introduced by hybridization, polyploidy, aneuploidy and apomixis are frankly recognized and some deference is given to the fact

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[1] Manual of Vascular Plants of Northeastern United States and Adjacent Canada by Henry A. Gleason and Arthur Cronquist. li & 1-810. D. Van Nostrand Co., Inc., Princeton, N. J. 1963. $11.75.

that the effects of these phenomena on the taxonomy of these two genera have not as yet been workd out. It is doubtful whether a sensible classification of *Rubus* and *Crataegus* can be produced without much more information than is now available.

I have not used this manual to identify any plants and that is the only way to test its utility to the student and the field botanist. The book has a flexible cover and is of a size that will be handy in the field. Certainly, it is an important addition to our literature on the vascular plants and the authors are to be congratulated for bringing it into published form.

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FURTHER CONSIDERATIONS IN STYLOSANTHES (LEGUMINOSAE)

ROBERT H. MOHLENBROCK

Since publication of the writer's "A Revision of the Genus *Stylosanthes*" in 1957, additional collections and further study have resulted in an increase in number of species in the genus. Nooteboom (1961), after studying considerable Malaysian material, has pointed out some errors in this writer's revision. These are corrected in this paper. New illustrations of the loments of each species are provided. These have been prepared by Miss Miriam Hope Wysong.

The species of *stylosanthes* have been divided into two sections from the time of Vogel (1838). It is unfortunate in choosing the type species for the genus from Swartz' *S. viscosa* and *S. procumbens* (= *S. hamata* (L.) Taub.) that I selected the latter, rather than *S. viscosa* which belongs to Vogel's Section Eu-Stylosanthes. Vogel's sectional names are valid, and should be recognized. The correct nomenclature of the sections follows:

SECTION STYLOSANTHES

Sect. *Eu-Stylosanthes* Vog. in Linnaea **12**:63. 1838. *Astyposanthes* Herter, in Rev. Sudamer. Bot. 7:209. 1943. Sect. *Astyposanthes* (Herter) Mohl. in Ann. Mo. Bot. Gard. **44**:327. 1957.

None of the flowers subtended by an axis rudiment; inner bracteole usually 1.

Type: *Stylosanthes viscosa* Sw.

SECTION STYPOSANTHES Vog. in Linnaea **12**:68. 1838. Sect. *Stylosanthes* sensu Mohl. (1957).

Each flower, or at least the lower, subtended by an axis rudiment; inner bracteoles usually 2.

Type: *Stylosanthes hamata* (L.) Taub.

Although Taubert described *S. sundaica* in 1891 in Section Styposanthes, I reduced it to *S. humilis* (a species with similar loments in Section Stylosanthes) because I could find no trace of an axis rudiment in the scanty material at my disposal. Nooteboom (1961), with ample material for study, reports the presence of an axis rudiment, albeit caducous, so that *S. sundaica* should be recognized as a valid species belonging to Section Styposanthes.

Five species of *Stylosanthes* are recognized in this paper which were not recorded in the author's revision in 1957. These are *S. ingrata, S. mucronata, S. suborbiculata, S. suffruiticosa,* and *S. sundaica.*

KEY TO THE SECTIONS OF STYLOSANTHES

A. Each flower, or at least the lower flowers, subtended by an axis rudiment; inner bracteoles usually 2 (1 in *S. sericeiceps*) .... Section *Styposanthes*

AA. None of the flowers subtended by an axis rudiment; inner bracteole usually 1 .... Section *Stylosanthes*

KEY TO THE SPECIES OF SECTION STYPOSANTHES

A. Bracts (8-) 10-15 mm. broad, with 11-21 conspicuous and usually broad, colored nerves.

  B. Fertile articulations of the loment often 2, the upper glabrous, the beak less than one-third as long as the upper articulation, glabrous or with a very few short stiff hairs; nerves of the bracteal sheath usually 15; stems usually with scattered bristles. Brazil, Venezuela. (Fig. 1) .... 1. *S. capitata*

  BB. Fertile articulation of the loment 1, pilose, the beak only slightly shorter than the upper articulation, pilose; nerves of the bracteal sheath usually 21; stems pilosulous to villous. Brazil, Paraguay. (Fig. 2) .... 2. *S. bracteata*

AA. Bracts at most 10 mm. broad, with fewer than 15 nerves which are inconspicuous.

  C. Beak of the loment straight or only slightly curved; leaflets glabrous on both surfaces (rarely with marginal cilia); teeth of the upper stipules mostly longer than the sheath. Florida, Central America, Mexico, Bahamas, Cuba. (Fig. 3) .... 3. *S. calcicola*

  CC. Beak of the loment uncinate or circinate; leaflets usually pubescent, at least on the lower surface (occasionally glabrous in *S. erecta* of Africa and *S. hamata* of the West Indies); sheath of the upper stipules mostly longer than the teeth.

    D. Loment completely glabrous or with some pubescence on the beak only or occasionally on the nerves in *S. mexicana.*

      E. Stems sericeous or bristly; leaflets sparsely but conspicuously bristly-ciliate; loment often green, with both articulations usually fertile; inflorescence obovoid. Mexico, Venezuela, Bolivia. (Fig. 4) .... 4. *S. mexicana*

EE. Stems glabrous or puberulent above; leaflets without bristly cilia; loment brown, with only one articulation usually fertile; inflorescence often narrow. West Africa. (Fig. 5) .... 5. *S. erecta*

DD. Loment pubescent on the body and usually on the beak.

F. Stem and bracts bearing tuberculate-based hairs (sometimes merely with tubercles); lower surface of leaflets usually villous with interspersed tuberculate bristles; beak of the loment usually shorter than the upper articulation (except in *S. sundaica* and sometimes in *S. fruticosa*, *S. macrocarpa*, and *S. nervosa*).

G. Beak of the loment half to one-third the length of the upper articulation.

H. Bracts shortly scabrous-hispid; inflorescence usually nearly as broad as long; beak of the loment short-bristly.

I. Leaflets often punctate beneath, obtuse; stem bearing short dark setae, the whole aspect of the plant dingy brown; fertile articulation usually 1, pubescent throughout. Brazil, Ecuador, Venezuela, Colombia, Bolivia. (Fig. 6) .... 6. *S. scabra*

II. Leaflets not punctate beneath, acute; stem setose or puberulent to densely pilose, not dingy brown; fertile articulations often 2, pilosulous only on the ribs. Bahamas, Cuba, Colombia, Venezuela, Peru. (Fig. 7) .... 7. *S. tuberculata*

HH. Bracts villous or with long tuberculate bristles; inflorescence often 2-3 times longer than broad; beak of the loment usually rufous-pilose.

J. Bracts softly villous and rarely with tuberculate bristles; inflorescence 2-3 times longer than broad; loment 1.0-1.5 mm. broad, the beak rufous-pilose. Ecuador, Peru, Galápagos Islands. (Fig. 8) .... 8. *S. sympodialis*

JJ. Bracts with tuberculate bristles; inflorescence about as broad as long; loment 1.5-2.5 mm. broad, the beak puberulent.

K. Beak of loment 1.5-3.0 mm. long; stems evenly pubescent. Africa. (Fig. 9) .... 9. *S. mucronata*

KK. Beak of loment 3.5-4.0 mm. long; stems unilaterally pubescent. Ceylon, India. (Fig. 10) .... 10. *S. fruticosa*

GG. Beak nearly equaling to exceeding the upper articulation.

L. Beak of the loment strongly circinate.

M. Beak longer than body of loment; stems not sericeous. East Indies. (Fig. 11) .... 11. *S. sundaica*

MM. Beak and body of loment about equal in length; stems sericeous. Honduras, Mexico. (Fig. 12) .... 12. *S. subsericea*

LL. Beak of the loment curved to strongly uncinate; bracteal sheath and stem with tuberculate bristles but not sericeous.

N. Upper articulation and beak combined 7.5-8.5 mm. long, the beak about equaling the upper articulation; plants to 0.2 mm. long. Mexico. (Fig. 13) .... 13. *S. macrocarpa*

NN. Upper articulation and beak combined 5.0-7.5 mm. long, the beak sometimes slightly shorter than the upper articulation; plants to 1 m. tall.

O. Fertile articulations mostly 2; bracteal sheath usually bearing long tuberculate-based bristles; leaflets elliptic, obtuse to sub-acute, usually puberulent.

P. Beak of loment 1.5-3.0 mm. long; stems evenly pubescent.

Q. Terminal leaflet 8-10 mm. long. British Guiana. (Fig. 14) .... 14. *S. suffruticosa*

QQ. Terminal leaflet 15-25 mm. long. Africa. (Fig. 9) .... 9. *S. mucronata*

PP. Beak of loment 3.5-4.0 mm. long; stems unilaterally pubescent. Ceylon, India. (Fig. 10) .... 10. *S. fruticosa*

OO. Fertile articulation usually 1; bracteal sheath short-hispid to densely ciliate; leaflets usually oblanceolate, acute to acuminate, glabrous or occasionally hispid beneath. Venezuela, Peru, Bolivia, Argentina. (Fig. 15) .... 15. *S. nervosa*

FF. Stem and bracts pilose, villous, or nearly glabrous, lacking tuberculate bristles; lower surface of leaflets pilose or appressed-villous or glabrous, never with tuberculate bristles; beak of the loment equaling or exceeding the upper articulation (except *S. sericeiceps*).

R. Beak of the loment equaling or exceeding the upper articulation; pubescence of the bracteal sheath whitish; stem usually not pubescent throughout. Florida, Bahamas, Cuba, Central America, Colombia, Venezuela. (Fig. 16) .... 16. *S. hamata*

RR. Beak of the loment about one-half as long as the upper articulation; pubescence of the bracteal sheath tan or rufous; stem often pubescent throughout.

S. Loment pubescent throughout; leaflets glabrous above, 15-26 mm. long; bracteal sheaths tan-pilose. Venezuela.

(Fig. 17) .... 17. *S. sericeiceps*

SS. Loment pubescent above, glabrous below; leaflets minutely pubescent above, 20-40 mm. long; bracteal sheaths rufous-pilose. Peru, Ecuador, Galápagos Islands. (Fig. 8) .... 8. *S. sympodialis*

KEY TO THE SPECIES OF SECTION STYLOSANTHES

A. Beak of the loment minute, at most about one-fifth as long as the upper articulation, the fertile articulation 1.

B. Fertile articulation shortly hairy throughout or rarely glabrous, terete, 2.5-5.0 mm. long. Eastern United States. (Fig. 18) .... 18. *S. biflora*

BB. Fertile articulation minutely tuberculate near the apex or rarely with a few scattered appressed white hairs, flattened, 1.5-3.0 mm. long. Bahamas, Central America, Mexico, South America. (Fig. 19) .... 19. *S. guyanensis*

AA. Beak of the loment from one-fourth as long to exceeding the upper articulation, the fertile articulations 1 or 2.

C. Leaflets 0.5-2.0 mm. broad; inflorescence very narrow and elongate; beak of the loment strongly uncinate, often 2-3 times as long as the pubescent upper articulation. Brazil, Guianas. (Fig. 20) .... 20. *S. angustifolia*

CC. Leaflets 2-6 mm. broad; inflorescence usually capituliform, globose to ovoid or obovoid; beak of the loment various.

D. Loment glabrous (occasionally pubescent only on the beak).

E. Loment with 2 fertile articulations, the beak straight or uncinate; bracteal leaflets stalked.

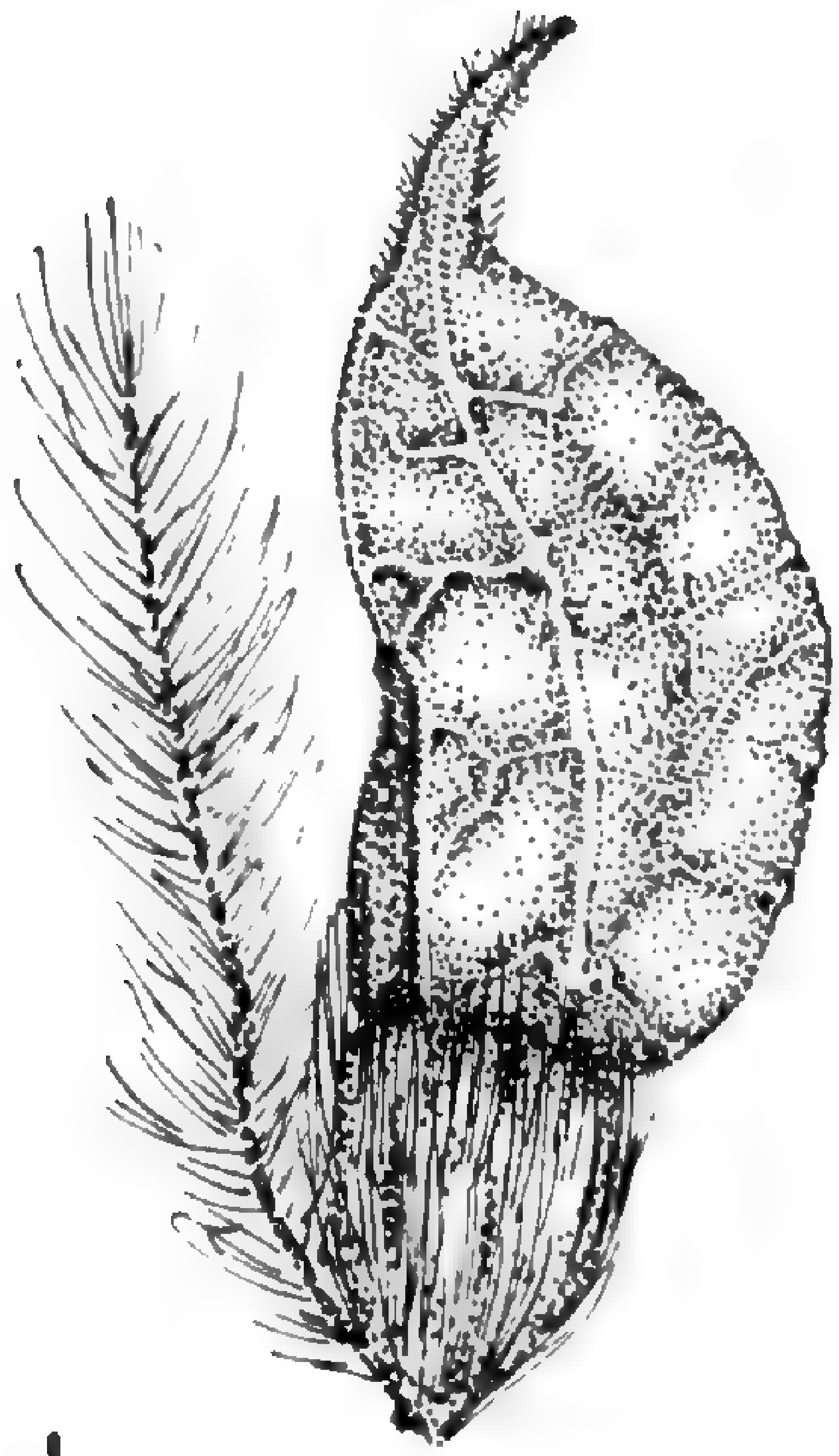
F. Beak straight or nearly so, about equaling the upper articulation, beak and upper articulation together about 5-6 mm. long; bracts, leaflets, and stems densely short-bristly. Brazil, Uruguay, Paraguay. (Fig. 21) .... 21. *S. leiocarpa*

FF. Beak uncinate, one-third as long as the upper articulation, beak and upper articulation together 3.0-3.5 mm. long; bracts and sometimes the leaflets and the stems with scattered long bristles, often glabrous. French Guiana. (Fig. 22). .... 22. *S. cayennensis*

EE. Loment with one fertile articulation, often two in *S. ingrata* the beak strongly uncinate or circinate; bracteal leaflets sessile or subsessile.

G. Loment conspicuously reticulate-nerved, about as broad as long (excluding the beak); inflorescence 4- to 8-flowered. Uruguay, Argentina. (Fig. 23) .... 23. *S. hippocampoides*

GG. Loment obscurely nerved, a little longer to twice as long as broad (excluding the beak); inflorescence 2- to 4-flowered.



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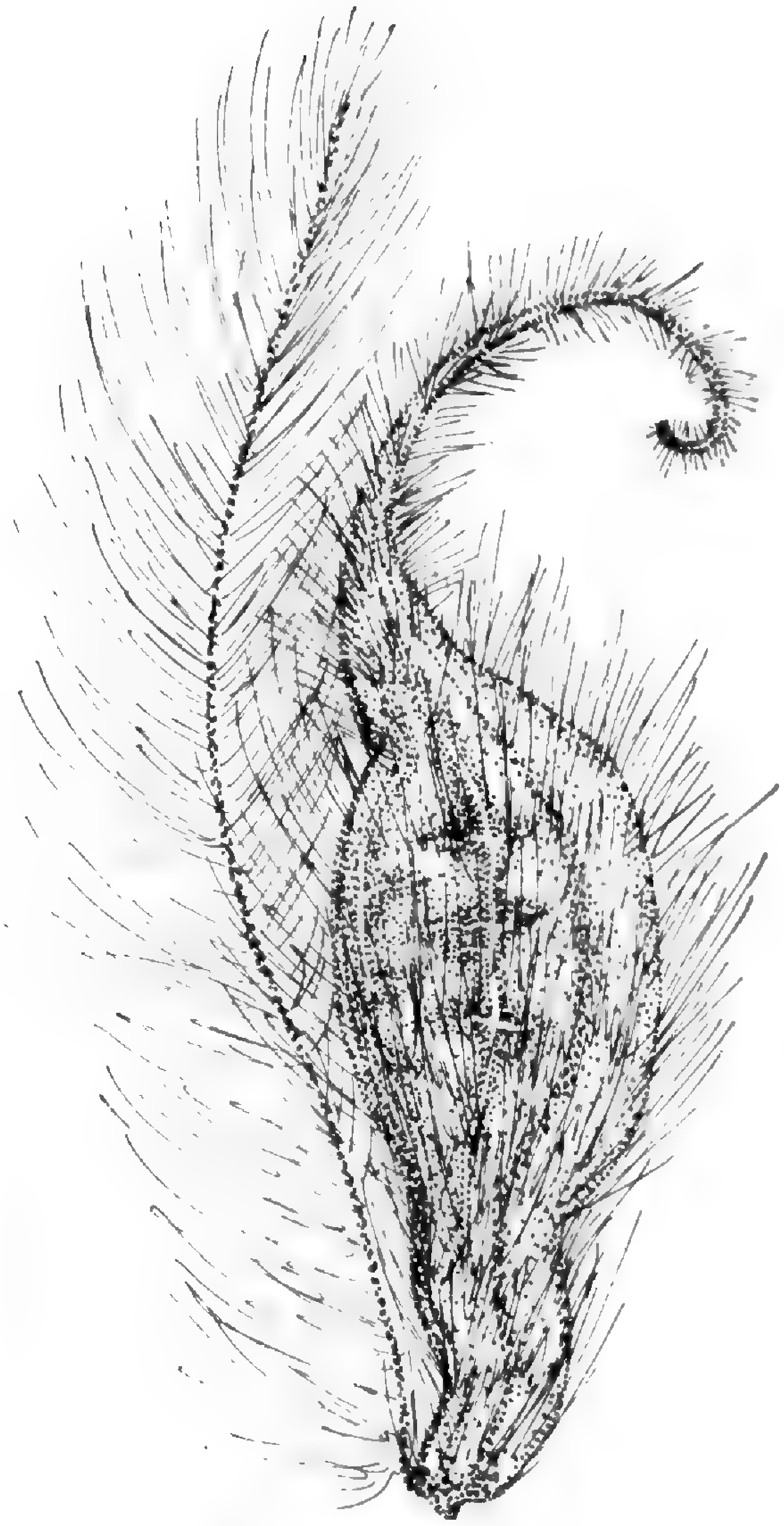

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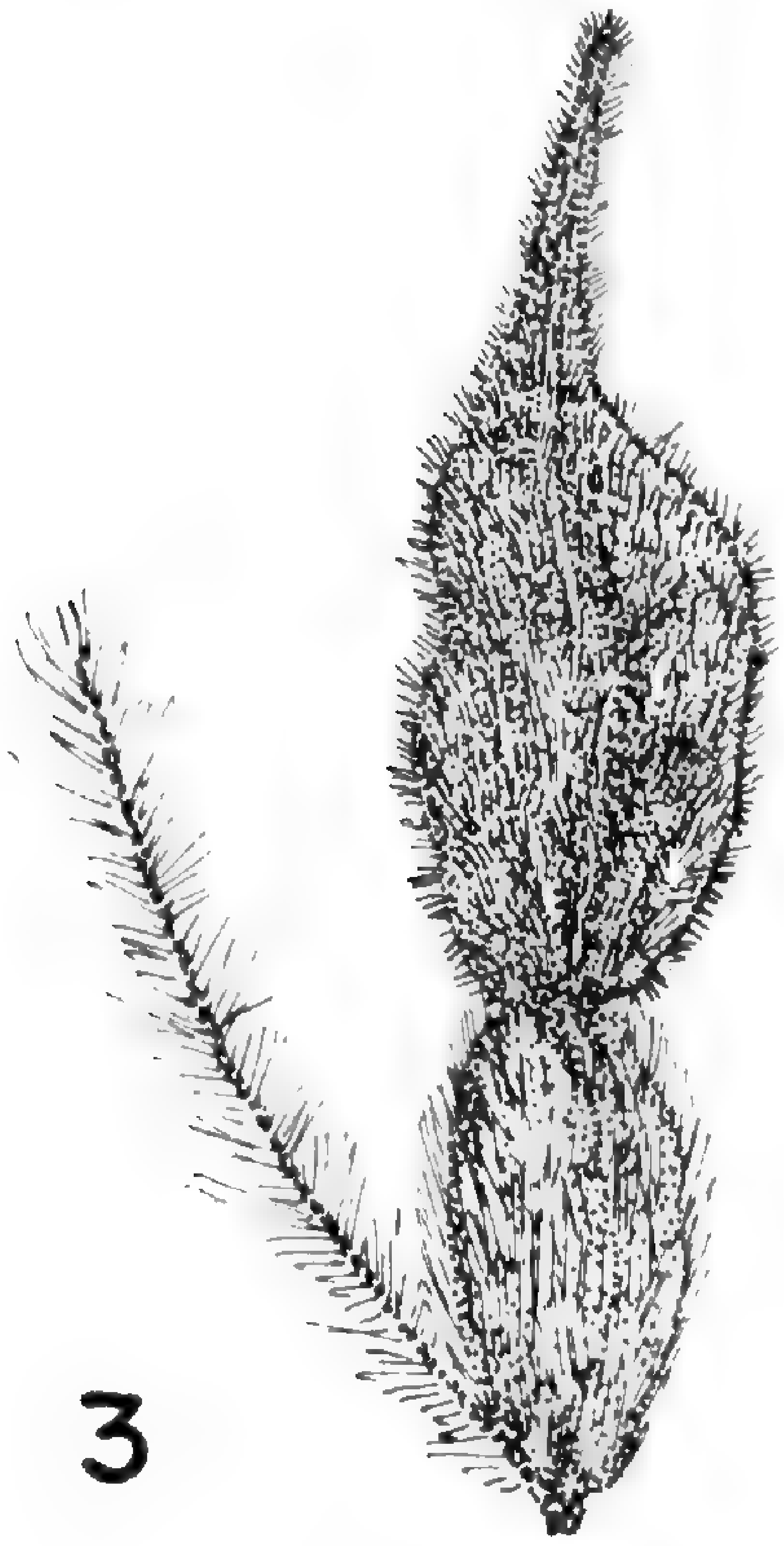

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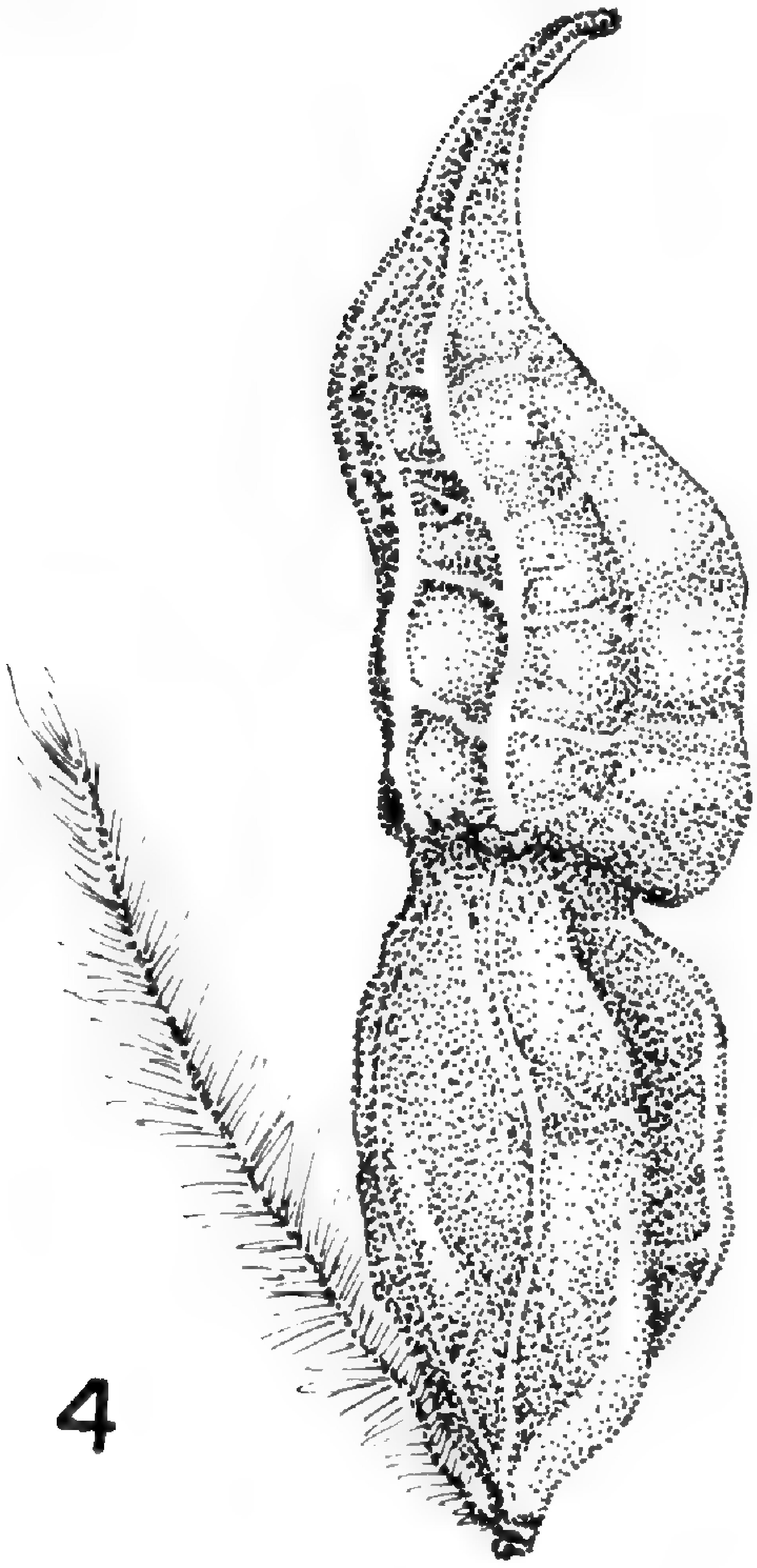
Fig. 1. Stylosanthes capitata, × 10.
Fig. 2. Stylosanthes bracteata, × 10.
Fig. 3. Stylosanthes calcicola, × 10.



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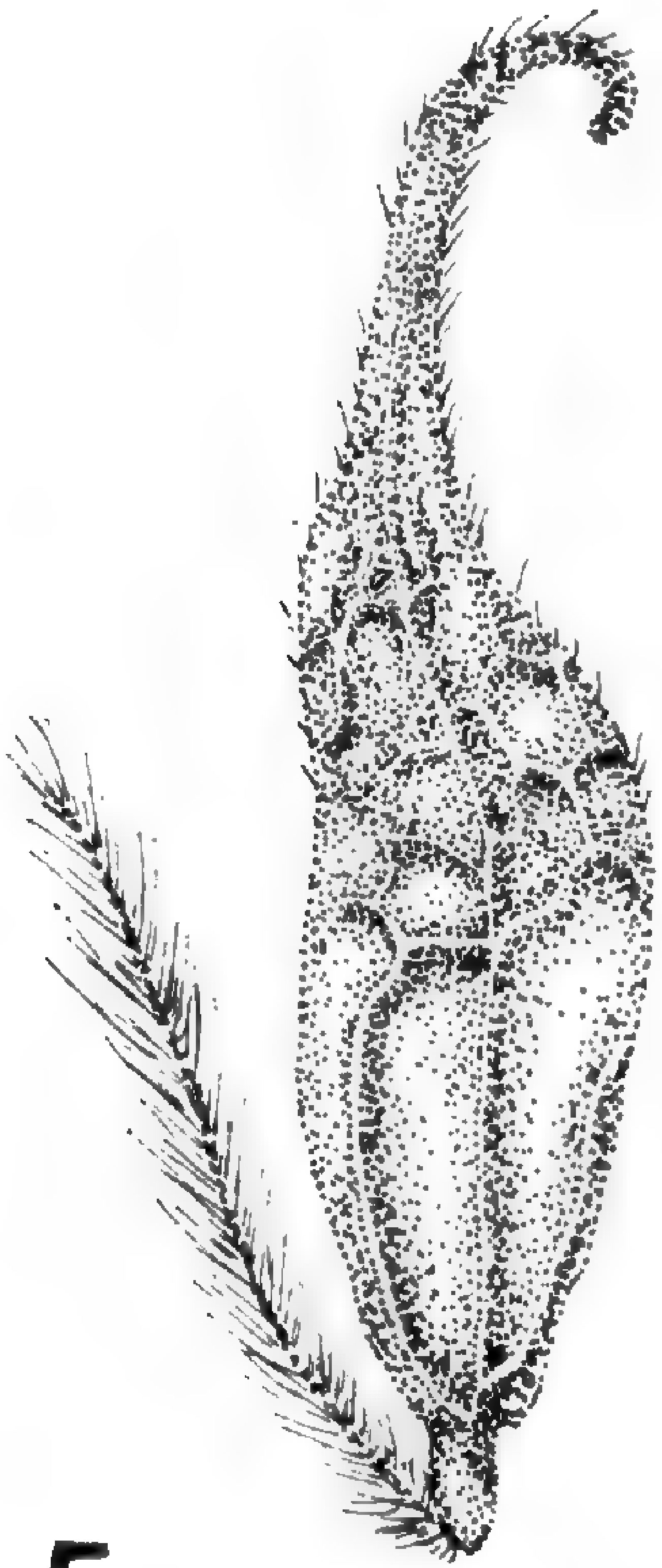

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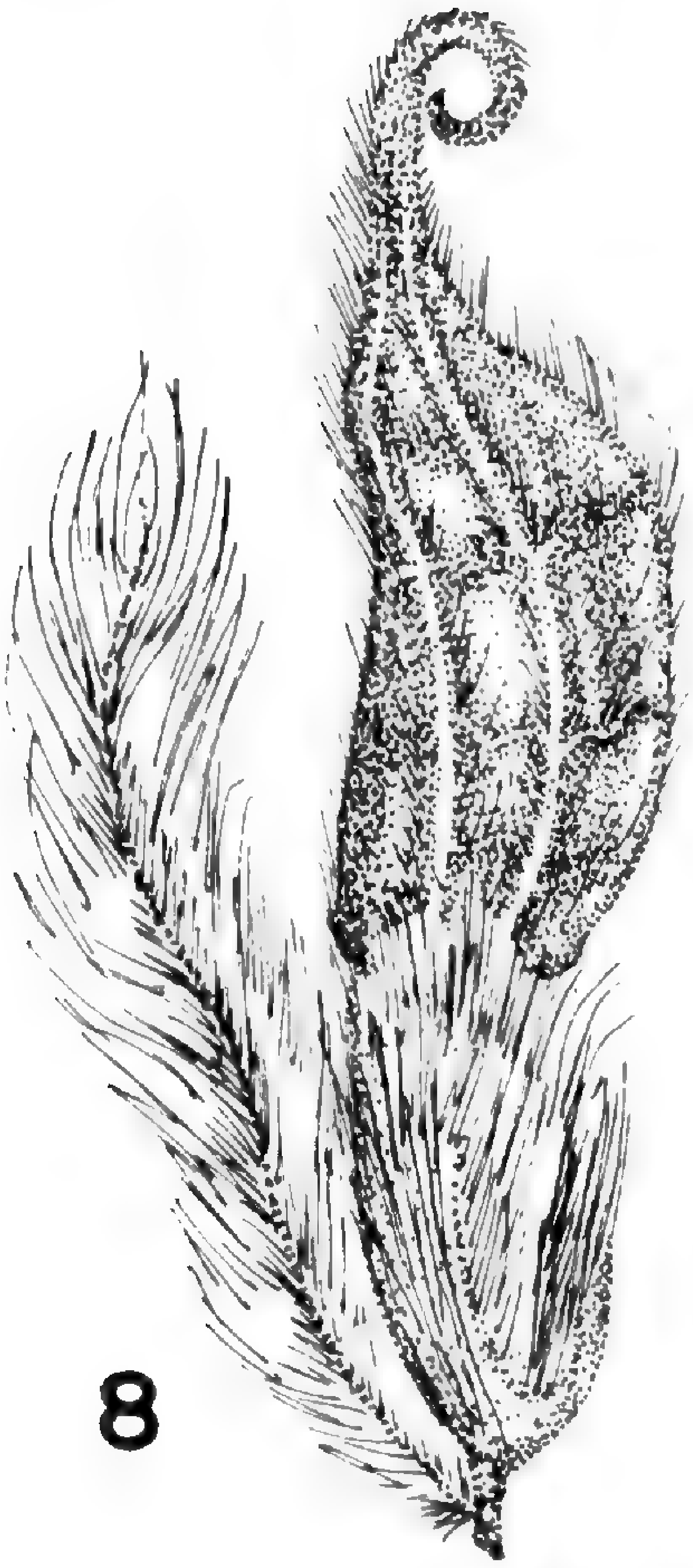
Fig. 4. Stylosanthes mexicana, × 10.
Fig. 5. Stylosanthes erecta, × 10.
Fig. 6. Stylosanthes scabra, × 10.
Fig. 7. Stylosanthes tuberculata, × 10.



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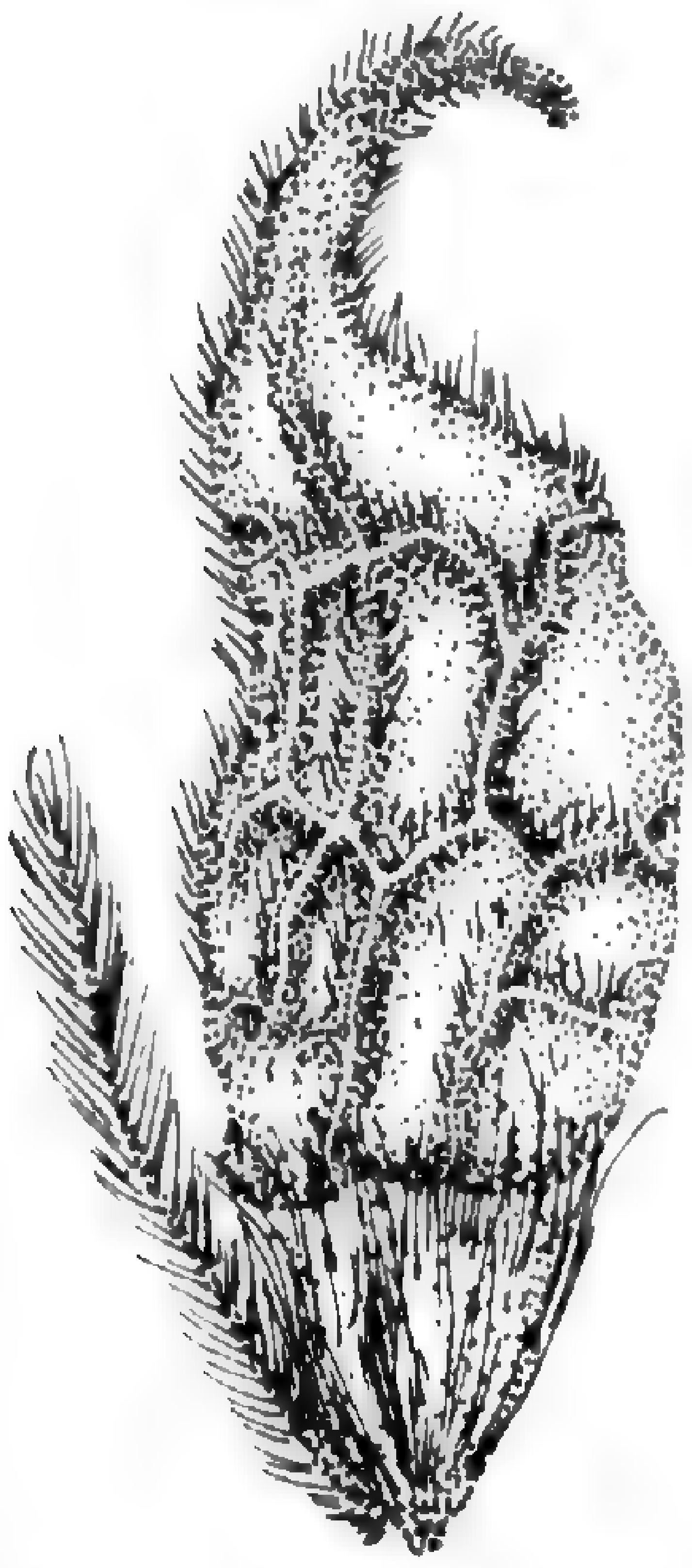

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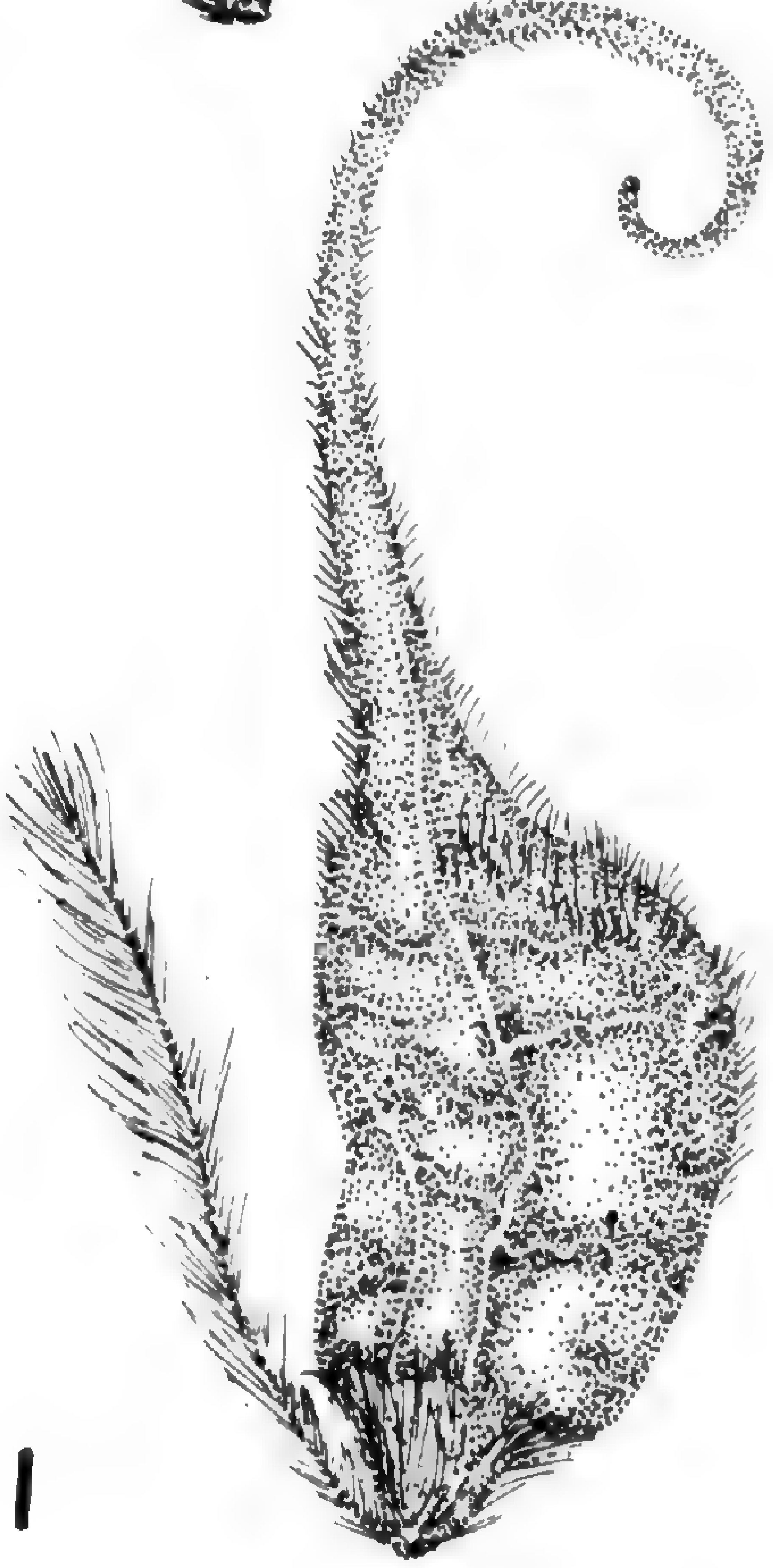

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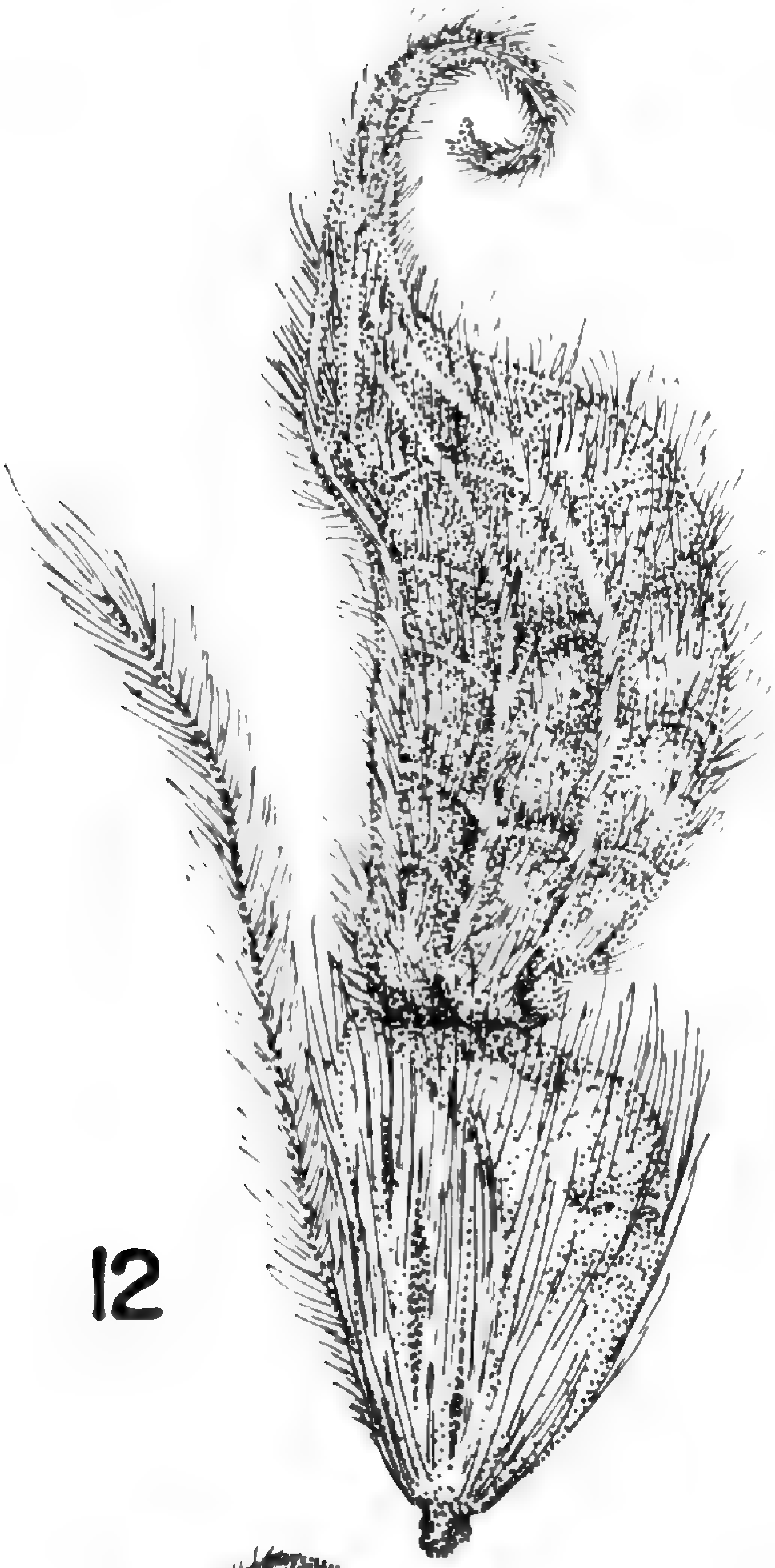
Fig. 8. Stylosanthes sympodialis, × 10.
Fig. 9. Stylosanthes mucronata, × 10.
Fig. 10. Stylosanthes fruticosa, × 10.
Fig. 11. Stylosanthes sundaica, × 10.



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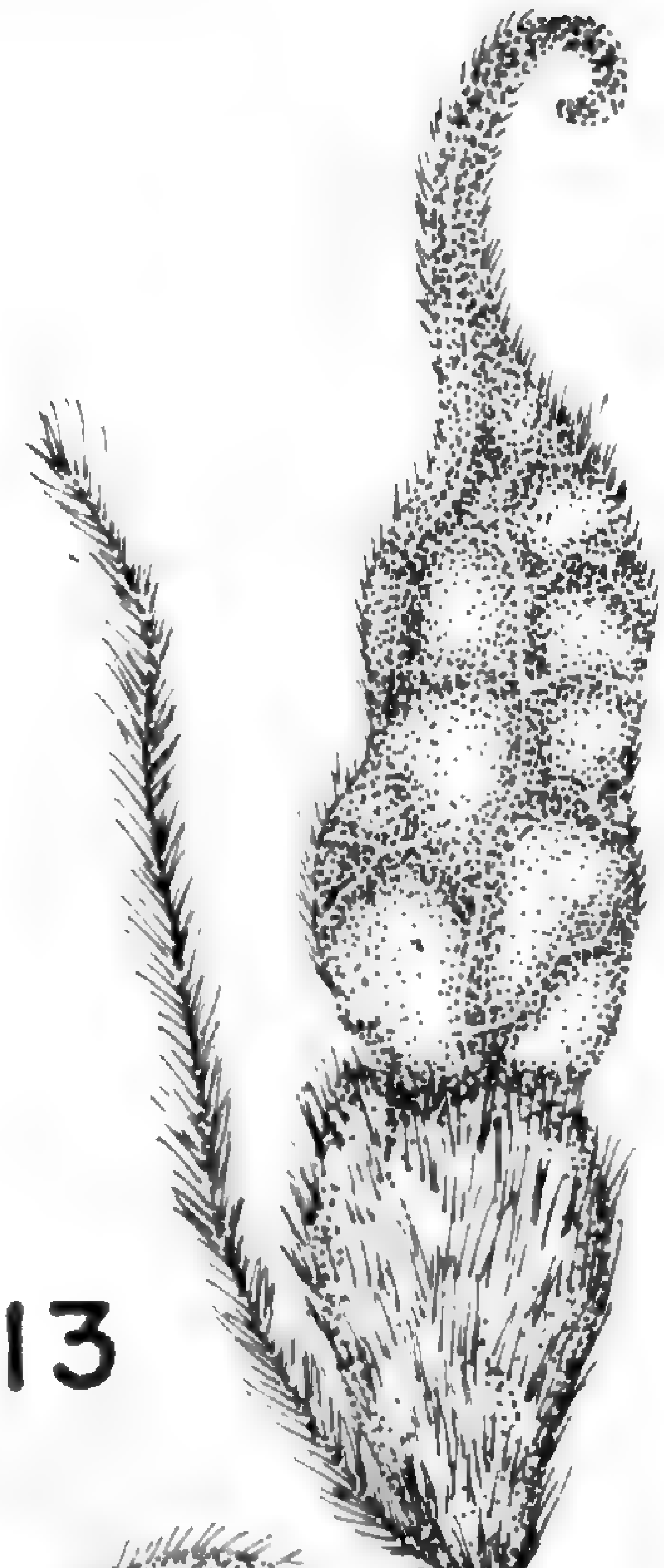

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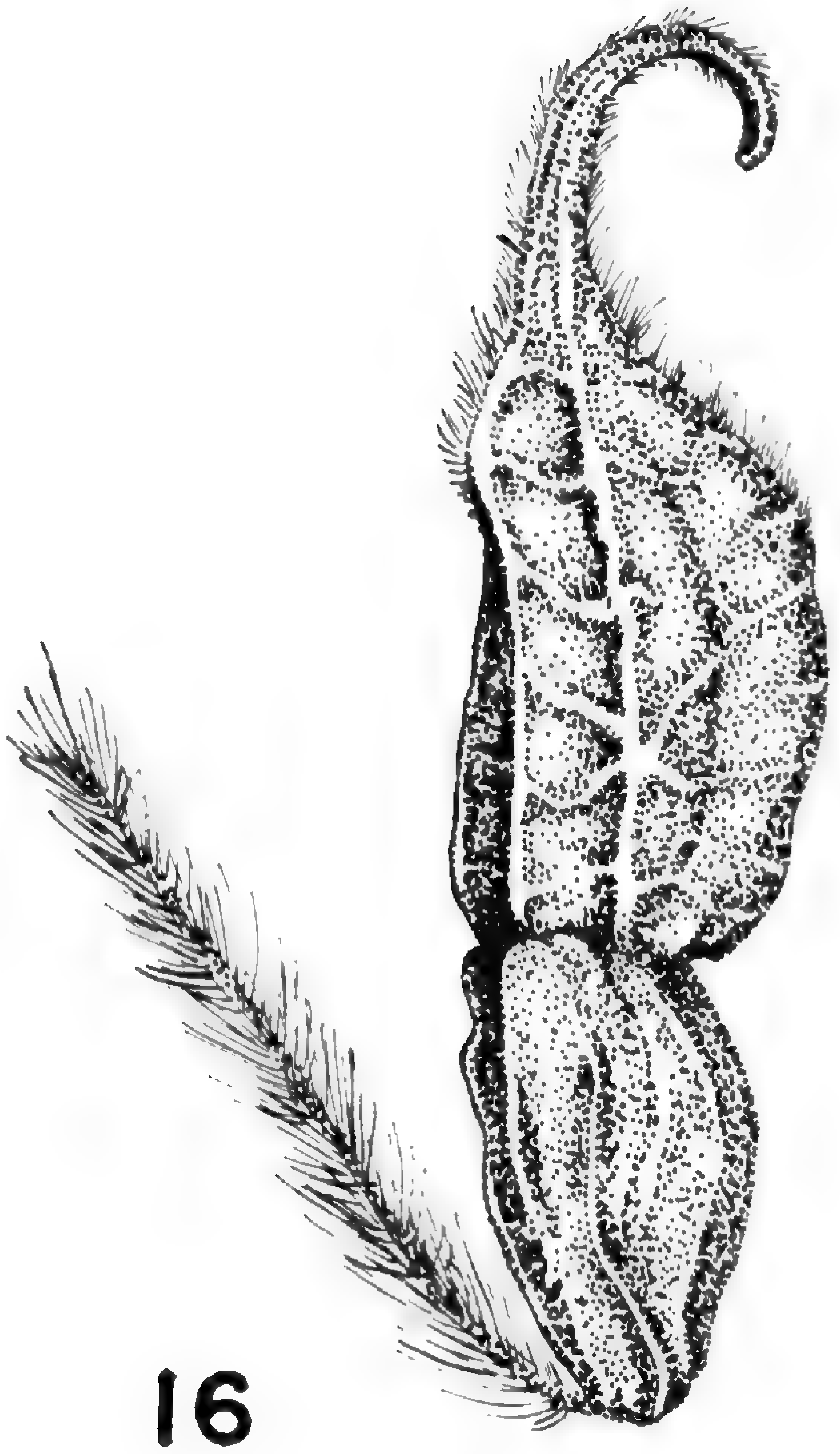
Fig. 12. Stylosanthes subsericea, × 10.
Fig. 13. Stylosanthes macrocarpa, × 10.
Fig. 14. Stylosanthes suffruticosa, × 10.
Fig. 15. Stylosanthes nervosa, × 10.



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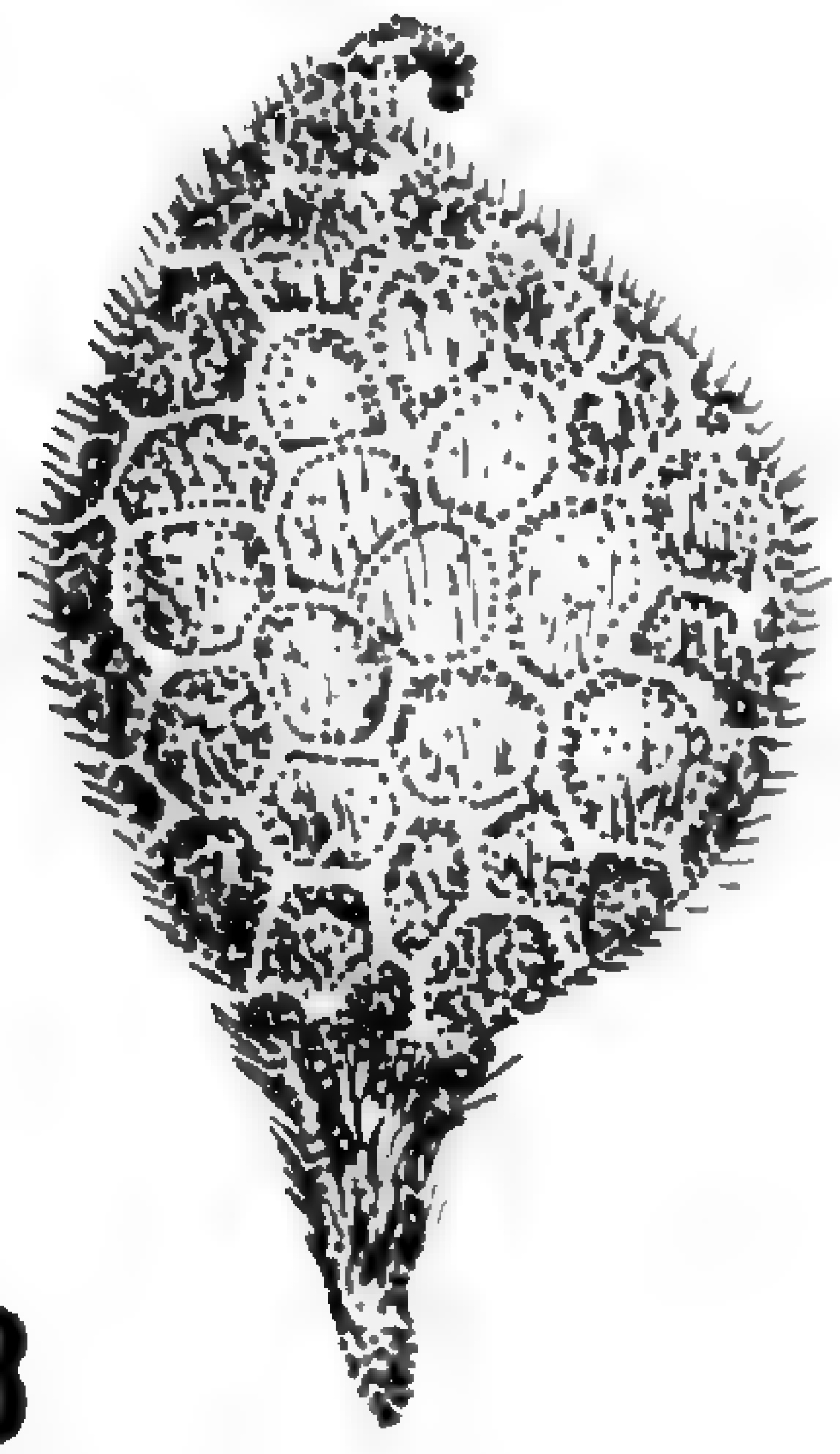

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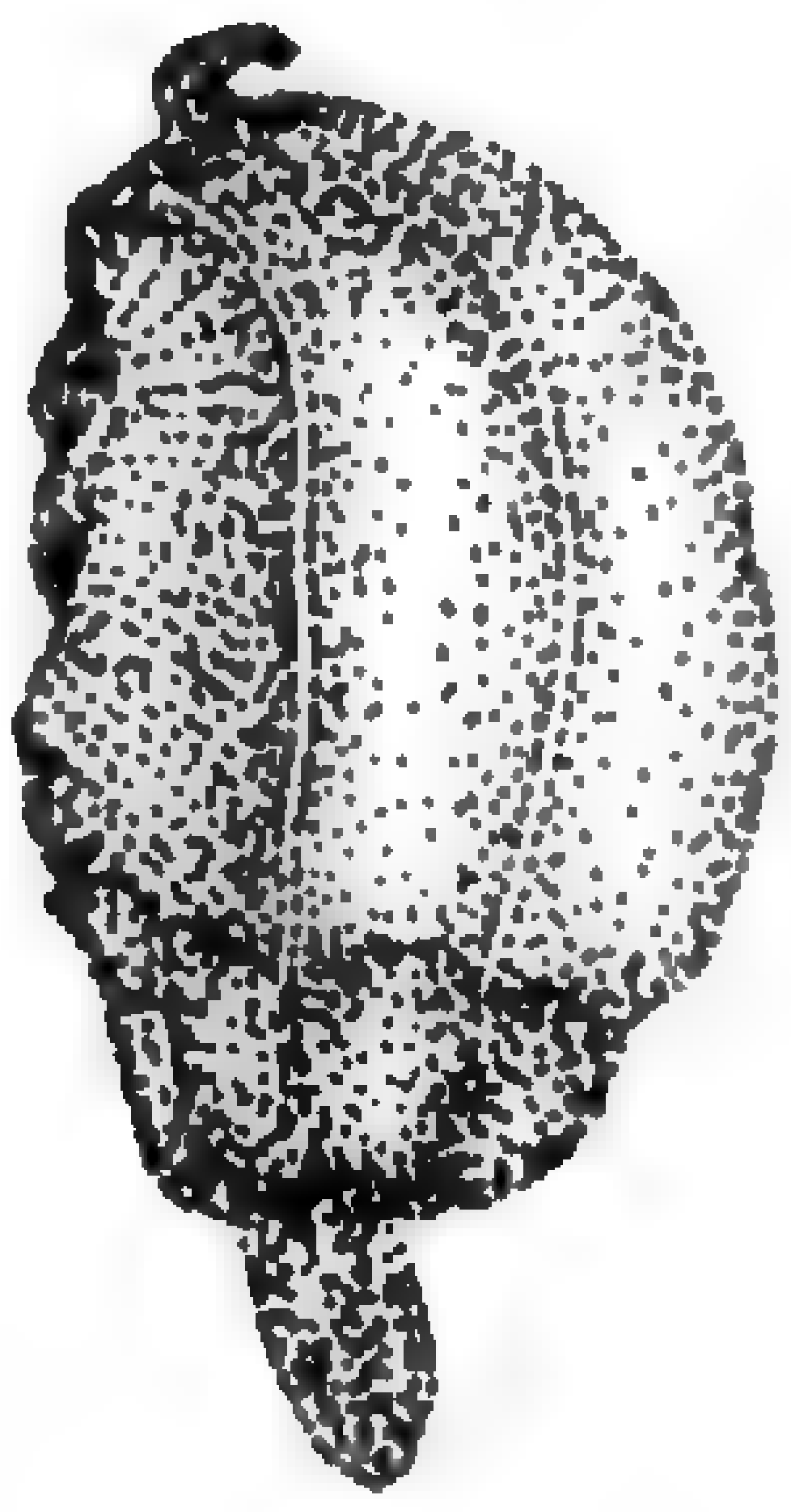

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Fig. 16. Stylosanthes hamata, × 10.
Fig. 17. Stylosanthes sericeiceps, × 10.
Fig. 18. Stylosanthes biflora, × 10.
Fig. 19. Stylosanthes guyanensis, × 10.

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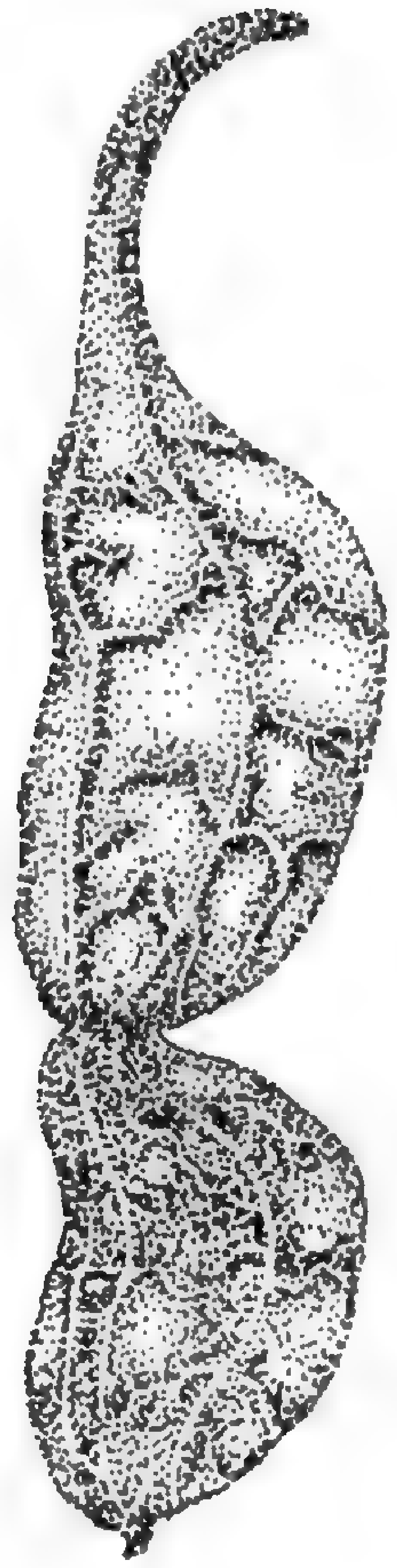

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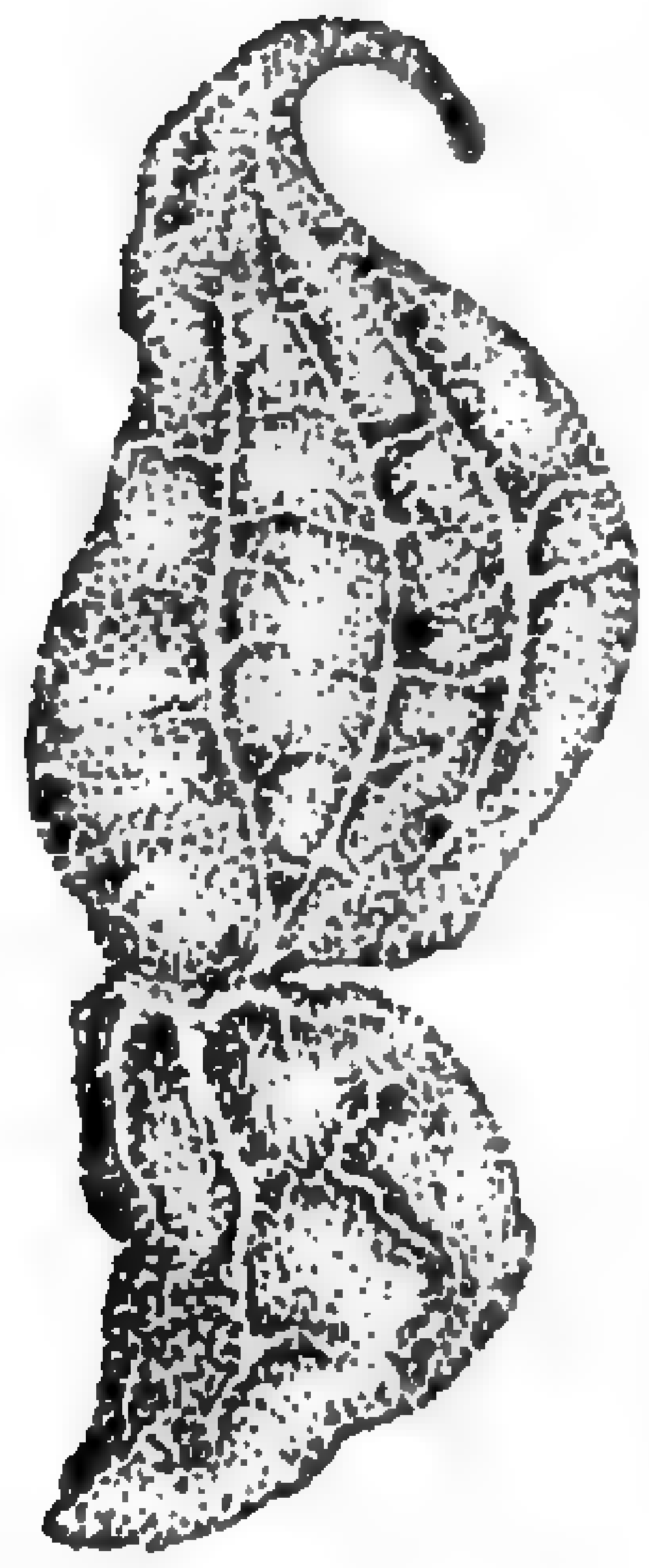

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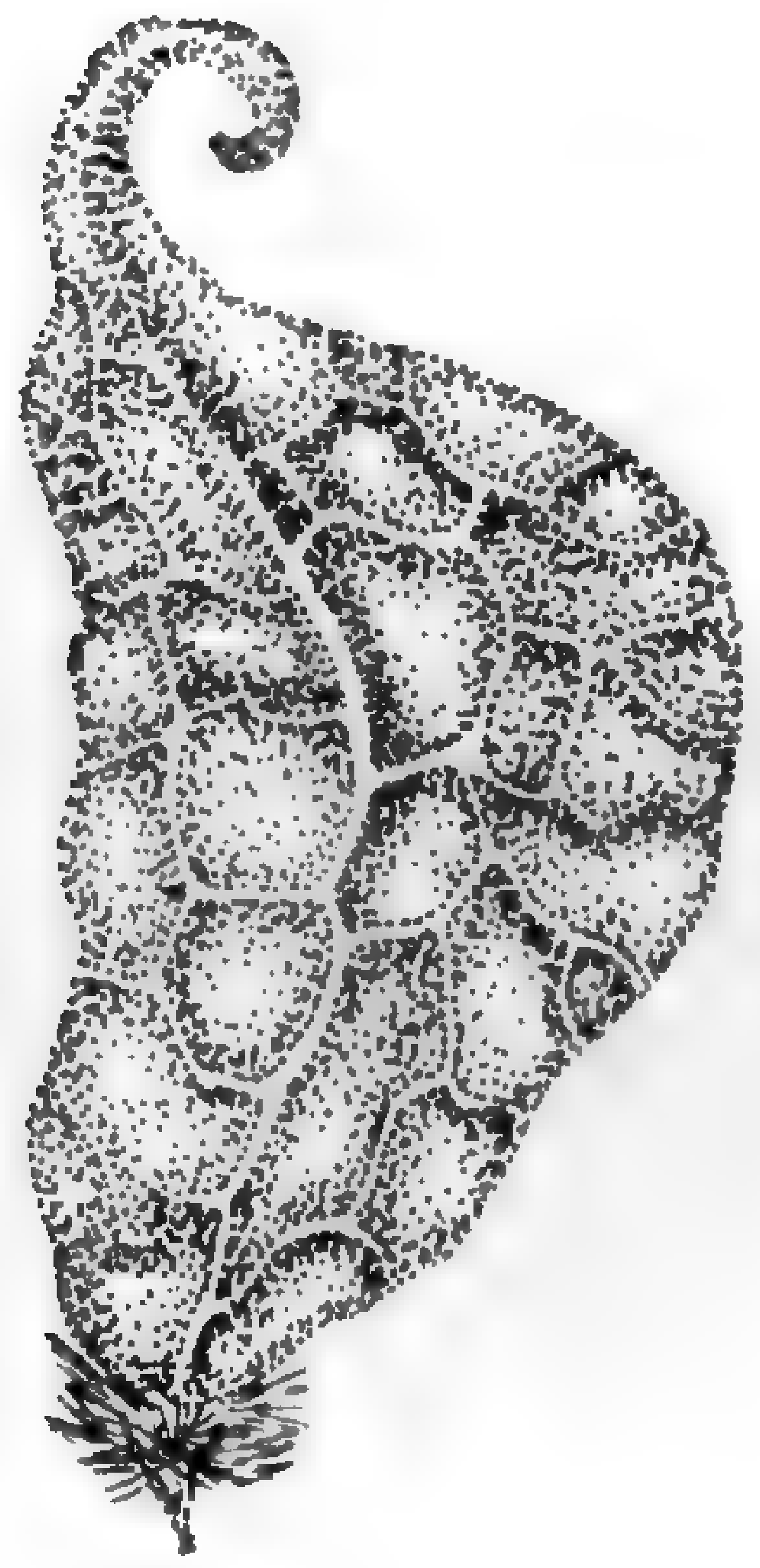

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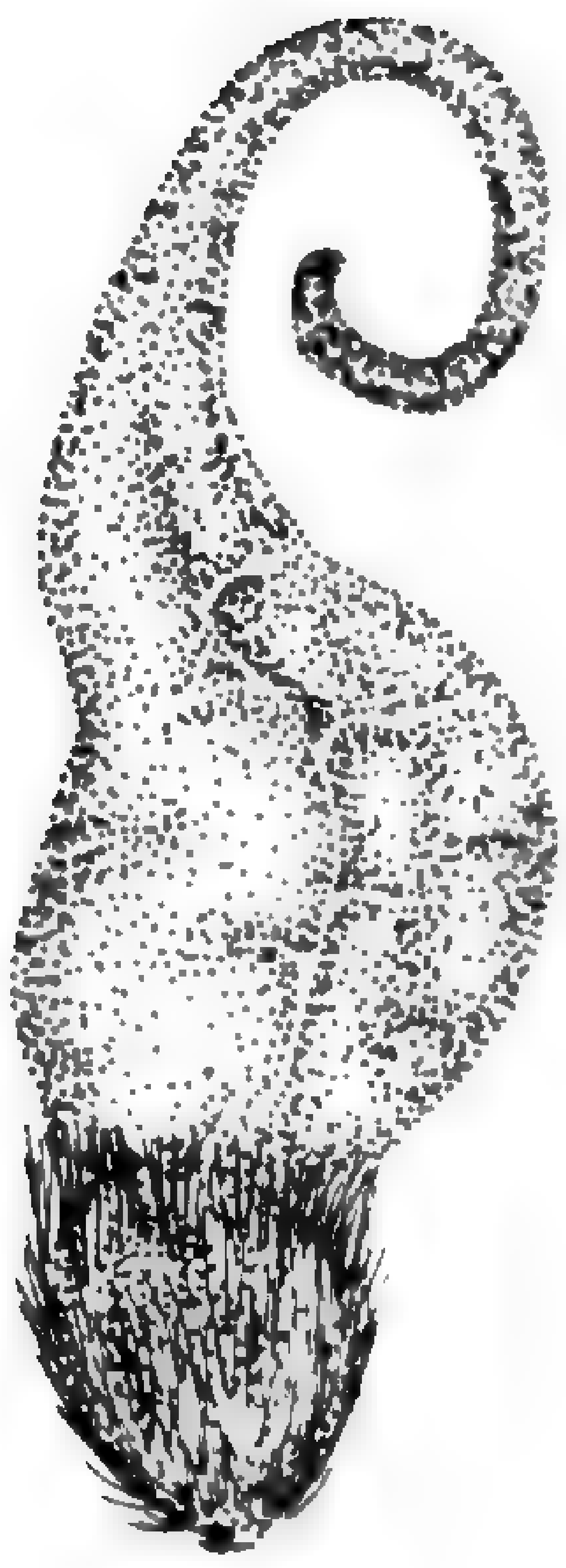
Fig. 20. Stylosanthes angustifolia, × 10.
Fig. 21. Stylosanthes leiocarpa, × 10.
Fig. 22. Stylosanthes cayennensis, × 10.
Fig. 23. Stylosanthes hippocampoides, × 10.



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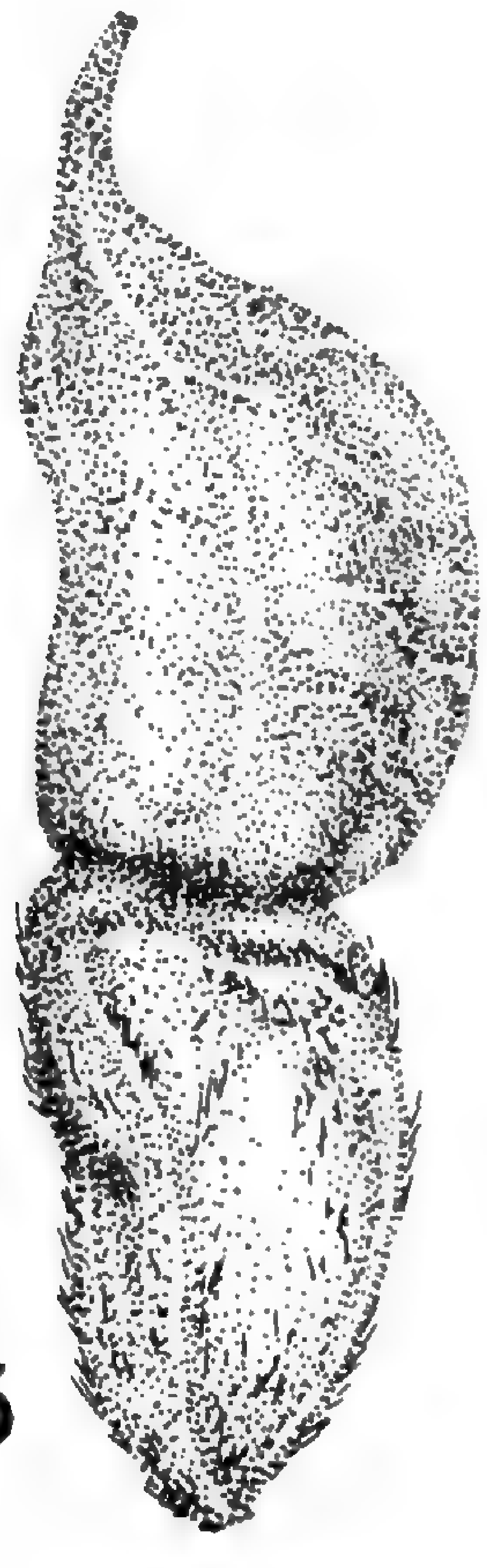

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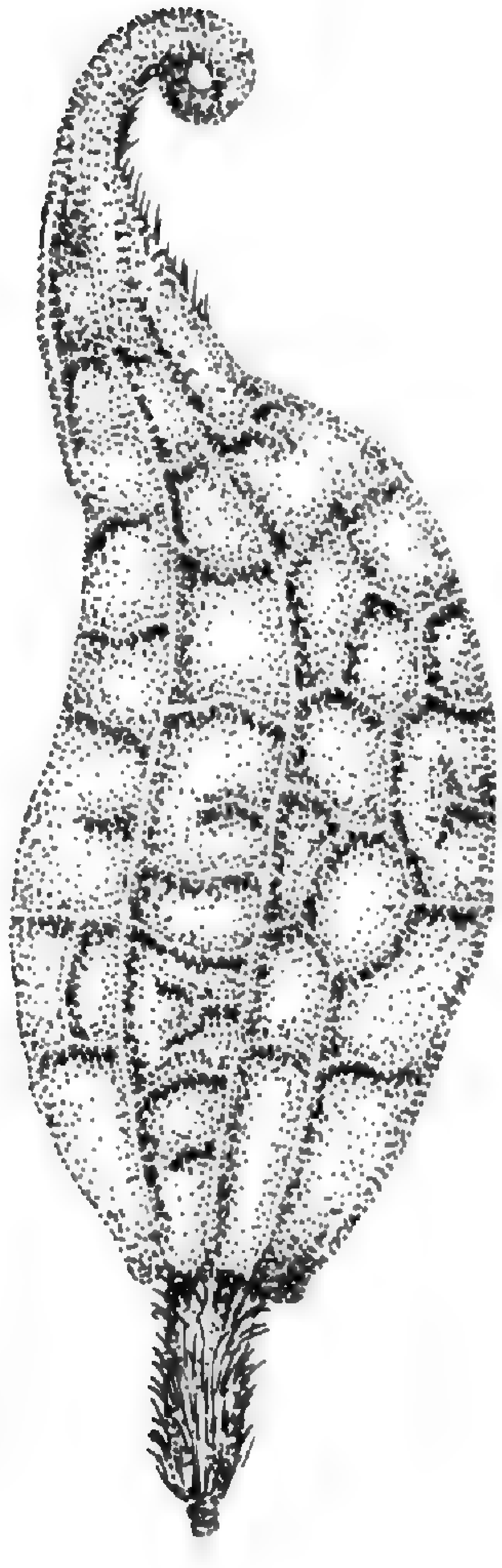

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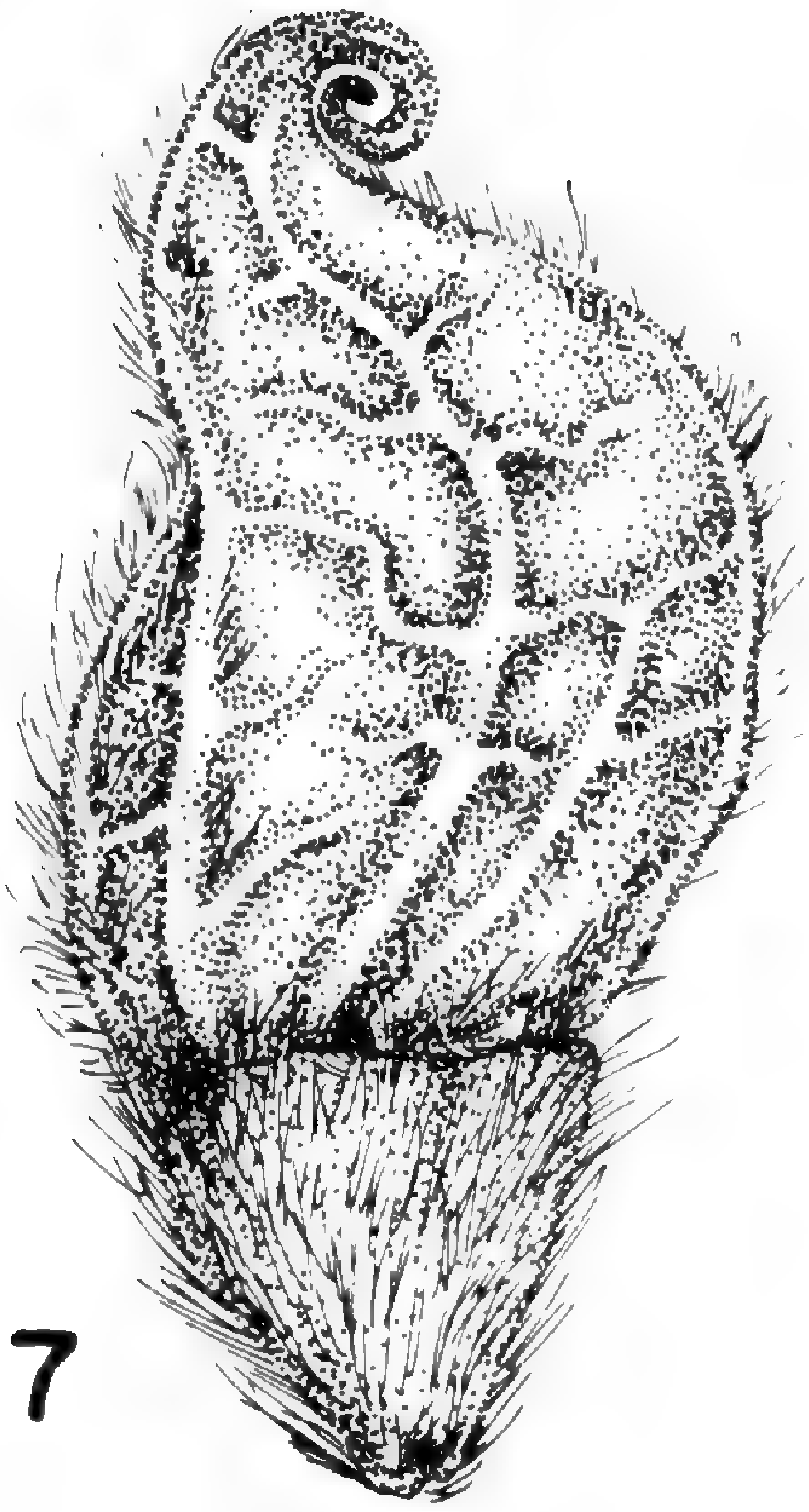
Fig. 24. Stylosanthes suborbiculata, × 10.
Fig. 25. Stylosanthes ingrata, × 10.
Fig. 26. Stylosanthes macrosoma, × 10.



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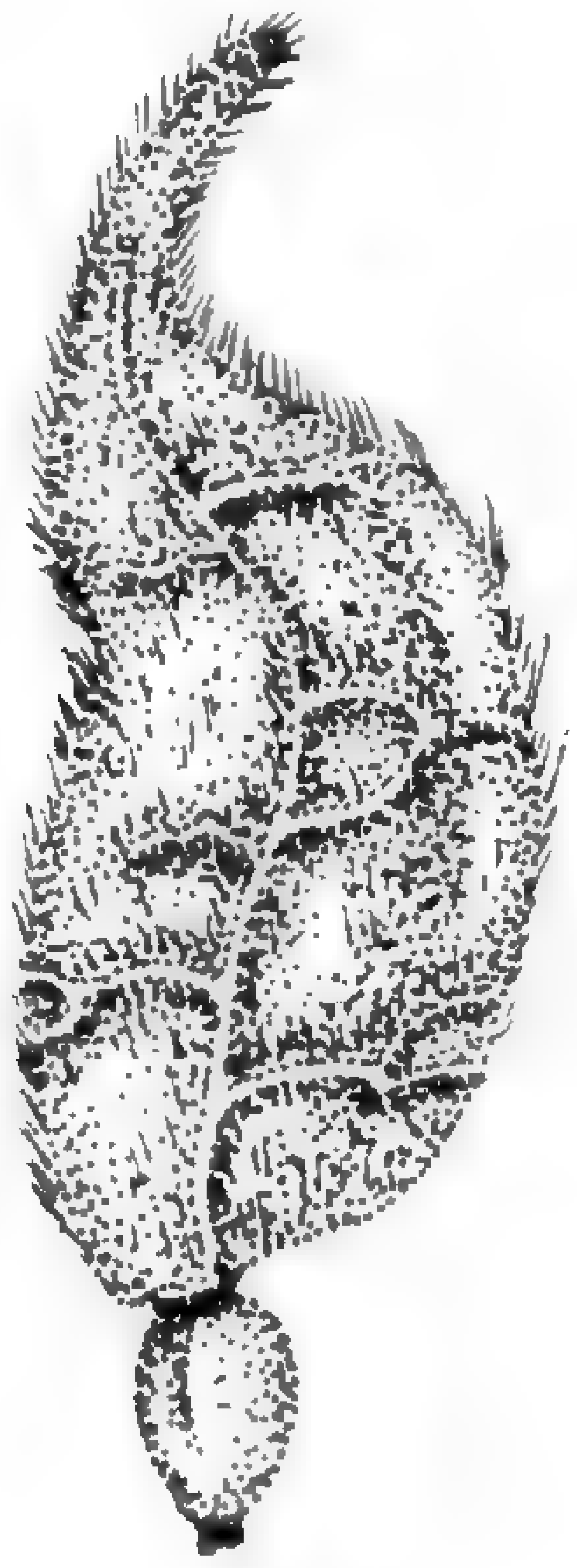

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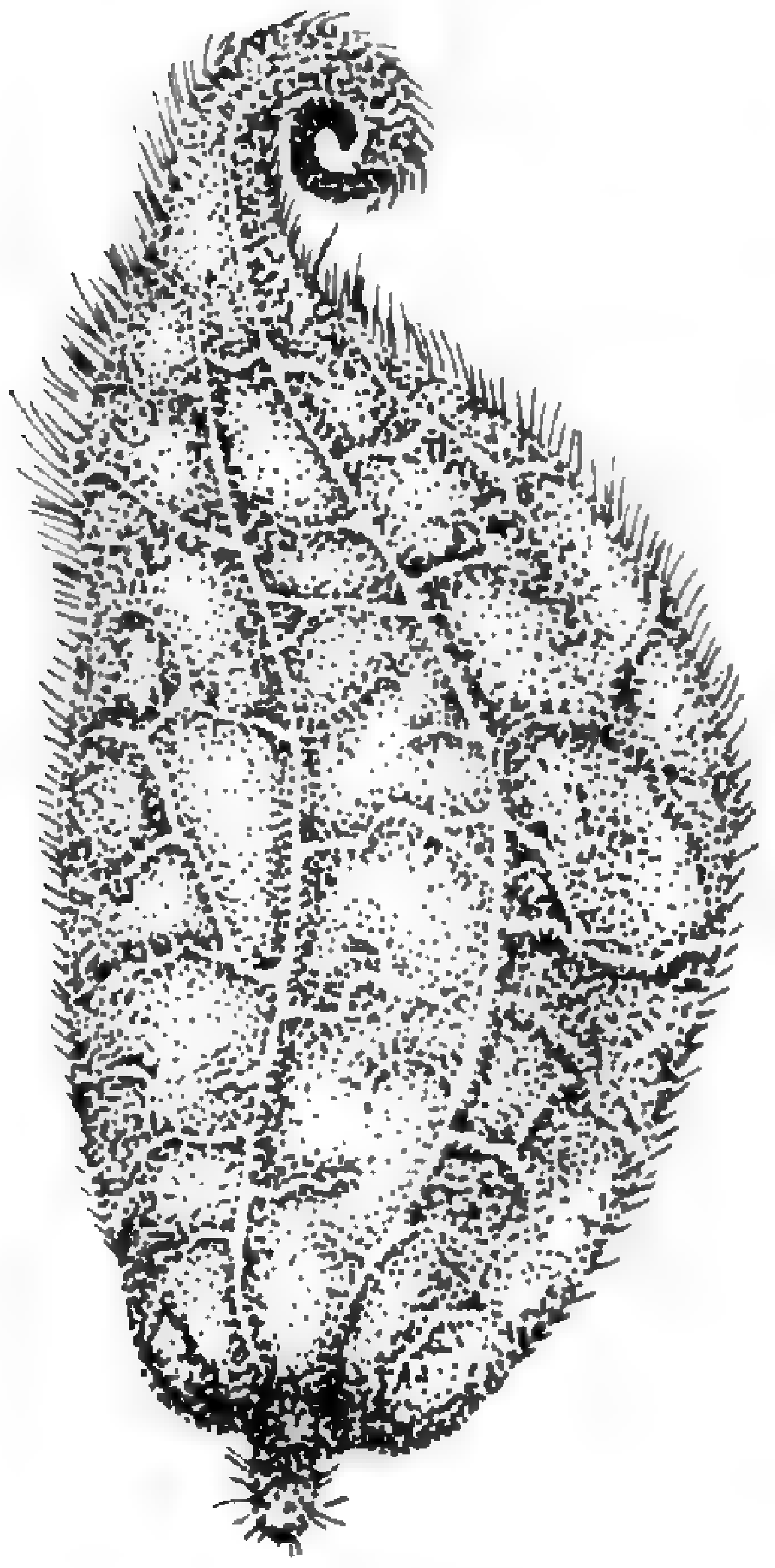

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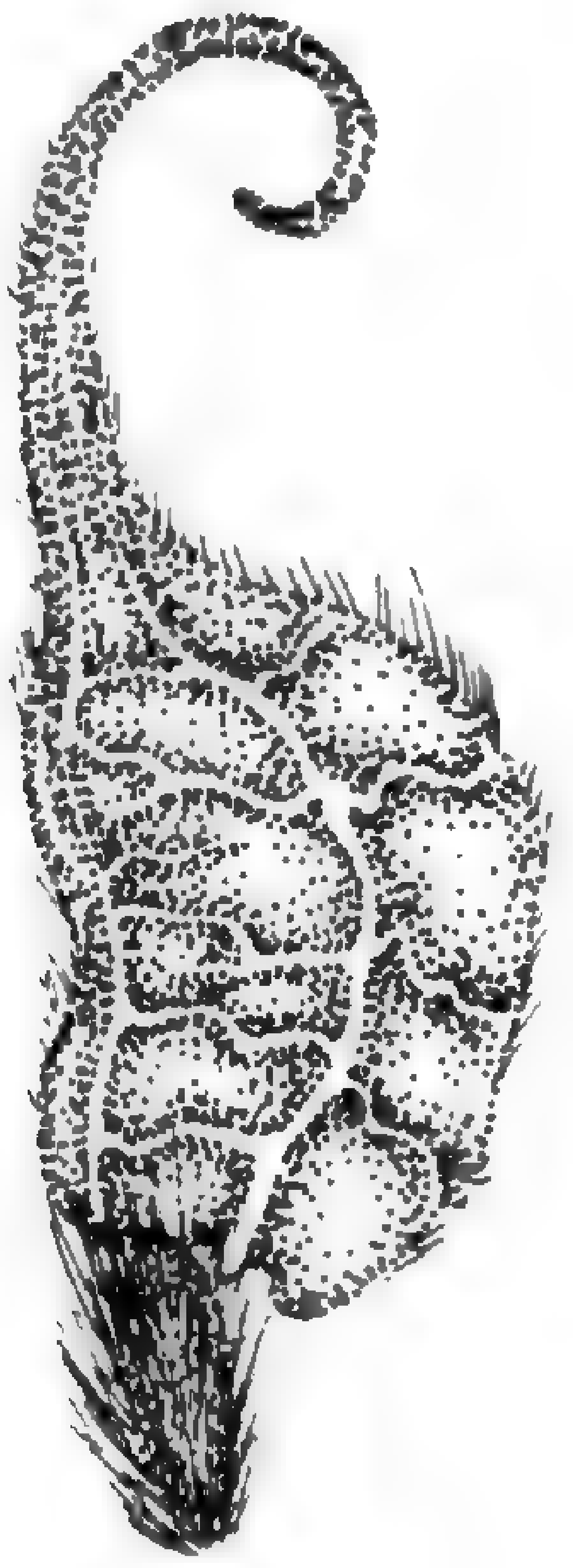

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Fig. 27. Stylosanthes viscosa, × 10.
Fig. 28. Stylosanthes figueroae, × 10.
Fig. 29. Stylosanthes montevidensis, × 10.
Fig. 30. Stylosanthes humilis, × 10.

H. Beak of loment about equalling body in length; leaflets suborbicular. Somaliland. (Fig. 24) .... 24. *S. suborbiculata*

HH. Beak of loment about one-half as long as the body; leaflets lanceolate to elliptic.

I. Upper articulation and beak together 3.0-4.5 mm. long; leaflets lanceolate. British Honduras. (Fig. 25) .... 25. *S. ingrata*

II. Upper articulation and beak together 5.0-7.5 mm. long; leaflets elliptic. Paraguay. (Fig. 26) .... 26. *S. macrosoma*

DD. Loment pubescent (if nearly glabrous, the stem viscid).

J. Beak shorter than or nearly equaling the upper articulation; stem often viscid.

K. Stems with viscid hairs or short-hispid; leaflets usually punctate beneath; fertile articulations 1 or 2.

L. Fertile articulations usually 2, the upper decidedly widest above the middle, the beak circinate, about one-third the length of the upper articulation. Bahamas, Cuba, Central America, Mexico, South America. (Fig. 27) .... 27. *S. viscosa*

LL. Fertile articulation usually 1, broadest at or below the middle, the beak nearly straight or slightly uncinate, one-half to nearly equaling the upper articulation. Colombia. (Fig. 28) .... 28. *S. figueroae*

KK. Stems without viscid hairs; leaflets not punctate; fertile articulation 1. Brazil, Paraguay, Uruguay, Bolivia, Argentina, Colombia. (Fig. 29) ...... 29. *S. montevidensis*

JJ. Beak nearly 2-4 times longer than the upper articulation; stems not viscid. Central America, Mexico, Bahamas, Cuba, Colombia, Venezuela, Brazil. (Fig. 30) .... 30. *S. humilis*

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NOMENCLATURAL CHANGES IN THE FAMILY PALMAE

S. F. GLASSMAN

In order to standardize the nomenclature for the forthcoming revision of Dahlgren's "Index of American Palms" (Field Mus. Nat. Hist. Bot. 14: 1-456. 1936) the following changes are necessary.

All names of *Pyrenoglyphis*, not already transferred, are being included under the genus *Bactris*. Since there already exists a *Bactris microcarpa* Spruce, based on another type *(Spruce 31)*, it is necessary to give *P. microcarpa* Burret (based on *Jenman 7725*) a new name.

Bactris Burretii Glassman, nom. nov. *Pyrenoglyphis microcarpa* Burret, Fedde Rep. 34: 250. 1934.

All species described under the genus *Yuyba* are being transferred to *Bactris*. *Yuyba*, as defined by Bailey (Gent. Herb. 8: 173. 1949.), is not a clear-cut genus. Its species apparently represent a specialized branch of the large genus *Bactris* in which the spathes and spadices have been considerably reduced in size and the spines have been reduced to small prickles, or are completely absent.

Bactris dakamana (Bailey ex Maguire) Glassman, comb. nov. *Yuyba dakamana* Bailey ex Maguire, Bull. Torrey Club 75: 108, fig. 9. 1948.

Bactris essequiboensis (Bailey ex Maguire) Glassman, comb. nov. *Y. essequiboensis* Bailey ex Maguire, l.c. 108, fig. 10.

B. Gleasonii (Bailey) Glassman, comb. nov. *Y. Gleasonii* Bailey, Gent. Herb. 8: 174, fig. 71. 1949.

B. Schultesii (Bailey) Glassman, comb. nov. *Y. Schultesii* Bailey, l.c. 174, fig. 71.

B. Stahelii (Bailey ex Maguire) Glassman, comb. nov. *Y. Stahelii* Bailey ex Maguire, Bull. Torrey Club. 75: 106, fig. 8. 1948.

B. trinitensis (Bailey) Glassman, comb. nov. *Y. trinitensis* Bailey, Gent. Herb. 7: 416. fig. 189. 1947.

In 1941 and 1942, Gregorio Bondar described several new species under the genus *Cocos*. Since that time all of these taxa have been transferred to other genera. After studying the type specimens of these species at the Chicago Natural History Museum, I have decided to make the following changes:

Syagrus Campos-Portoana (Bondar) Glassman, comb, nov. *Cocos Campos-Portoana* Bondar, Field Mus. Nat. Hist. Bot. 22: 460. 1942. *Arecastrum Campos-Portoanum* (Bondar) Hawkes, Arq. Bot. S. Paulo **II:** 175. 1952.

This taxon is more closely related to species of *Syagrus* than *Arecastrum*. Although the seed cavity is slightly irregular, it is mostly smooth inside; and the seed itself is only slightly gibbous and has a pointed tip. In the genus *Cocos*, only one species, *C. nucifera* L., is being recognized at the present time.

Syagrus Getuliana (Bondar) Glassman, comb. nov. *Cocos Getuliana* Bondar, Bol. Inst. Centr. Fom. Econ. Bahia **9:** 35, fig. 8-9. 1941. *Barbosa Getuliana* (Bondar) Hawkes, l.c. **177.**

This species does not belong to *Barbosa*, a doubtful segregate of the genus *Syagrus*, because the fruit is without a distinct operculum and the endosperm of the seed is homogeneous rather than ruminate.

Syagrus × mataforme (Bondar) Glassman, stat. nov. *Cocos mataforme* Bondar, Field Mus. Nat. Hist. Bot. **22:** 459. 1942. *Syagrus mataforme* (Bondar) Hawkes, l.c. 178.

This taxon is apparently a hybrid between *Syagrus vagans* (Bondar) Hawkes, a trunkless palm, and *S. coronata* (Mart.) Becc. It grows alongside of these two species in the Municipio of Santa Teresinha in the state of Bahia. *S.* × *mataforme* has the trunk characters of *S. coronata*, but shows a similarity in leaves and inflorescences to the other species. The fruits seem to be intermediate in size (both length and diameter) and shape, and the endocarp is intermediate in thickness between the two species. Both *S.* × *mataforme* and *S. vagans* have short, dentate spines on the margins of the lower half of the petiole, whereas in *S.*

coronata the petiole has long, narrow, flat spine-like appendages along most of its length.

Syagrus Ruschiana (Bondar) Glassman, comb. nov. *Cocos Ruschiana* Bondar, Bol. Inst. Centr. Fom. Econ. Bahia **9:** 45, fig. 10-13. 1941. *Arikuryroba Ruschiana* (Bondar) Toledo, Arq. Bot. S. Paulo **II:** 6. 1944.

This taxon is more closely related to species of *Syagrus*. The endosperm is only ruminate externally and the petioles have smooth margins, whereas in the questionable genus *Arikuryroba* the endosperm is both externally and internally ruminate and the petiole margins are spiny.

Syagrus Tostana (Bondar) Glassman, comb. nov. *Cocos Tostana* Bondar, Field Mus. Nat. Hist. Bot. **22:** 458. 1942. *Arikuryroba Tostana* (Bondar) Hawkes, Arq. Bot. S. Paulo **II:** 175. 1952.

The endosperm of this species is not ruminate and therefore should not be included in the genus *Arikuryroba*. *Syagrus Tostana* appears to be closely related to *S. coronata*.

UNIVERSITY OF ILLINOIS, CHICAGO

HYBRIDIZATION OF RUBUS HISPIDUS AND R. SETOSUS[1]

FREDERIC STEELE AND A. R. HODGDON

In an earlier paper (Hodgdon and Steele 1962) it was pointed out that *Rubus allegheniensis* is highly variable in its glandularity thus casting doubt on the validity of using the presence or absence of glands on the primocane as a character to separate species in the Section *Alleghenienses.* It is presumed that this and other characters such as the nature of the inflorescence, shape of leaf or leaflet, amount of pubescence, etc., may show a similar degree of intraspecific variability in many species of the Subgenus *Eubatus.* Part of the taxonomic confusion in the blackberries undoubtedly has resulted from the failure of students to appreciate the range of variability in the better known and more widely distributed species.

An added dimension of variation in *Rubus* Subgenus *Eubatus* is produced by hybridization. With reference to crossing in the group, Bailey (1941) presented a singularly critical commentary on those taxonomists such as Rydberg, Brainerd and Bicknell who had postulated or accepted hybridity as an important factor in the American blackberries. Bailey was unwilling to accept hybridization as of importance in the group, for he stated (p. 7) "It is to be noted that even after all these years of assumption of miscellaneous crossing in the American brambles we do not yet have a satisfactory demonstration of the problem in nature . . ." and later on, "one may find in the field what are apparently real hybrids but they appear to be no more common or any more puzzling than in other large genera; and in such cases a scrap on an herbarium sheet would not be evidence.

The hybridity postulate cannot explain the pomological blackberries."

In order to understand Bailey's thinking about Rubus better it may be well to quote further. Toward the end of page

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[1] Published with approval of the Director of the New Hampshire Agricultural Experiment Station as Scientific Contribution No. 314.

7 he gave the following criteria for recognizing hybrids, "(1) the presence of the two parents in the vicinity; (2) occurrence usually in small numbers, as if incidental or exceptional to the main population; (3) characters that appear to belong only to the parents in various degrees of combination."

From the context in which he wrote, it is evident that Bailey's rejection of hybridity was a reaction to the common but unfortunate taxonomic practice of calling plants hybrids without sufficient evidence, but his thinking about hybrids is hardly acceptable as a generalization in the light of present knowledge. Hybridization between species may occur infrequently or not at all in many groups, although it is a frequent process in many genera and it is certainly common in *Rubus* Section *Eubatus* in which hybrids may be found between many of the common well-known species whenever these occur together in some abundance in disturbed areas.

Fernald (1950) had quite accepted hybridization in the blackberries. But it is one thing to accept hybridization as an operating mechanism in a group and another to apply it successfully in working up the taxonomy of that particular group. Fernald's procedure in the Manual was to retain all but the most obviously overlapping taxa. He would have had to be highly arbitrary to do otherwise for all of the hundreds of "species" that had been described were set apart on the basis of supposed morphological differences that seemed to make each distinct and in the majority of cases there was no available information to show that one was any better as a species than another. He did perform the valuable service of eliminating a very large number of very dubious taxa in the group. Because he did retain those taxa which he believed to be most distinct morphologically, his treatment does provide an excellent point of departure for further work. In the "Manual" therefore is to be found the nucleus of any sound taxonomic study of blackberries in Northeastern America.

Gleason & Cronquist (1963) have accepted the fact that hybrids are common in blackberries; they have also reduced the number to a very few and at times arbitrarily selected "collective species" some of which are too broad to represent biological realities and others are trivial and based on inconsistent distinctions. While attractive to the non-specialist who wants to give some name to his collections, their treatment does have shortcomings. If an enormous assemblage of taxa is to be reduced to few, it is only by an intensive and specialized approach that the accurate dilineation of all the basic species can be accomplished.

This paper presents evidence that hybrid and introgressing populations between 2 species of *Rubus* Section *Eubatus* do occur rather frequently and further that three widely recognized, so-called, species exhibit taxonomic characteristics that are shared by various of these evident hybrids. Thus perhaps for the first time we present evidence from field studies that hybridization is an important factor in blackberry taxonomy.

Quite early Brainerd and Peiterson (1920) suggested hybridization as an important factor in the Rubus problem, and proposed a rather elaborate scheme of hybrids. Although they made a number of collections and did some experimental work, they published no direct evidence of hybridization and their results were not accepted by Bailey or Fernald. Nevertheless an examination of specimens in the Pringle Herbarium at the University of Vermont has convinced us that some of Brainerd and Peiterson's conclusions were valid. However, each supposed hybrid must be considered separately and appropriate tests applied. We have used the following criteria for hybridization: 1. that the putative parents be present in the area; 2. that the supposed hybrids occupy a disturbed environment; 3. that the supposed hybrids show some degree of intermediacy between the two parents. Blackberries frequently grow in disturbed environments, such as gravelly edges of roads or lumbered areas so condition 2 is easily satisfied. It was realized that many of the populations would show introgression with one of the parents.

Although we have similar evidence that many species of *Rubus* hybridize, this paper will be concerned with *R. hispidus* and *R. setosus*. *R. hispidus* is typically a blackberry of dry, open, or shady habitats with rather poor soil. It also grows in boggy areas. It is most easily recognized by its prostrate habit, lack of sharp prickles, and three lustrous coriaceous primocane leaflets. *R. setosus* is typically an inhabitant of alluvial meadows and poorly drained soil, but will grow in a variety of open habitats. It is a low erect blackberry with numerous soft bristles and poor fruit.

The first indication that these species might hybridize arose when the senior author noticed a mongrel population of blackberries along the gravelly edge of a newly constructed state road. A number of clones were scattered in the bare gravel, each somewhat different from the others, and all clearly having existed for only two years. Both *R. hispidus* and *R. setosus* grew in the area so it seemed quite possible that this was a hybrid population. Collections were made and investigations started on the possibility of frequent hybridization and introgression of these two species.

To analyze the situation it was decided to use the hybrid index method as described by Stebbins (1950). For each colony of blackberries investigated, 8 plants, consisting of both primocane and floricane from the same rootstock were collected. Each plant was tagged at the time of collection with data as to the growth habit. It was noticed that new primocanes often started off as erect plants, and may not have developed trailing tendencies until after flowering time so no collections were made until after the first of July. In the case of a long primocane, the midportion with leaves that seemed to be typical of the whole plant were secured; for the floricane, care was taken to secure a vigorous branch of the inflorescence with remains of flowers. Fruits often do not develop. Samples were taken from the colony at regular intervals in the case of a roadside population, or else in such a way as to indicate the range of variation.

In the preparation of the index all characters except growth habit were rated 0, 1 or 2.

TAXONOMIC CHARACTERS USED IN STUDY

GROWTH HABIT — varies from prostrate through low and high doming, to erect. This is an excellent character and it was rated from 0 to 4. Good *R. hispidus* is always prostrate, but in certain situations may trail on vegetation to some height above the ground. Floricanes of *R. setosus* are often reclining or lodged because of the weight of snow; if the primocane is erect the plant is considered erect. It should be emphasized that growth habit can only be accurately rated if notes are made at time of collection. A number of otherwise excellent herbarium specimens lack this essential data.

ARMATURE PER DECIMETER — a good character but somewhat subject to environmental modification. The count included prickles, bristles, and glands. Although *R. setosus* typically has a large number of bristles, they may be quite sparse near the base of the stem; their number is also affected by shade.

LENGTH OF THE LONGER BRISTLES — runs from .25 cm. or less for *R. hispidus* to .4 cm. or greater for *R. setosus.* It is not always consistent.

CHARACTER OF PRIMOCANE LEAF — *R. hispidus* coriaceous and lustrous under good light; *R. setosus* dull and chartaceous.

NUMBER OF PRIMOCANE LEAFLETS — *R. hispidus* typically 3; *R. setosus* 5 or sometimes 3 with 2 of them partly divided.

LENGTH OF CENTRAL PRIMOCANE LEAFLET — *R. hispidus* noticeably smaller, usually less than 5 cm.; *R. setosus* 6.5 cm. to 11 cm. This character is subject to some environmental modification.

Position of broadest part of leaf was expressed as the ratio of the distance of the broadest part of the leaf to the center of the leaf divided by half the length. This ratio varies from .1 to .3 for *R. hispidus;* thus the leaves tend to be obovate. In *R. setosus* the ratio is usually 0 with leaflets broadest at the middle.

CHARACTER OF TEETH OF LEAFLET — *R. hispidus* has teeth rounded with an abrupt point; *R. setosus* has teeth triangular or accuminate.

LEAF TIP OF CENTRAL PRIMOCANE LEAFLET — *R. hispidus* is usually rounded and abruptly pointed; *R. setosus* typically has an accuminate tip.

DIAMETER OF PRIMOCANE — *R. hispidus* 2mm. or less; *R. setosus* usually 3 mm. or more but occasionally less in shady situations.

GLANDULARITY OF FLORAL AXIS — *R. hispidus* has either no glands or rather sparse glands of uniform length; *R. setosus* has abundant glands of varying length.

Table I. List of characteristics used in Hybrid index with values assigned.

	R. hispidus		*R. setosus*
Growth habit	Prostrate = 0	Doming = 2	Arching to erect = 4
Armature per dm.	0-2000 = 0	2001-2999 = 1	3000 or more = 2
Bristle length	3 mm. or less = 0	3.1-3.9 = 1	4 mm. or more = 2
Character of leaf	Lustrous coriaceous = 0	Intermediate = 1	Dull Chartaceous = 2
No. primocane leaflets	3 = 0	3-5 = 1	5 = 2
Length of leaflet	0-5 cm. = 0	5-6.5 = 1	6.5 or more = 2
Mid ratio	.3-.1 = 0	——	0 = 2
Teeth	*R. hispidus* type = 0	Intermediate = 1	*R. setosus* type = 2
Tip of leaflet	Abruptly pointed = 0	——	Acuminate = 2
Stem-diameter	2 mm. = 0	——	3 mm. or more = 2
Glands in infl.	0-few = 0	——	Abundant = 2

Discussion

In order to provide standard material for effective comparisons, we made collections from characteristic *Rubus hispidus* and *R. setosus* colonies. The results of the analysis of these collections provide the information about the two species shown in figure 1. A total of 11 hybrid or introgressing populations were analyzed of which only 6 could be shown in the diagram. In general these were chosen to show the range of intermediacy in these populations. It is

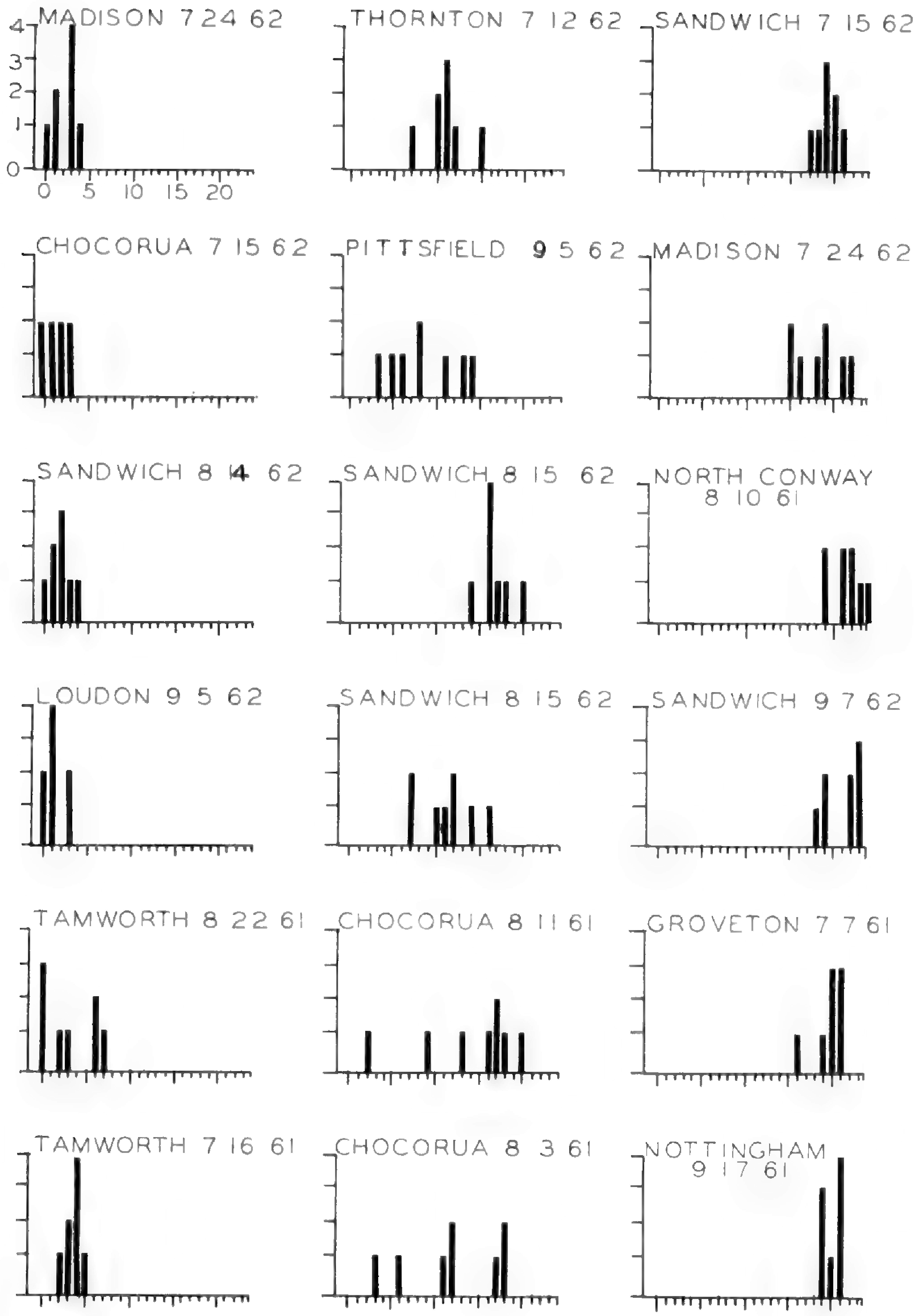

Figure 1. Frequency Distribution Diagram: *Rubus hispidus* populations at left. *R. hispidus* × *R. setosus* in center and *R. setosus* at right. The hybrid index values are on the horizontal axis, the numbers of individuals measured on the vertical axis (scale given in upper left of diagram).

to be noted that in some of the populations certain plants may grade into one or both parents though the majority fall into a position between them. The limit of anything we would tend to call *R. hispidus* would be not more than 7 in value while *R. setosus* would be not less than 16 on the scale.

During this investigation it has become apparent that several controversial "species" are hybrids or introgressants intermediate in character between *Rubus hispidus* and *R. setosus*. Those most clearly intermediate are *R. adjacens* Fernald, *R. jacens* Blanchard and *R. trifrons* Blanchard. Two others, *R. spiculosis* Fernald and *R. tholiformis* Fernald display many intermediate features and may belong in this category or may have a more complicated heredity.

In the folders of *R. adjacens* in the Harvard Herbaria one finds a varied assortment of material varying from specimens close to *R. setosus* to strongly intermediate plants. The same in general holds true for *R. jacens* while *R. trifrons* has more frequently been confused with *R. hispidus*. To lend clarity to this problem we have investigated the type specimens of these three and have graded each according to our hybrid index values. Although information is lacking about the habit of growth of the type of *R. trifrons,* it is possible nonetheless, to get a fairly good idea of the probable relationship of these three from the total values. The hybrid index value of 11 for *R. adjacens* shows it to be clearly intermediate between *R. hispidus* and *R. setosus* as does the value of 10 for *R. jacens*. *R. trifrons,* as might be suspected from its frequent confusion with *R. hispidus,* has a slightly lower value of 9.

We conclude that hybridization and introgression of *R. hispidus* and *R. setosus* occur frequently especially in disturbed areas giving rise, in addition to the above mentioned recognized taxa, to various other forms difficult to classify.

We wish to thank the curators of the Gray Herbarium, the Arnold Arboretum Herbarium and that of the New England Botanical Club for permission to examine their collections of Rubus. We also extend thanks to Dr. H. W. Vogelmann and L. Charette for the loan of specimens and

for permitting us to examine the Rubus collections in the Pringle Herbarium at the University of Vermont.

Voucher specimens are deposited in the herbarium of the University of New Hampshire.

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AND UNIVERSITY OF NEW HAMPSHIRE, DURHAM.

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HEDYOTIS AUSTRALIS IN GEORGIA

KENTON L. CHAMBERS

The recently completed merger of *Houstonia* with *Hedyotis* (W. H. Lewis, Rhodora 63: 216-223, 1961, and other authors) provides yet another epithet for the hapless Small Bluet whose name is confused among *Houstonia patens* Ell., *H. minima* Beck, and *H. pusilla* Schoepf in the two principal manuals of the northeastern flora. In *Hedyotis,* the species must be called *H. crassifolia* Raf., and current opinion favors the placement of all three of the above names in synonymy (see, for example, L. H. Shinners, Field & Lab. 18: 100, 1950, and Spring Flora of the Dallas-Fort Worth Area, 359-360, 1958).

On March 23, 1963, I found *Hedyotis crassifolia* growing on grassy roadsides in Ocmulgee National Monument, Macon, Georgia, and with it an "obviously different" species

Figure 1. A. *Hedyotis australis* Lewis & Moore *(K. L. Chambers 1973)*; B. *Hedyotis crassifolia* Raf. *(K. L. Chambers 1974)*; both × 2/3.

Plate 1287

having much smaller, white corollas and a distinctive growth form (fig. 1). The white-flowered species is *Hedyotis australis* Lewis & Moore (Southwestern Naturalist **3**: 208-211, 1959) based on *H. crassifolia* var. *micrantha* Shinners. The chromosome numbers of *H. crassifolia* and *H. australis* have been reported to be 2n = 16 and 2n = 32, respectively (W. H. Lewis, Amer. Journ. Bot. **49**: 855-865, 1962); and Lewis and Moore (op. cit.) report five distinctive characteristics by which the two species can be distinguished. A clear morphological hiatus was observed between the two populations growing intermingled at Macon, which supports the assumption by Lewis and Moore that a barrier to crossability exists. In view of the intraspecific polyploidy reported in *Hedyotis caerulea* (L.) Hook. (W. H. Lewis and E. E. Terrell, Rhodora **64**: 313-323, 1962) and other species, one might not wish to predict that *H. australis* and *H. crassifolia* will be found to differ consistently in chromosome number throughout their area of geographical overlap. However, an additional barrier to interbreeding is provided by the predominant self-fertilization which must occur in these species, both of which have monomorphic flowers with the stigma closely surrounded by the anthers. *Hedyotis australis* is said by Lewis (op. cit., 1962) to be the most highly evolved species in subgenus *Edrisia* (= *Houstonia*); in the specimens from Georgia the corolla-tube is only 1.3 mm. long, about 2/3 the length of the sepals, and the anthers are inserted 0.3 mm. from the base of the tube. In habit, the plants differ from *H. crassifolia* in their less divaricate branching, their erect rather than nodding floral buds, and their well distributed cauline leaves.

The Ocmulgee population of *H. australis* represents a disjunction three states eastward from the range reported for the species by Lewis and Moore (Louisiana to Arkansas and Texas). However, as the plant becomes familiar to collectors, it will probably be found through the intervening area. Collection data for this report are as follows: *K. L. Chambers 1973;* grassy roadside flat, 100 yards east of the Great Temple Mound, Ocmulgee National Monument, Bibb

County, Georgia; associated species, *Krigia oppositifolia* Raf., *Viola rafinesquii* Greene, *Phacelia dubia* (L.) Trel. Specimens are to be deposited at the herbaria of Oregon State University, Southern Methodist University, and Harvard University.

DEPARTMENT OF BOTANY, OREGON STATE UNIVERSITY, CORVALLIS.

DROSERA FILIFORMIS IN CONNECTICUT. — In a dry bog in the state leased area "Latimer Brook" just east of Route #161 in East Lyme, in a space of approximately 500 square feet grow at least seventy-five plants of *Drosera filiformis* Raf. Among the sundews are *Drosera intermedia, Vaccinium macrocarpon,* a *Rubus* of the type *hispidus* and the moss, *Polytrichum commune* in two comparatively bare spots in contrast to the grassy or shrubby cover of most of the bog. Other plants in the immediate vicinity are *Iris prismatica, Myrica gale, Kalmia angustifolia, Calopogon pulchellus, Chamaedaphne calyculata* var *angustifolia, Gaultheria procumbens* and *Vaccinium angustifolium* var. *laevifolium.*

On June 23, 1963, the Connecticut Botanical Society held one of its field trips at this site and at least 40 people saw the plants. At this meeting two plants were taken and transferred to the eastern part of Guilford, Conn. in a bog where it is hoped they may persist for some time.

Mr. J. J. Neale reports that there is a sheet of this species in the herbarium of the Connecticut Botanical Society, from the collection of Anna E. Carpenter, labelled "July 29, 1905, South Glastonbury, Mrs. F. W. Starmer". Connecticut botanists who have seen this specimen have thought it unlikely to have been native there. Though South Glastonbury is some thirty miles northwest of East Lyme, this alleged record now perhaps appears a little less improbable.

Specimens have been deposited in the Gray Herbarium and the herbaria of the New England Botanical Club, the Connecticut Botanical Society, and the University of Connecticut. — WILLIAM R. LINKE JR., NEW LONDON.

EPILOBIUM × WISCONSINENSE, HYBR. NOV.

DONALD UGENT

The following hybrid between *Epilobium coloratum* Biehler and *E. glandulosum* var. *adenocaulon* (Haussk.) Fernald was discovered during the preparation of a treatment of the Onagraceae of Wisconsin (Ugent, 1962: 105-110). The recent series of "Preliminary Reports on the Flora of Wisconsin" reflects the efforts of Hugh H. Iltis and his students to achieve a Flora of Wisconsin, a goal set by the late Norman C. Fassett.

Epilobium × wisconsinense, hybr. nov.

Caules tetragoni, laxe dumosi-ramosi, constanter patuli-glandulosi et minute pilosi. Folia caulina petiolata, laminis longioribus 3-6.5 cm. longis, 8-21 mm. latis, anguste lanceolatis, apice acuminatis, margine excisiserrulatis vel serrulatis; petiolis 1-3 mm. longis. Flores solitarii, supra-axillares. Gemmae orbiculatae, sepalis apice ereflexis, aut reflexis, saepe intermediis. Calyces 3-4.2 mm. longi. Petala purpurea vel lilacina, 3.5-6 mm. longa. Capsulae maturae 1-3.5 (-4.5) cm. longae. Semina maxime sterilia, quibus maturis 1-1.2 mm. longis, 0.2-0.5 mm. latis, striati-papillosis; comae fuscae vel fulvae, quibus immaturis albis.

HOLOTYPUS: Polk Co., Wisconsin, edge of road in wet swamp, not common, West Sweden Tp. sec. 36, *Johnson s. n.* (WIS).

Stems loosely bushy-branched, spreading glandular pubescent as well as minutely pilose, the sides as well as the angles pubescent. Larger leaves 3-6.5 cm. long, 8-21 mm. wide, narrowly lanceolate, acuminate, closely and irregularly serrulate, on petioles 1-3 mm. long. Flowers solitary in the upper leaf axils; buds rounded, or with divergent sepal-tips, often somewhat intermediate. Calyx 3-4.2 mm. long. Petals purple or lilac, 3.5-6 mm. long. Mature capsules 1-3.5 (-4.5) cm. long. *Seeds mainly aborted,* the mature ones 1-1.2 mm. long, 0.2-0.5 mm. wide, *striate-papillose;* the coma brown or tawny, white in inmature capsules.

Southern and northwestern Wisconsin, very sporadic in disturbed sedge-goldenrod peat marshes, spring-saturated sedge meadows, and along wet swampy roadsides, river banks, and railroad tracks. Flowering from early July to early September, and fruiting from mid-August to early September.

This hybrid resembles *Epilobium coloratum* in the sharply

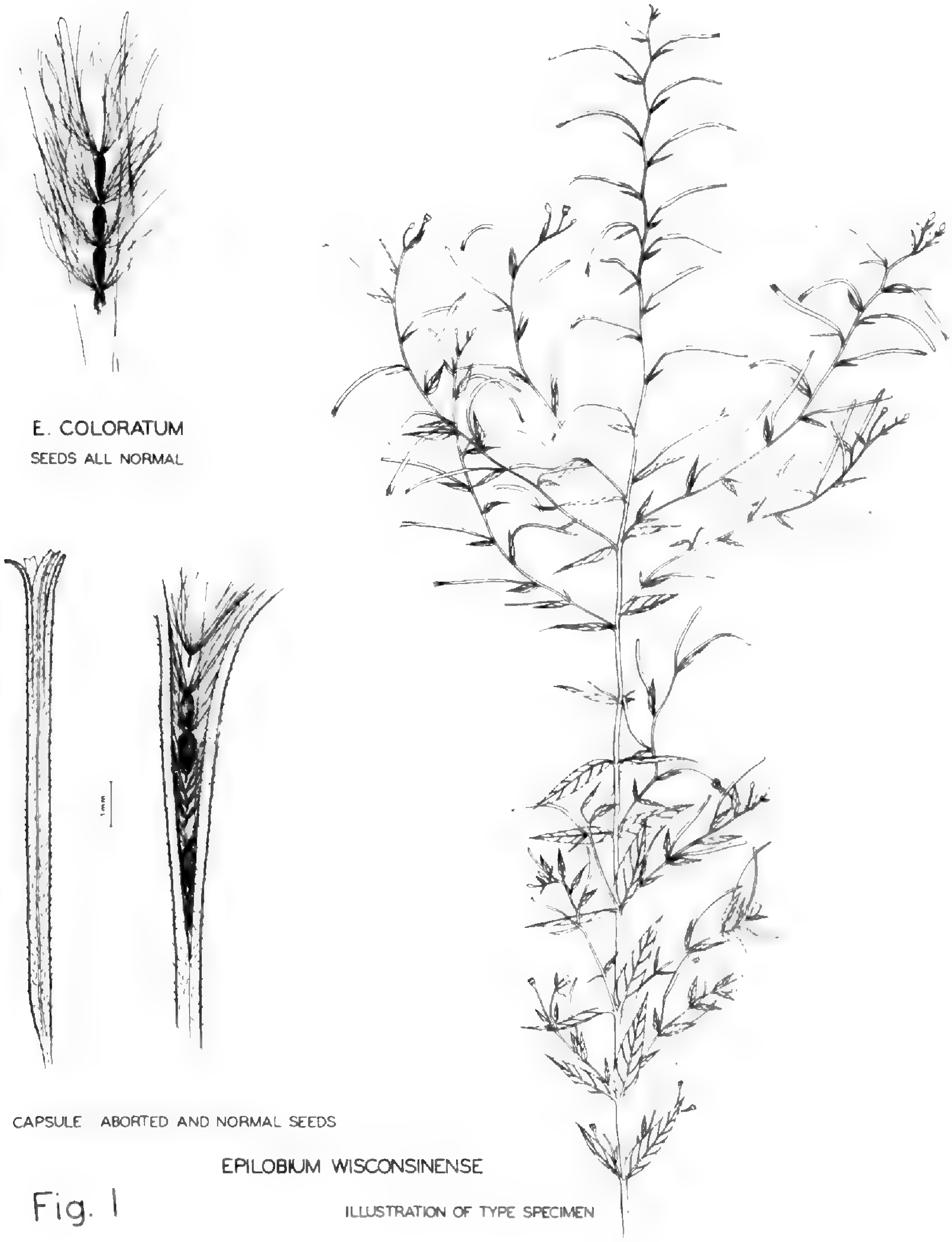


Fig. 1

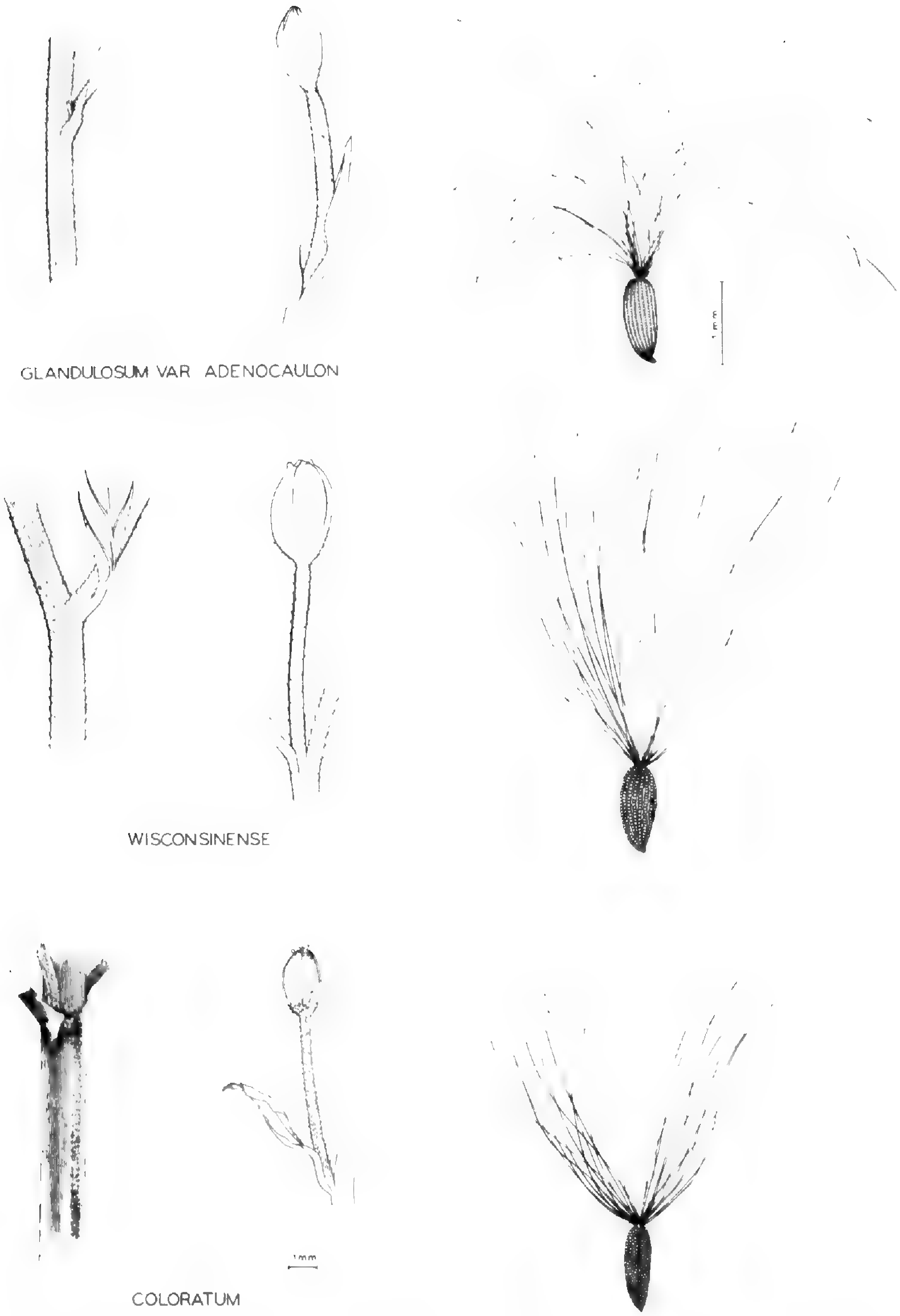


Fig. 2 STEMS, BUDS, AND SEEDS OF SOME WISCONSIN EPILOBIUMS

and irregularly serrulate leaves, the bushy-branched inflorescence (with the lower branches longer and less crowded than usual), the papillose nature of the seeds, and in the brown or tawny hairs of the coma. The pubescence of the stem and the striate character of the seeds are features definitely associated with *Epilobium glandulosum* (Fig. 2). Unlike either parent, the hybrid has short capsules containing many aborted seeds (Fig. 1). The shortness and slenderness of the hybrid capsules are no doubt due to the abnormally high amount of seed abortion, which on different plants may vary from 28% to 96% (Fig. 3).

SPECIMEN	CAPSULE	NUMBER OF SEEDS		% ABORTION
		ABORTED	MATURE	
Hale sine loc.	1	49	10	85
	2	83	14	
	3	55	7	
Bachman & Patrick Dunn Co.	1	110	7	94
	2	84	5	
	3	98	6	
Burger Jefferson Co.	1	18	35	27
	2	20	45	
	3	16	60	
Johnson Polk Co.	1	74	4	94
Benner Polk Co.	1	92	4	95
	TOTAL	719	197	78

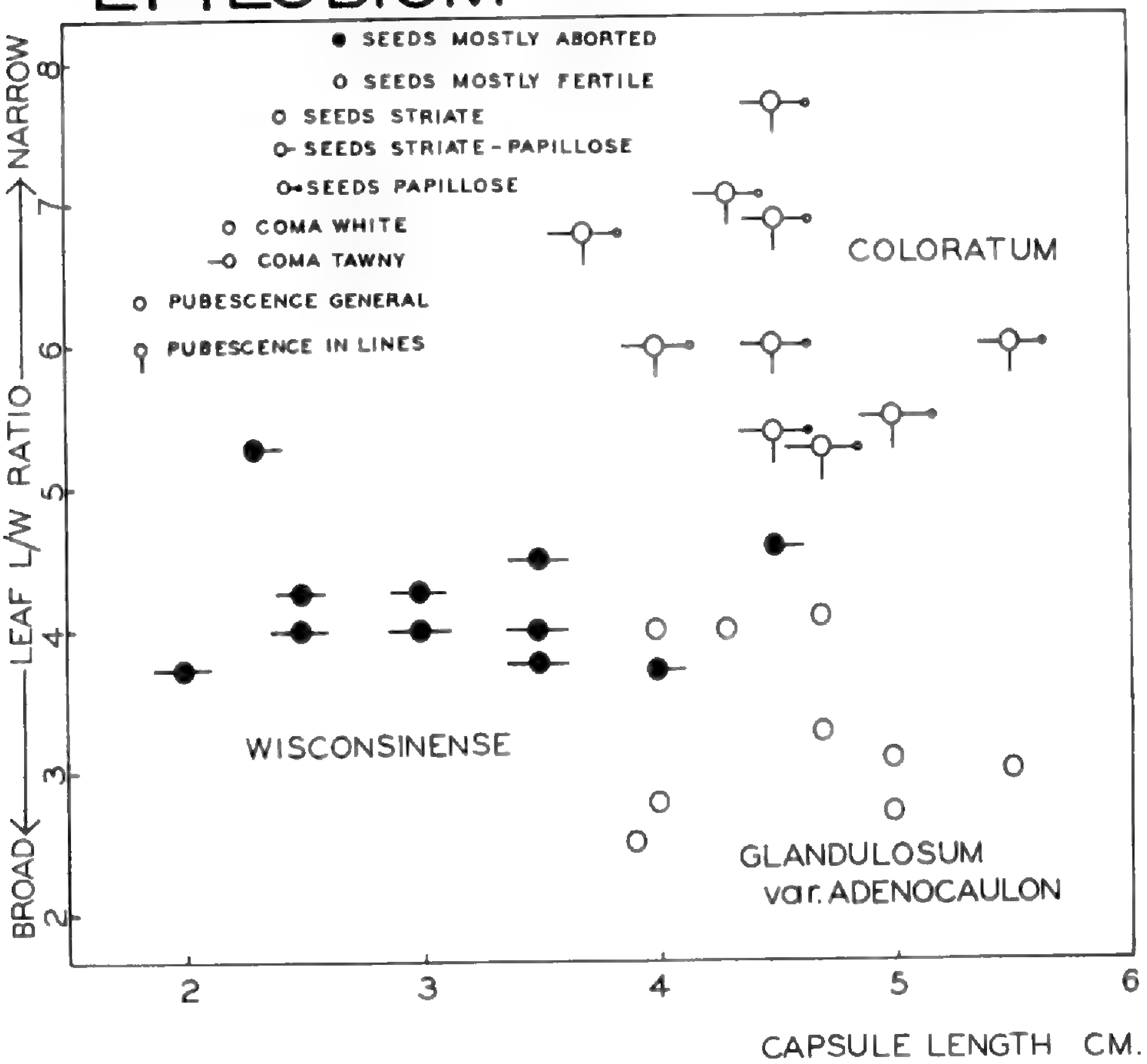
FIGURE 3. Seed abortion in *Epilobium* × *wisconsinense*.

The scatter-diagram (fig. 4), illustrates the intermediate shape of the hybrid leaf, as well as the unique short length of its capsules.

Epilobium glandulosum var. *adenocaulon* is frequently associated with *E. coloratum*, and not uncommonly plants of both taxa have been collected together and mounted on the same herbarium sheet. When comparing the phenology of these plants, one can observe that when *Epilobium coloratum* is in flower, *E. glandulosum* var. *adenocaulon* is generally in fruit, var. *adenocaulon* flowering about two and one half weeks earlier (fig. 5). This seasonal isolation may be important in keeping these taxa relatively distinct.

It should be noted that our hybrids occur in an area where the ranges of both parent species overlap. *Epilobium glandu-*

EPILOBIUM FIG. 4



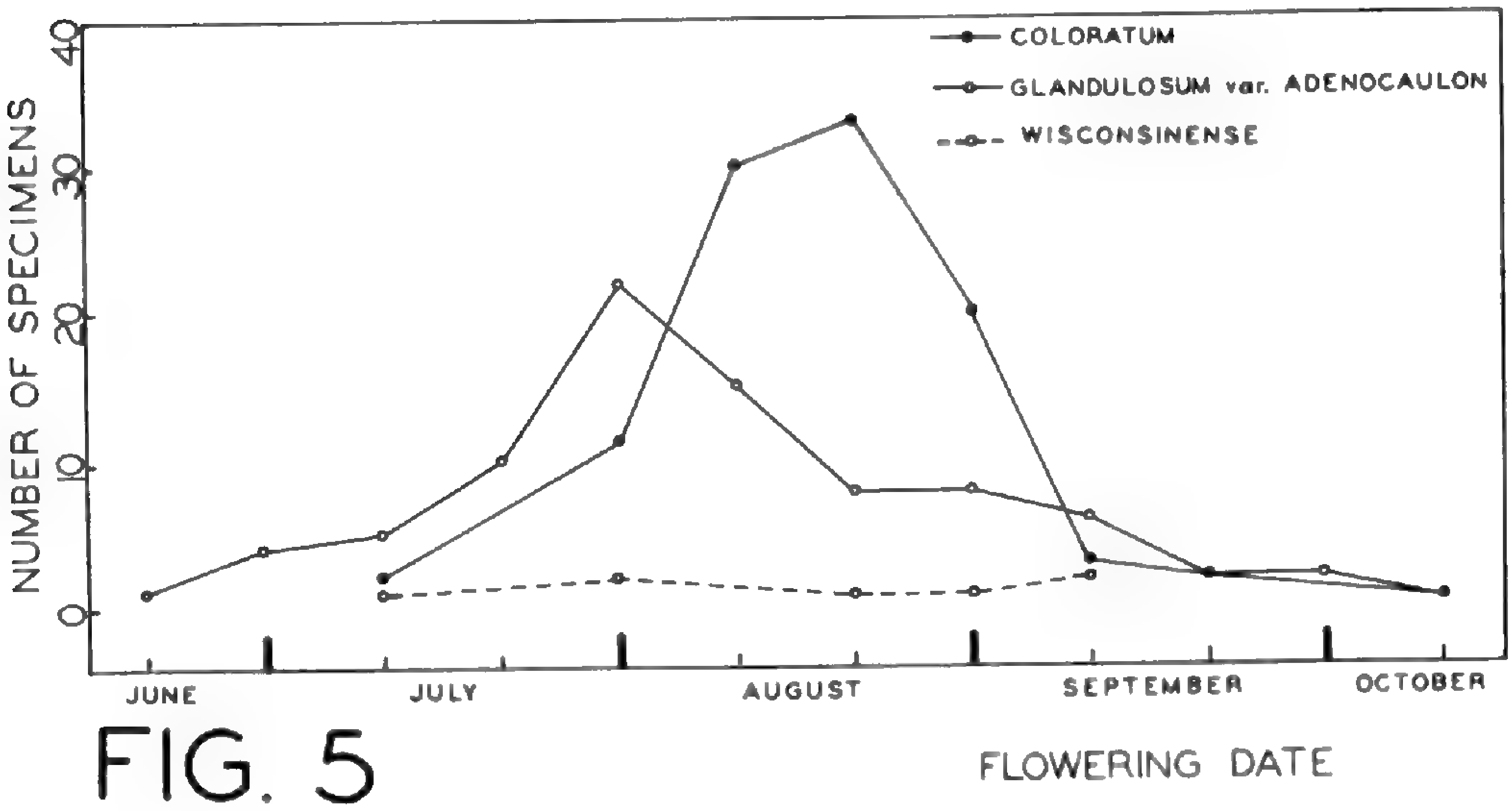


FIG. 5

losum var. *adenocaulon* has a wide northern distribution, ranging from Alaska to Newfoundland, south to Delaware, *northern Illinois,* and, at higher elevations along the Rocky Mountains, to Colorado. *Epilobium coloratum,* a species with eastern and southeastern affinities, extends from Georgia to Kansas north to Minnesota, and across *northern Wisconsin* to southern Quebec (Fernald, 1950; Gleason, 1952).

Epilobium coloratum and *E. glandulosum* var. *adenocaulon* are both known to hybridize with other species. The following hybrids are reported in *Index Kewensis* and the Gray Herbarium Card Index: *Epilobium coloratum* × *Epilobium lineare* Muhl., *Epilobium coloratum* × *Epilobium commutatum* Haussk., and *Epilobium adenocaulon* Haussk., × *Epilobium canadense* Levl.

SPECIMENS EXAMINED. WISCONSIN: *sine loc.* [ca. 1860?] *Hale s. n.* (WIS). Dunn. Co.: railroad tracks, Menomonie, *Bachman & Patrick 7-10* (WIS). Grant Co.: Potosi, *Davis s. n.* (WIS); along streams, Boscobel, *Sylvester 13590* (MIL). Jefferson Co.: disturbed sedge-goldenrod peat marsh, Town of Sullivan, sect. 13, *Burger 152* (WIS). Lafayette Co.: Fayette, *Cheney s. n.* (WIS). Polk Co.: St. Croix Falls, *Baird s. n.* (WIS); river bank, 8 mi. north of St. Croix Falls, *Benner 363* (MINN); edge of road in wet swamp, not common, West Sweden tp. sec. 36, *Johnson s. n.* (WIS). Walworth Co.: spring-saturated sedge meadow, Delavan, *Wadmond 17439* (MINN, WIS).

I wish to thank Albert M. Fuller and Emil P. Kruschke, Milwaukee Public Museum (MIL), Thomas Morley, University of Minnesota (MINN), and Peter J. Salamun, University of Wisconsin-Milwaukee, for the loan of specimens; Mrs. Janice Paynter for her excellent drawings; the Wisconsin Alumni Research Foundation and the J. J. Davis Fund for financial support; and especially Hugh H. Iltis for his advice and assistance.

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HERBARIUM, DEPARTMENT OF BOTANY
UNIVERSITY OF WISCONSIN

THE IDENTITY OF BUMELIA LACUUM SMALL[1]

OLGA LAKELA

The author's interest in the genus resulted from collecting and identifying representative floristic components in the white sand formation of central Florida. *Bumelia* was commonly encountered in the scrub association of *Persea humilis, Garberia heterophylla, Sabal Etonia, Quercus Chapmanii* and other scrub species with the overhead of *Pinus clausa* and *Ceratiola ericoides.*

B. lacuum was described by Dr. Small from the white sands of Highlands County.[2] In studies of North American species of Sapotaceae, Dr. A. Cronquist regarded the taxon conspecific with *B. tenax* (L.) Willd.,[3] described from South Carolina. It was discovered there by Dr. Alexander Garden who dispatched specimens to Linnaeus.

Despite limited knowledge of the genus, the author feels justified, as a result of her observations, placing on record certain characters of the two species. Pubescence has been found to be a reliable character in separating specific lines, (Wood & Channel).[4] Individual hairs have a central attachment, T-beam fashion. When the hairs are thinly acicular, straight and sericeous, the indumentum is appressed with a few diverging ends, as in the leaves of *B. tenax.* The dense, pannose indumentum of *B. lacuum,* mostly obscuring the lateral veins and the apical area of the midrib, at least when young, is due to long, sinuous implexed hairs with a tendency to curl. The overall pubescence in *B. lacuum* seems slightly coarser and less sericeous than that of *B. tenax.*

In contrast to the pubescence, the pedicel-length has been

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[1] Contribution No. 3. Botanical Laboratories of University of South Florida.

The author is grateful for the loan of specimens from the University of Georgia Herbarium.

[2] SMALL, J. K. Man. S. E. Fl. 1034. 1933.

[3] CRONQUIST, A. Studies in the Sapotaceae III. Jour. Arnold Arb. **26:** 453-471. 1945.

[4] WOOD, C. E. and R. B. CHANNEL. The Genera of the Ebenales in the Southeastern United States. Jour. Arnold Arb. **41:** 1-10. 1960.

found to be highly variable and unreliable (Wood & Channel, *Op. Cit.*). In the given species the variations in the length of the pedicels are consistent in comparable stages of development. Seemingly short and thick, they are 2-5 mm. long

Bumelia lacuum Small. a. Surface of sand Josephine Creek, Highlands County, Florida. Plate 1288 in *B. lacuum,* when the corolla begins to show between the spreading sepals. *(Lakela, 25096 & 25120).* When mature, they are 8-9 mm. long with fruits 9-12 mm. in length. The pedicels of *B. tenax* are slenderly clavate, 8-11 mm. long. (*A. H. Curtiss, 5678* U. GA.). A part of this collection is a short twig in winter condition with two pedicels, 12 mm. long with calyces denuded of fruit. Mature fruit has not been available for study.

In flowers of the two species there is a difference in the texture of the corolla tube. In *B. lacuum* it is membranaceous, semi-opaque, obscuring the finer vascular traces. The median lobe in the fully expanded corolla is clawed; flanking the claw on each side, the crescentic margins of the lateral lobes affect a small opening. The margins of all the lobes are more or less denticulate and narrowly translucent. Thin texture and broad translucent margins of corolla lobes are characteristic of the flowers of *B. tenax.* The terminal lobe is sessile. In support of this observation made on a limited amount of material reference is made to Sargent, *Silva of North America,* Tab. CCXLVI, illustrating the *B. tenax* flower.[5]

Dr. Clark segregated *B. lacuum* from *B. tenax* on the basis of shrubby versus tree-like habit.[6] Suffice it to state that the shrub is stoloniferous. The photograph shows five young plants with stolons radiating from the underground base of the parent shrub. (*James D. Ray, Jr.* and *O. Lakela, 11054,* 25 June, 1962. White sand scrub, Josephine Cr., east of US 27, Highlands Co., Florida).

The colonial habit of *B. lacuum* was not observed in a plant of *B. tenax,* 2.5 m. high, in coastal sands of northern St. Lucie County. The large plant had a single stem and young plants beneath its crown were proved to have originated from seeds.

These observations seem to validate the specific status of *B. lacuum.*

UNIVERSITY OF SOUTH FLORIDA, TAMPA

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[5] SARGENT, C. S. Silva 5: 167. 1893.

[6] CLARK, ROBERT B. A Revision of the Genus *Bumelia* in the United States. Ann. Missouri Bot. Gard. **29:** 155-182. 1942.

JOHN LYON, NURSERYMAN AND PLANT HUNTER[1]

Not a little of the pleasure that most botanists and horticulturists feel for their work derives from the richness of human association with plants. That a certain kind of plant was used medicinally 150 years ago, for example, surrounds it with an added interest.

Here is an account of the travels, business transactions, lists of plants collected and botanical and horticultural contributions of the Scotchman John Lyon during the years 1799-1814 in eastern United States.

It was Lyon presumably for whom the ericaceous genus *Lyonia* was named.

More than 50 species were introduced or re-introduced by Lyon into the nursery trade. *Pieris floribunda, Rhododendron calendulaceum, Nyssa sylvatica* and *Iris fulva,* to name but a few were initial introductions by him.

The relations of Lyon to Pursh, Nuttall and other botanists of his time are amply documented and it becomes evident that Lyon was hardly less influential in the field of botany than in horticulture.

Following an introduction and discussion under several headings the main body of the work, as might be expected from the full title, is devoted to the presentation of Lyon's journal. For several of the years there are day by day reports covering months of activity. These might become tedious except that they contain frequent information of historical interest. Often too they are relieved by footnotes of a most informative kind that, for this reviewer at least, greatly enhanced the account.

A map showing Lyon's journeys is included and a reproduction for the first time of his printed plant sales catalogue of 1812. Several indexes permit easy use as a reference work. The book is attractively bound in heavy paper.

ALBION R. HODGDON, UNIVERSITY OF NEW HAMPSHIRE.

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[1] John Lyon, Nurseryman and Plant Hunter and his Journal, 1799-1814 by Joseph and Nesta Ewan. pp. 1-69, 2 figs., 3 maps, Trans. Am. Philos. Soc. vol. 53. pt. 2, Philadelphia, 1963. $2.00.

NEW RECORDS OF GRASSES FROM THE CHICAGO REGION AND LOWER MICHIGAN

S. F. GLASSMAN

All specimens cited in this article are deposited in the herbarium of the University of Illinois, Navy Pier (CHI).

Stipa comata Trin. & Rupr. Cook (Illinois): Morton Grove, along Milwaukee R. R., loamy soil, June 21, 1961, *Glassman 5607*. Not previously recorded from any of the counties in the Chicago region. Apparently, the only other station in Illinois is Winnebago Co. (Fuller, Fell & Fell, 1949), in the northwestern part of the state. Deam (1940) listed it from only one locality in northeastern Indiana; Fassett (1951) cited it from southern Wisconsin; and Chase (1951) mentioned it for Michigan. *Stipa comata* resembles *S. spartea* Trin., common in all seven counties of the Chicago region, but can easily be distinguished from that taxon by the shorter culms, narrower leaf blades, and shorter glumes, lemmas, calluses and awns.

Elymus arenarius L. Berrien (Michigan): 1/4 mile south of Concession building, Weko Beach, Bridgeman, on fore dune, scattered clumps, associated with *Ammophila breviligulata* Fernald, Aug. 13, 1961, *A. S. Rouffa 5665*. In the Great Lakes region, this species is otherwise known only from Illinois, between Wilmette and Waukegan (Steyermark & Swink, 1952), and from one locality in Wisconsin (Iltis, Reed & Melchert, 1960). *Elymus mollis* Trin., a closely related species, is found along Lake Superior in Upper Michigan (Bowden, 1957); but, apparently this is the first record of *E. arenarius* for the state of Michigan. There are no specimens of this taxon for Michigan in the University of Michigan herbarium, and Dr. E. G. Voss, curator of vascular plants, knows of no authentic records for the state.

UNIVERSITY OF ILLINOIS, NAVY PIER

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NOTES ON GREAT WASS ISLAND, MAINE. — Great Wass Island projects well out to sea south of Jonesport in Washington County. In company with Ralph Burns of Bailey's Mistake, Lubec, we set out on July 24, 1963, to follow a trail leading toward the seaward end of the island. In an open area near the island's center were several features of interest. An attractive open bog, had the usual bog-plants but expanses of granitic ledge nearby, largely devoid of vegetation, supported scattered trees of *Pinus Banksiana* Lamb. and on closer examination disclosed small patches of *Hypericum gentianoides* (L.) BSP. The pine had already been reported from Great Wass Island but some features of its manner of reproduction deserve comment. Most of the trees seen were bearing cones, the majority of which were opening soon after ripening. No evidences of fire in recent decades were evident yet numerous seedlings and young pines from 2-7 years of age were observed growing in cracks and in shallow soil at the edges of the ledges. It would appear that fire is not necessary in this area to open the cones of Jack-Pine although it seems to be the belief of most persons who know the species that the cones remain closed until subjected to fire. The *Hypericum* here is at least 25 miles northeast of its previously reported northeastern limit in Hancock County, Maine. Specimens of our collections are to be found in the Herbarium of the University of New Hampshire. RADCLIFFE B. PIKE and A. R. HODGDON, UNIVERSITY OF NEW HAMPSHIRE.

NOTE ON PRIMULA LAURENTIANA IN MAINE

In 1906 Joseph A. Cushman accompanied by S. N. F. Sanford visited Libby Island, Machiasport, Washington County, Maine, and reported the occurrence of *Primula laurentiana* (Rhodora 9: 217, 1907). He noted that this *Primula* was only to be found around the light and the nearby oil-house. He suggested that seeds of this plant were probably introduced here by birds being killed by flying into the light and falling at its base which is, of course, a regular occurrance. He also remarked that the soil near the buildings had been disturbed by grading.

A visit by the author to this same island in 1962 showed *Primula laurentiana* to be still present in the neatly mowed turf around the base of the light. It gave the appearance of a lawn weed so thickly did the rosettes of leaves dot the ground. From certain angles the intensely white undersides of the farinose leaves gave a most unusual appearance to the light-keepers lawn. The plants were abundant within ten or 15 feet of the base of the light tower and completely absent further away. Several hours careful search of the rest of the island failed to reveal a single plant growing in any other location. There were several spots of disturbed soil such as flower beds, paths and grading about buildings in addition to a considerable space maintained as lawn. In any of these areas this aggressive primrose could conceivably have established itself. An examination of rock-crevices and niches in cliff-faces where one would normally expect to find this plant failed to show any. The soil on the island was uniform being a deep layer of humus typical of Maine coast islands. The vegetational cover was largely of ericaceous and other acid soil plants including: *Empetrum nigrum*, *Vaccinium vitis-idaea*, *Ledum groenlandicum*, and *Rubus Chamaemorus*. *Sedum Rosea*, *Iris Hookeri* and *Campanula rotundifolia* were also present.

The vigorous growth of *Primula laurentiana*, a well-known calciphile under such circumstances and in such a restricted area, can possibly be explained by the whitewash which is applied to the granite tower of the light semiannually. Small flakes of the whitewash could be seen on the surface of the ground near the light, the chalky surface of the tower being continually eroded by wind and rain and largely deposited on the surrounding soil. As whitewash is almost entirely lime this would serve to make calcium available in the immediate vicinity of the light and thus provide an essential element for the growth and continued survival of *Primula laurentiana.*

The use of ordinary paints, which have no calcium in their pigments, on the other buildings on the island probably explains why the plant does not grow near these other structures.

Cushman postulated that other outlying islands and headlands along the Maine coast may have had seeds of *Primula laurentiana* introduced by migrating birds similar to the situation on Libby Island. He found the plant near the Moose Peak Light House on Mistake Island and on Black Head on Head Harbor Island. It has also been found on Crumple Island still further west and on Schoodic Point in Acadia National Park.

A visit to Moose Peak Light on Mistake Island, in September of this year showed *P. laurentiana* to be present in great vigor in rock crevices under and beside the elevated walkway which leads from the keeper's living quarters to the light itself some hundred yards away. The guard rails on this walk-way have been whitewashed and again this is a possible explanation of the long continued presence of this plant. Along with the primrose *Lomatogonium rotatum* was also growing — a great rarity on the Maine coast.

Black Head on nearby Head Harbor Island has changed a great deal since Cushman's visit more than a half century ago. According to Mr. Thurman Alley who was born and brought up on the island the growth of trees has changed Black Head so that he can now hardly find his way. This may account for the fact that the author was unable to find any Primulas. However, the quantities of broken shells of crabs, sea urchins, clams and mussels all over the cliffs indicates that there would be a source of calcium for *Primula laurentiana* when other conditions are right.

It is interesting to think that the continued presence of the rare *Primula laurentiana* in at least two places on the Maine coast may be due to the whim of the U. S. Coast Guard as to the kind of paint it uses.

RADCLIFFE B. PIKE, UNIVERSITY OF NEW HAMPSHIRE

Volume 65, No. 763 including pages 193-288, was issued September 30, 1963.

Rhodora

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Rhodora

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NEW ENGLAND BOTANICAL CLUB

Vol. 65 October-December, 1963 No. 764

CONTRIBUTION TO THE FUNGUS FLORA OF NORTHEASTERN NORTH AMERICA. III[1]

HOWARD E. BIGELOW AND MARGARET E. BARR[2]

Many of the fungi reported in this contribution were collected during the 1962 field season in Baxter State Park, Maine, or in adjacent areas of Piscataquis and Penobscot counties. This large wilderness region abounds in resources for the scientist as well as for the sportsman and vacationer. A variety of habitats exists over extremes of elevation in the Katahdin Range and these provided interesting additions to our earlier studies in Maine. We are grateful to Mr. Austin H. Wilkins, Forest Commissioner, for the privilege of studying the fungi of this valuable preserve, and to Mr. Helon Taylor, Supervisor of Baxter Park, for his kind assistance during our work.

Also included are notes on species and collections from elsewhere in the northeast. Some of the records extend the known range of several taxa, while other data provide a better understanding of species described by Peck as well as Ellis and Everhart. The senior author is responsible for the investigations on agarics, and the junior author for those on pyrenomycetes. The colors noted in the descriptions of agarics are from Ridgway, R. 1912. Color standards and color nomenclature. Washington, D. C.

We acknowledge with appreciation the support of Na-

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[1] I. Rhodora **62**: 186-198. 1960. II. Rhodora **64**: 126-137. 1962. Contribution from the Department of Botany, University of Massachusetts, Amherst.

[2] Mrs. Howard E. Bigelow.

tional Science Foundation Grant G 19534. Dr. Clark Rogerson, Curator of the Cryptogamic Herbarium, New York Botanical Garden and Stanley J. Smith, Senior Curator of Botany, New York State Museum kindly have extended the opportunity to study the type material of Peck and Ellis and Everhart.

BASIDIOMYCETES

Clitocybe eccentrica Peck, Bull. Torrey Club 25: 321. 1898. Plate 1289.

Pileus 1-6 cm. broad, plano-depressed at first, soon expanding to infundibuliform, margin thin and narrowly inrolled, even, arched, often wavy and lobed in age, surface sometimes with thin canescent coating at first but soon glabrous, hygrophanous and moist, whitish to pale watery buff at first ("tilleul buff", "avellaneous"), darker in age (nearly "wood brown", "tawny olive"), white or sordid white when faded; flesh thin and cartilaginous, concolorous with the pileus, odor fragrant at times or absent, taste bitter or absent.

Lamellae decurrent, crowded, narrow, thin, forked, not intervenose, whitish to pale cream, edges even and straight.

Stipe 3-5 cm. long, 2-7 mm. thick at apex, equal or nearly so, base densely white strigose and with numerous rhizomorphs, glabrous or appressed-fibrillose above, compressed at times, often eccentric, soon hollow, pliant, concolorous with pileus or lamellae.

Spores 4.5-6 × 2.5-3.5 μ, elliptical to pyriform in face view, sublacrymoid in side view, smooth, not amyloid, white or faintly cream tinged in mass; basidia 14.5-21 × 4-5 μ, 4-spored; cystidia not differentiated; pileus tissue: homogeneous, hyphae mostly cylindrical, 2-8.5 μ in diameter, clamp connections present; gill trama interwoven, hyphae mostly cylindrical, 2-7 μ in diameter.

Usually cespitose, sometimes gregarious. On hardwood logs.

Material examined: *Bigelow 3900*, Madawaska Lake, Aroostook Co., **Maine**, August 10, 1956; *10342*, Abol Field, near Baxter State Park, Piscataquis Co., July 18, 1962; *10766*, Ragged Mt., Penobscot Co., August 5, 1962; *10849*, near Norcross, Penobscot Co., August 8, 1962; *10995*, Abol Field, August 14, 1962; *11111, 11112,* near Norcross, August 18, 1962; *11260*, Cedar Lake, Penobscot Co., August 24, 1962; *7185*, Mt. Toby, Sunderland, **Massachusetts**, July 28, 1958; *7647*, Mt. Toby, August 30, 1958; *8969*, Conway State Forest, Conway, August 1, 1960; *9044*, Conway State Forest, August 9, 1960; *E. A. Burt*, S. Dunmore, **Vermont** (type of *Clitocybe eccentrica*).

Clitocybe leptoloma (Peck) Peck, N. Y. State Mus. Bull. 157: 68. 1912. Plate 1290.

Agaricus leptolomus Peck, N. Y. State Mus. Rep. 32: 26. 1879.
Clitocybe subbulbipes Murrill, N. Am. Fl. 9: 404. 1916.

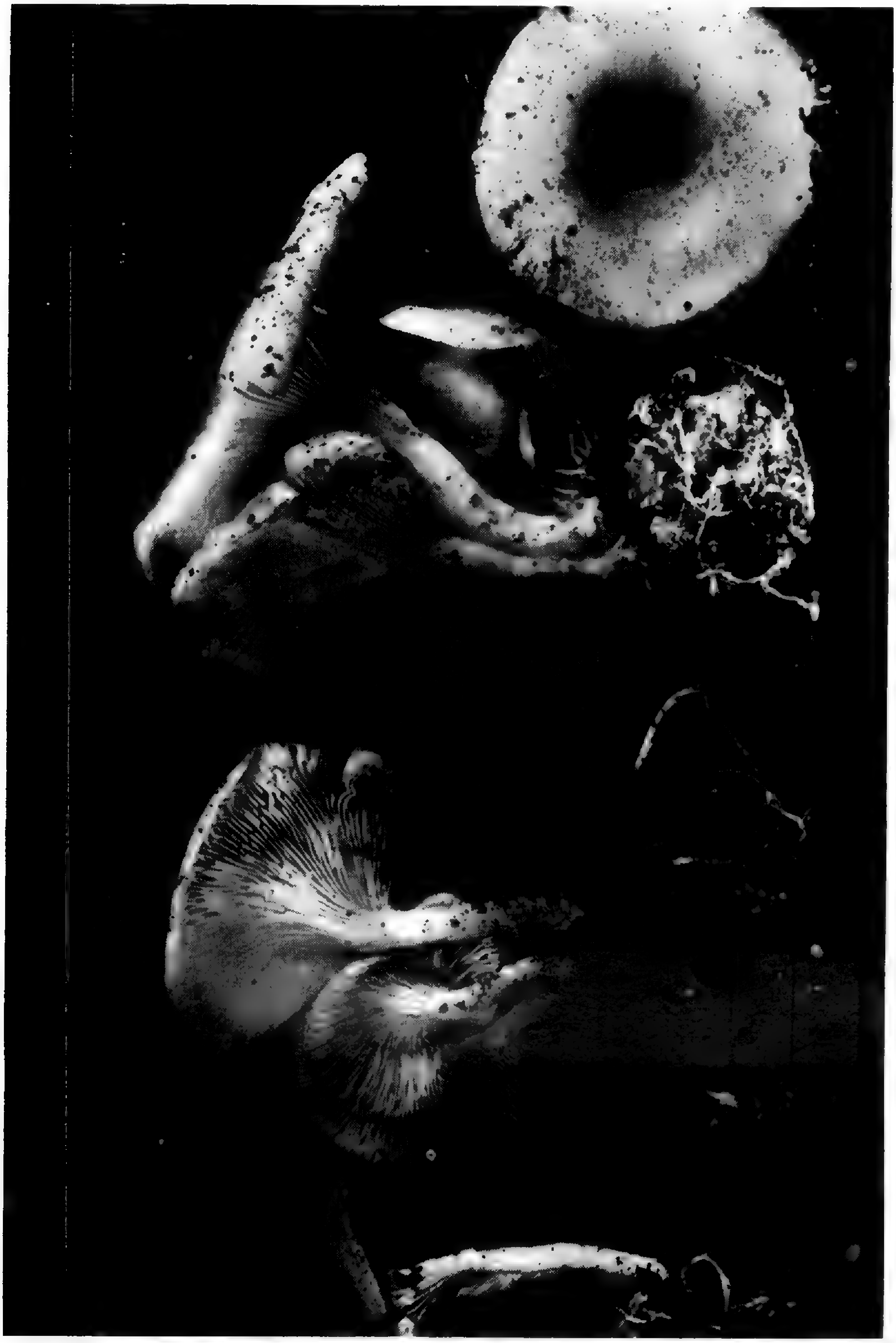


Plate 1289

Clitocybe eccentrica Peck. × 1

Clitocybe leptoloma (Peck) Peck. × 1   Plate 1290

Pileus 1-6 cm. broad, broadly convex at first, soon expanding to plane with disc usually shallowly depressed, margin narrowly inrolled and edge slightly white canescent, finally becoming infundibuliform, margin often arched and undulate, at times repand or sinuate, occasionally faintly pellucid-striate, thin, surface glabrous, hygrophanous, watery buff moist ("warm buff", "pinkish buff", "cinnamon buff", "pinkish cinnamon"), paler in age but disc often remaining dark and tinged with pink, fading to whitish or pale buff ("pale pinkish buff"), disc remaining moist and colored for some time after margin faded; flesh thin, watery and concolorous with moist pileus, whitish when faded, odor and taste not distinctive.

Lamellae adnate to short decurrent at first, becoming moderately to long decurrent, narrow (1-4 mm.), close or sometimes crowded, occasionally forked, intervenose at times, whitish to pale yellowish or pale buff ("cartridge buff", "light buff", "pale pinkish buff", "pale pinkish cinnamon"), not fading with pileus, edges usually straight and even.

Stipe (1-)2-5.5(-7) cm. long, (1-)2-5(-10) mm. thick at apex, equal or either end enlarged, base usually with watery buff tomentum, a few white rhizomorphs present, often curved, compressed at times, stuffed becoming hollow, glabrous or fibrillose-striate, ground color watery buff ("pale pinkish buff", "pinkish buff", "cinnamon buff").

Spores 4-5.5(-6.5) × 2.5-3.5(-4.5) μ, broadly elliptical to elliptical, smooth, not amyloid, pinkish tinted ("pale pinkish buff") in heavy deposit; basidia 16.5-25(-28) × 4-6(-6.5) μ, usually 4-spored, at times also 2-spored; cystidia not differentiated; pileus tissue: cuticular hyphae cylindrical, 1.5-4(-7) μ in diameter, tramal hyphae cylindrical to inflated, 3-10(-18) μ in diameter, clamp connections present; gill trama regular, hyphae cylindrical, 2-6.5(-14) μ in diameter.

Solitary, scattered, gregarious, or subcespitose. On or near hardwood logs, or attached to buried hardwood debris.

Material examined: *Bigelow 4326*, Guerette, Aroostook Co., **Maine**, August 24, 1956; *10407*, near Norcross, Penobscot Co., July 22, 1962; *10565*, near Millinocket, July 27, 1962; *11000*, Abol Field, near Baxter State Park, Piscataquis Co., August 14, 1962; *11047*, Medway, Penobscot Co., August 15, 1962; *11141*, near Norcross, August 18, 1962; *11154*, Katahdin Lake Trail, Baxter State Park, August 20, 1962; *11192*, Trout Mt., Piscataquis Co., August 22, 1962; *11428*, Bear Brook, Piscataquis Co., August 31, 1962; *7186*, *7187*, *7189*, Mt. Toby, Sunderland, **Massachusetts**, July 28, 1958; *7413*, *7414*, Amherst, August 9, 1958; *8159*, Hawley, Franklin Co., July 16, 1959; *8182*, *8183*, Mt. Toby, July 18, 1959; *9678*, Alum Pond, Fiskdale, Worcester Co., August 2, 1961; *9702*, Conway, Franklin Co., August 7, 1961; *C. H. Peck*, Indian Lake, **New York** (type of *Agaricus leptolomus*); *W. A. & E. L. Murrill 199*, Lake Placid, July 17-19, 1912 (type of *Clitocybe subbulbipes*); *Bigelow 5625*, *5632*, *5633*, *5640*, Lac Munroe, Mt. Trem-

Clitocybe truncicola (Peck) Saccardo. × 2 Plate 1291 blant Park, **Quebec**, July 23, 1957; *5768, 5786*, Lac Munroe, July 25, 1957; *5910, 5911, 5912*, Lac Munroe, July 27, 1957; *5978 - 5984*, Lac Munroe, July 28, 1957; *9734, 9735*, Newfane - Wardsboro, **Vermont**, August 26, 1961.

Clitocybe truncicola (Peck) Saccardo, Syll. Fung. 5: 184. 1887. Plate 1291.

Agaricus truncicola Peck, Buffalo Soc. Nat. Sci. Bull. 1: 46. 1873.

Pileus 1-3.5(-5.5) cm. broad, broadly convex with margin inrolled and slightly incurved at first, becoming plane, margin remaining narrowly inrolled, even, broadly depressed in age and margin wavy, surface heavily canescent appearing finely matted-fibrillose in places under a lens, white, sometimes faintly watery-yellowish about disc in wet weather, canescence appressed in age then faintly buff overall, rarely rivulose; flesh white, thin, firm, no distinct odor and taste.

Lamellae adnate to short decurrent, close to crowded, narrow (up to 3 mm., rarely 5 mm. broad), not forked or intervenose, whitish ("cartridge buff"), edges even.

Stipe 1-3(-4) cm. long, 1.5-5(-15) mm. thick at apex, equal or base slightly enlarged, rhizomorphs few or absent, basal mycelium sparse, apex slightly pruinose at times, innately-fibrillose below, stuffed (interior white), often curved, eccentric at times, terete, white, finally pale buff in age ("cream buff", "pale pinkish buff").

Spores 3.5-4.5(-5) × 2.5-3.5(-4) μ, subglobose to broadly elliptical or elliptical, smooth, not amyloid, white in mass; basidia 12-23(-26) × 3.5-5(-6) μ, 4-spored; cystidia not differentiated; pileus tissue: cuticular hyphae cylindrical, 2-4(-5) μ in diameter, tramal hyphae usually cylindrical, 2-10 μ in diameter, clamp connections present; gill trama regular, hyphae cylindrical, 2.5-6 μ in diameter.

Scattered or gregarious, rarely solitary or subcespitose. On hardwood logs and stumps.

Material examined: *Bigelow 4082*, Madawaska Lake, Aroostook Co., **Maine**, August 17, 1956; *4120*, Madawaska Lake, August 18, 1956; *10637*, near Norcross, Penobscot Co., July 30, 1962; *10705*, Abol Field, near Baxter State Park, Piscataquis Co., August 2, 1962; *10998*, Abol Field, August 14, 1962; *11227*, Abol Field, August 23, 1962; *11364*, near Norcross, August 29, 1962; *11427*, Bear Brook, Piscataquis Co., August 31, 1962; *11539*, Katahdin Lake Trail, Baxter State Park, September 6, 1962; *C. H. Peck*, Croghan, **New York**, September (type of *Agaricus truncicola*).

The three preceding Clitocybes of section *Candicantes* fruited abundantly during 1962 and provided several opportunities for a close comparison of fresh carpophores. Although very similar in microscopic features these species are quite distinct when gross features are compared. *C.*

eccentrica generally grows in cespitose fashion on logs and is distinctive from the other two lignicolous species by long strigose hairs at base of stipe and a conspicuously depressed cap. *C. leptoloma* is separated by the pinkish to buff cap when moist (recalling *C. diatreta*) and pinkish-buff spores in *heavy* deposit. Typically, *C. truncicola* is heavily canescent. Although fully expanded or old specimens may lose this coating, especially if water-soaked, the white spore deposit always will separate *C. truncicola* from *C. leptoloma*. Faded specimens of the two species are virtually impossible to distinguish if a spore deposit is lacking.

Hygrophorus chrysodon (Fr.) Fries, Epicr. Myc. p. 320. 1838.

Material examined: *Bigelow 11577*, Conway, **Massachusetts**, October 20, 1962; *11585*, Conway State Forest, Conway, October 21, 1962.

Hygrophorus fuligineus Frost *apud* Peck, N. Y. State Mus. Rep. 35: 134. 1884.

Material examined: *Bigelow 10027*, Women's Club State Forest, New Salem, **Massachusetts**, November 7, 1961; *11586*, Harvard Forest, Petersham, November 3, 1962.

Marasmius strictipes (Peck) Singer, Lilloa **22**: 326. 1951.

Collybia strictipes Peck, N. Y. State Mus. Rep. 41: 62. 1888.

Gymnopus strictipes (Peck) Murrill, N. Am. Fl. 9: 357. 1916.

Pileus 2-6.5 cm. broad, convex at first with the margin narrowly incurved and inrolled, not striate, expanding to broadly convex, plane in age, disc often rugulose, subumbonate at times, glabrous, moist, disc with irregular rusty-orange stains ("orange rufous", "ochraceous orange", "mars orange"), margin watery buff ("warm buff" to "ochraceous buff"); flesh thin, watery pallid, odor and taste rather disagreeable.

Lamellae adnexed to adnate, seceding at times, close or crowded, narrow (1-4 mm.), occasionally forked, whitish ("pale pinkish buff"), edges crenate or eroded under a lens, slightly undulate.

Stipe 3-8.5 cm. long, 3-9 mm. thick at apex, equal or the base slightly enlarged, base white tomentose or strigose, central, hollow, cortex brittle, compressed at times in age, surface white pruinose at first, becoming appressed, whitish to very pale yellowish.

Spores 6-9(-10) × 3-4 μ, narrowly elliptical to subcylindrical, base attenuated and somewhat curved in side view, smooth, not amyloid, white in mass; basidia 23-33 × 5.5-7.5 μ, 2- and 4-spored; cheilocystidia present, 19-36 × 4-7.5 μ, more or less basidioid in shape, forked at times, 2-celled at times; pileus tissue: cuticle pale yellow to pale orange in KOH, pigment intracellular or in wall, cuticle consisting of pilocystidia, cellular, clavate to globose or obtuse, mostly pedicellate, sometimes irregular in shape, 14-28 μ in diameter, walls smooth, thin or somewhat thickened, trama dextrinoid in Melzer's reagent, hyphae cylindrical to inflated or irregular, 6-13 μ in diameter, clamp connections small and inconspicuous, lactifers present occasionally; gill trama regular to subparallel, dextrinoid, hyphae cylindrical to somewhat inflated, 3-12 μ in diameter.

Often solitary, sometimes gregarious or subcespitose. Usually beneath hardwoods, rarely conifers.

Material examined: *Bigelow 10376*, Katahdin Lake Trail, Baxter State Park, **Maine**, July 19, 1962; *10438*, near Abol Campground, Baxter State Park, July 23, 1962; *10540*, Foster Field, Baxter State Park, July 26, 1962; *10631*, Norcross, Penobscot Co., July 30, 1962; *11099*, Katahdin Stream Campground, Baxter State Park, August 17, 1962; *11411*, Katahdin Lake Trail, Baxter State Park, August 30, 1962; *7493*, Leverett, **Massachusetts**, August 14, 1958; *8145*, Hawley, Franklin Co., July 16, 1959; *8181*, Sunderland, July 18, 1959; *9784*, Conway, September 5, 1961; *C. H. Peck*, Catskill Mts., **New York**, September (type of *Collybia strictipes*); *Bigelow 9743*, Newfane, **Vermont**, August 26, 1961; *9817*, Whitingham, September 10, 1961.

This species belongs to section *Globulares* of *Marasmius* as Singer (1951) has indicated. Although the general aspect certainly seems typical of a *Collybia*, the nature of the pileus cuticle and the dextrinoid reaction of pileus and gill trama clearly indicate the proper position within *Marasmius*.

In New England, rarely have I found more than a single carpophore at a time, yet it is not an uncommon species under hardwoods during the summer. Field characters for easy recognition are the rusty-stained pileus with rugulose surface, and the straight, pale stipe.

The distribution of *M. strictipes* is unusual on present records. It is known with certainty to occur from Michigan to Maine in the northeast, and in Mexico from the work of Singer (1958).

Phaeocollybia christinae (Fr.) Heim, Encyc. Mycol. 1: 71. 1931.

Material examined: *Bigelow 6704*, North Sunderland, **Massachusetts**, July 7, 1958; *7154*, Mt. Toby, Sunderland, July 28, 1958.

Species in *Phaeocollybia* which have small spores and lack clamp connections on the hyphae of pileus are only two, *P. christinae* and *P. jennyae*. These are separated by differences in the taste of flesh, surface of pileus, and color of spores when revived in KOH. The Massachusetts specimens fit the interpretation of Smith (1957).

Phaeocollybia rufipes Bigelow, *sp. nov.* Plate 1292.

Pileus 1-4 cm. latitudine, conicus demum convexo-umbonatus, vis-

Phaecollybia rufipes Bigelow, *sp. nov.* × 1 Plate 1292 cidus, glaber, hygrophanus, ferruginus demum pallido-alutaceus; odor raphanaceus, sapor farinaceus; lamellae emarginatae, confertae, angustae vel latae, primum pallide alutaceae tum argillaceae; stipes 8-15 cm. longitudine, apice 3-5 mm. crassitudine, pallido-alutaceus dein argillaceus, glaber, deorsum attenuatus, radicatus, rufescens; sporae 7-8.5 × 4-5 μ; cheilocystidia filamenteo, 27-31 × 3-5 μ; hyphae defibulatae.

Typum legit *H. E. Bigelow*, n. *11478*, Katahdin Lake Trail, Baxter State Park, Maine, September 1, 1962; in Herb. Univ. Mass. conservatum.

Pileus 1-4 cm. broad, acutely conic or cuspidate at first with margin slightly incurved and narrowly inrolled, even, becoming convex with a large acute umbo, in age broadly convex to nearly plane, umbo remaining acute, margin becoming faintly striate, viscid, glabrous, hygrophanous, color brown (near "orange cinnamon") fading to buff (near "light ochraceous buff"); flesh thin, concolorous with pileus when moist, fading to whitish or pale buff, odor raphanoid, taste slowly farinaceous when crushed.

Lamellae emarginate, close, narrow to moderately broad (2-5 mm.), "pinkish buff" when young, becoming brown with spores ("cinnamon buff" to "clay color"), edges fimbriate, wavy or crenate in age.

Stipe 8-15 cm. long, radicate and tapering downward, apex 3-5 mm. thick, base deeply embedded in substrate, surface glabrous, cortex fibrous and easily splitting lengthwise, brittle, stuffed becoming hollow, apex "pinkish buff" or "apricot buff", darkening somewhat to "cinnamon buff", rufous (dark "brick red") downward, darkest toward the tapered end, not blackening.

Spores 7-8.5 × 4-5 μ, broadly fusoid in face view, inequilateral in side view, apical pore distinct, sometimes with slight knob at apex, wall thickened, with short and rather inconspicuous spines, yellowish-brown in KOH, spore deposit "snuff brown"; basidia 19-31 × 4.5-8 μ, 4-spored; cheilocystidia filamentous, 27-31 μ long, 3-5.5 μ in diameter, smooth, hyaline, often subcapitate at apex; pileus tissue: cuticular hyphae with gelatinizing walls, hyaline, 3-4.5 μ in diameter, subcuticular zone and trama brown in KOH, hyphae cylindrical to somewhat inflated, 4-12 μ in diameter, walls finely encrusted with pigment or sinuous-thickened, clamp connections absent, yellowish-brown laticiferous hyphae present; gill trama broad, subparallel, brown in KOH, hyphae cylindrical, 2.5-10 μ in diameter, laticiferous hyphae present.

Scattered to gregarious, under spruce and fir.

Material examined: *Bigelow 11478* (type), *11479*, Katahdin Lake Trail, Baxter State Park, **Maine**, September 1, 1962.

Numerous carpophores were found in each collection of this unusual agaric. They were deeply embedded in the needle beds and difficult to remove without breaking the stipes. Frequently, only the caps were visible above the ground level.

In comparison with the North American species known previously in *Phaeocollybia* (Smith, 1957), *P. rufipes* is most closely related to *P. laterarius* Smith of section *Phaeocollybia.* From this species, *P. rufipes* differs in color of pileus, non-blackening stipe, more hair-like cheilocystidia, habitat, and both spore length and shape. The odor and taste of *P. rufipes* probably are distinctive as well, as is the hygrophanous nature of the pileus. These features are not mentioned specifically in the original description of *P. laterarius.*

ASCOMYCETES

Barya parasitica Fuckel, Symb. Mycol. p. 93. 1870.

Material examined: *Barr 3359A*, on *Bertia moriformis*, Katahdin Stream Campground, Baxter State Park, **Maine**, July 10, 1962; *C. H. Peck*, on *Bertia moriformis* and decayed wood of *Fagus*, Catskill Mts., **New York**, September, (type and isotype of *B. parasitica* var. *caespitosa* Peck).

My collection is a small one, whereas those of Peck's bear hundreds of perithecia grouped over the *Bertia* and nearby wood. Seaver (1910) described a collection from New York City with numerous perithecia. Outside of these three localities, I have found no records of *B. parasitica* in North America. It is known in Europe, and has been reported to be rare. Munk (1957) has a good description of the species from Danish material.

B. parasitica is a non-stromatic member of the Clavicipitaceae. The yellowish perithecia are seated on a dingy whitish subiculum, and eventually darken to grayish yellow-brown. The asci are characteristic of the family, cylindrical with an enlarged and refractive apex, through which a narrow canal can be seen. The ascospores are filiform, hyaline to faintly yellowish, several-septate and guttulate.

Herpotrichiella spinifera (Ell. & Ev.) Barr, *comb. nov.* Page 302, figures 1-3.

Melanomma spiniferum Ellis & Everhart, North Amer. Pyreno. p. 184. 1892.

Ascostromata 70-112 μ in diameter, globose to conical, entirely immersed or upper portion erumpent, scattered to gregarious, lower wall thin, light grayish brown to nearly hyaline, of two to four layers of polygonal cells, 8-11 μ wide, upper exposed portion of wall blackened, short setose around apex, setae at times inconspicuous, 7.5-22 μ long, 5-5.5 μ wide near base, blackish-brown, often irregular, simple, ends blunt or pointed, wall thick, apical pore up to 25 μ wide.

Asci 27-44 × 7.5-15.5 μ, saccate, narrowed to rounded apex and sessile base, wall double, thickened above, few in a fascicle, pseudoparaphyses indistinct.

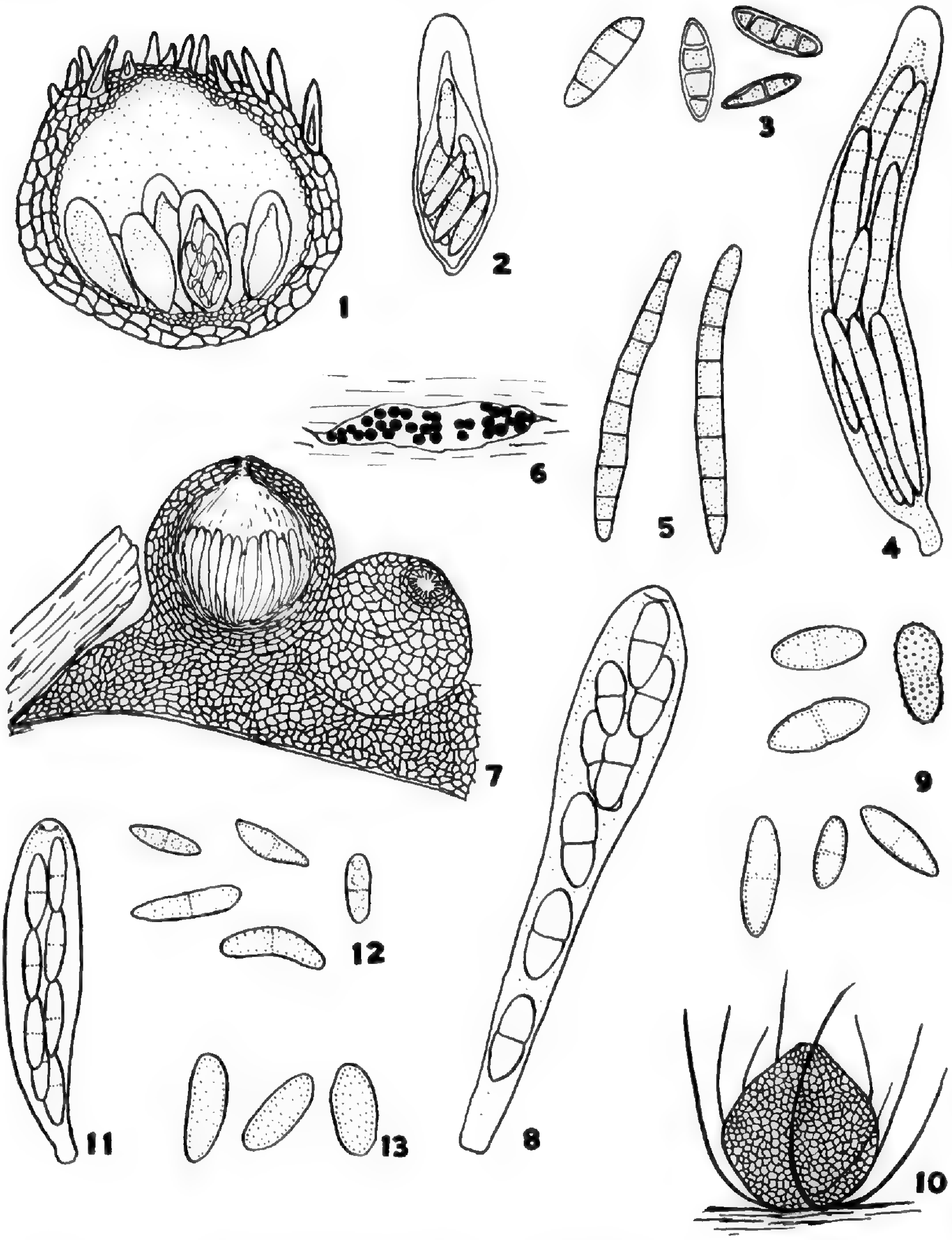
Spores (10-)12-15.5 × 3.5-4.5 μ, hyaline when young, light olive brown or grayish brown at maturity, clavate-elliptical, broadest in upper third, tapered to rounded ends, straight to slightly curved, (1-, 2-)3-(4-, 5-) septate, not or slightly constricted at septa, cell above primary septum broadest, contents guttulate or one globule in each cell, wall thin, smooth or very finely roughened, crowded in the ascus.

Immersed in pore surface of old resupinate basidiomycetes.

Material examined: *A. Commons*, on *Corticium* sp.(?), Wilmington, **Delaware**, September, 1890, Ell. & Ev. N.A.F. Second series 2610; *Barr 3326*, on old *Poria* sp., Abol Stream, Baxter State Park, **Maine**, July 6, 1962; *R. H. Petersen* and *C. T. Rogerson*, on *Sabacina incrustans*, Toxaway River junction with Bear Wallow Creek, Transylvania Co., **North Carolina**, July 29, 1961; on old *Stereum*, same data as above; on old *Stereum*, along Corbin Creek, branch of Whitewater River, Transylvania Co., August 9, 1961; on old *Stereum*, 4 miles south of Upper Falls of Whitewater River, Oconee Co., **South Carolina**, August 14, 1961.

Dr. Rogerson has kindly communicated his collections of *Herpotrichiella spinifera* to me, and has compared them with type material of *Melanomma spiniferum*. N.A.F. 2610 is part of the material from which the species was originally described. My collection from Maine is identical with it and with Rogerson's material.

The three collections on *Stereum* bear both *H. spinifera* and a representative of the Trichosphaeriaceae, as yet unidentified. The latter fungus is the more conspicuous, with superficial, collapsing, setose perithecia, and 3-septate ascospores. The ascostromata of *H. spinifera* in these collections are very short setose, and were at first thought to be glabrous. Further examination has shown that setae are present, and in all respects these specimens are identical with the others cited above. Rogerson (*in litt.*) noted that the "glabrous" form was similar to what Ellis called *Melanomma porothelia* (Berk. & Curt.) Sacc. However, *M. porothelia*



Figs. 1-3. *Herpotrichiella spinifera* (Ell. & Ev.) Barr, *comb. nov.:* 1, ascostroma, 2, ascus, 3, ascospores. Figs. 4, 5. *Tubeufia cerea* (Berk. & Curt.) Barr, *comb. nov.:* 4, ascus, 5, ascospores. Figs. 6-9. *Nectria atrofusca* (Schw.) Ell. & Ev.: 6, habit of perithecia on stroma erumpent through bark, 7, perithecia on stroma, 8, ascus, 9, ascopores. Figs. 10-12. *Niesslia barbicincta* (Ell. & Ev.) Barr, *comb. nov.:* 10, perithecium, 11, ascus, 12, ascospores. Fig. 13. *Phylleutypa wittrockii* (Erikss.) Petrak: ascospores. Fig. 1, × 400; figs. 2-5, 8, 9, 11-13, × 750; fig. 6, × 10; figs. 7, 10, × 80.

is identical with *Litschaueria corticiorum* (Hoehnel) Petrak, a member of the Xylariaceae, according to Petrak (1923). What Ellis considered *M. porothelia* is obviously different from Berkeley and Curtis's fungus.

In most of the species at present known to belong to the genus *Herpotrichiella*, considerable variation in length and septation of ascospores occurs. Mueller (in Mueller and von Arx, 1962) considered that the genus *Didymotrichiella* Munk (1953), erected for species with one-septate spores, could not be distinguished satisfactorily from *Herpotrichiella*, and reduced *Didymotrichiella* to synonymy with the latter. In comparing the described species, *H. spinifera* appears to be most closely related to *H. setosa* Barr and *H. fusispora* Barr (1959). *H. spinifera* bears setae only at the apex of the ascostroma, whereas the other two species are setose over most of the wall. *H. spinifera* also differs from these two species in shorter spores, and in having the ascostromata more deeply immersed in the substrate.

Munk (1953) erected the family Herpotrichiellaceae to accommodate *Herpotrichiella* and four other genera of similar aspect. Mueller and von Arx (1962) reduced the family to synonymy under the Pleosporaceae. Such disposition appears logical to me, as familial distinctions can scarcely be made on the bases of small size and greenish or olive grayish ascospores.

Nectria atrofusca (Schw.) Ellis & Everhart, Journ. Mycol. 1:140. 1885. Page 302, figures 6-9.

Sphaeria atrofusca Schweinitz, Trans. Am. Philos. Soc. ser. 2, 4: 206. 1832.

Creonectria atrofusca (Schw.) Seaver, Mycologia 1:186. 1909.

Cucurbitaria seriata Peck, N. Y. St. Museum Rep. 28: 75. 1876.

Otthia seriata (Peck) Sacc. Syll. Fung. 1: 739. 1882.

Otthiella seriata (Peck) Sacc. & D. Sacc. Syll. Fung. 17: 662. 1905.

Plowrightia staphylina Ell. & Ev. Proc. Acad. Phila. 1890: 248.

Otthia staphylina (Ell. & Ev.) Ell. & Ev. North Amer. Pyreno. p. 251. 1892.

Otthiella staphylina (Ell. & Ev.) Dearness & House, N. Y. St. Museum Bull. 266: 71. 1925.

Stroma immersed in wood tissue, yellowish brown, composed of thin-walled, compact cells, with yellowish brown hyphae penetrating deep into wood, elliptical, rounded, or elongate, up to 4 mm. long, 150-600 μ wide, (80-)115-400 μ thick; perithecia grouped on and bases immersed in stromatic tissue, forming rounded or elongate rows and erumpent through splits in bark, brown to blackish and shining when dry, brown or yellowish brown when fresh, glabrous, apex collapsing or pinched in at sides when dry, but not cupulate, short papillate or conic, 150-275 μ in diameter, 180-300 μ high, wall of two distinct layers, outer dark to light brown and crust-like, 16-33 μ thick, composed of 4-6 layers of polygonal thick-walled cells, inner layer yellowish to hyaline, 8-13 μ thick, of compressed rows of thin-walled cells, pore 20-33 μ wide, surrounded by elongate cell layers, brown externally, lined with hyaline periphyses.

Asci 50-82 × 6.5-12 μ, clavate or oblong, narrowed to stipe of varying length, apex rounded-truncate, wall single, thin but slightly thickened and with refractive line at apex, non-amyloid, (4-)8-spored, paraphyses delicate and slender, eventually compressed.

Spores 9-15(-17.5) × 4-6(-7.5) μ, hyaline, light dull yellowish in mass and in age, oblong, elliptical, or ovoid, ends rounded, straight to inequilateral, 1-septate in the middle, not constricted, wall thin, smooth, in age finely roughened, contents homogeneous or minutely guttulate, obliquely uniseriate to partially biseriate in the ascus.

Erumpent through bark on dead or dying limbs of *Staphylea trifolia*, less often on *Evonymus* sp.

Material examined: *Barr 3182*, South Deerfield, **Massachusetts**, May 10, 1962; *L. N. Johnson 594*, Ann Arbor, **Michigan**, April 1, 1893; *C. Devol*, Albany, **New York**, October, 1874 (type of *Cucurbitaria seriata* on *Evonymus* sp.); *J. Dearness 1560*, London, **Ontario**, (type of *Plowrightia staphylina* Ell. & Ev.); *663*, London, May 25, 1891; *1848*, Parkhill, May 24, 1892; Parkhill, May, 1892; same data, Ell. & Ev. N.A.F. Second series 3320; London, December, 1903, Fungi Columbiani, Bartholomew 1943; London, 1912, Rehm Ascomycetes 2041; London, June, 1913, Sydow, Fungi exot. exs. 184; *B. M. Everhart 527*, West Chester, **Pennsylvania**, October 1, 1885; same data, Ell. & Ev. N.A.F. Second series 1547; *J. Dearness*, Montreal, **Quebec**, November 8, 1898.

According to Rogerson (*in litt.*), the type of *Sphaeria atrofusca* Schweinitz is identical with Ellis specimens designated *Nectria atrofusca* and with my collection from Massachusetts. Type and authentic material of *Plowrightia staphylina* Ell. & Ev., and the type collection of *Cucurbitaria seriata* Peck are also identical. Wall and centrum structure, as well as the delicate paraphyses, thin-walled asci, and variable nature of ascospores, all lead to disposition of the fungus as a *Nectria*.

According to Munk's (1957) description of *Melanopsam-*

ma pomiformis (Pers. ex Fr.) Sacc., many points of similarity exist between it and *N. atrofusca.* Several specimens of *M. pomiformis* from Europe and North America were studied to compare the two species. The major distinction is in the perithecial wall which is carbonaceous in *M. pomiformis,* much softer and more fleshy in *N. atrofusca.* They cannot be considered identical. Mueller and von Arx (1962) have transferred *M. pomiformis* to *Chaetosphaeria.* This genus belongs in the Trichosphaeriaceae (Sphaeriaceae), and within the family is close to *Eriosphaeria.* The Hypocreaceae, while related to the Sphaeriaceae in ascus structure, is distinguished by the bright or light colored, more fleshy perithecia.

In the genus *Nectria, N. atrofusca* appears to belong in the *Ochroleuca* group, as delimited by Booth (1959). *N. pallidula,* as described by Booth, is similar in many respects. It differs in the brighter color of perithecia, roughened wall, and constricted spores. I have not seen authentic material, nor a good description of *N. ochroleuca* (Schw.) Berk., to compare with *N. atrofusca,* but apparently it is also much lighter in color than the latter species.

Niesslia barbicincta (Ell. & Ev.) Barr, *comb. nov.* Page 302, figures 10-12.

Byssosphaeria barbicincta Ell. & Ev. Journ. Mycol. 4: 63. 1888.

Trichosphaeria barbicincta (Ell. & Ev.) Sacc. Syll. Fung. 9: 603. 1891.

Herpotrichia barbicincta (Ell. & Ev.) Ell. & Ev. North Amer. Pyreno. p. 158. 1892.

Perithecia 120-185 μ in diameter, globose to conical, collapsing cupulate when dry, black, shining, scattered singly or grouped on scanty or abundant subiculum of brown, thick-walled hyphae, apical pore small, periphysate, wall brittle, thin, 6-7.5 μ thick, composed of few compressed layers of cells, blackish brown externally, light brown to hyaline within, setose around base, setae few, curved upward around perithecium, dark brown, septate, apex blunt and often pallid, (27-) 60-200 μ long, 3.5-7.5 μ wide near base, frequently similar setae scattered on hyphae of subiculum, not associated with perithecia.

Asci 46-66 × 6-10 μ, oblong, apex rounded-truncate, stipe short, wall single, thin, with minutely refractive area at apex, non-amyloid, paraphyses filiform, hyaline, thin-walled.

Spores 10-16.5 × 2-4 μ, greenish hyaline, oblong or fusoid, ends rounded or pointed, straight, inequilateral, or slightly curved, 1-septate in the middle, not constricted, wall thin and smooth, contents minutely guttulate, overlapping bi- to uniseriate in the ascus.

Superficial on old fungi and on adjacent leaf or wood surfaces.

Material examined: *Barr 3766*, Ruggles Pond, Wendell State Forest, **Massachusetts**, September 22, 1962; *1292A*, The Gorge, U.M.B.S., Cheboygan Co., **Michigan**, July 22, 1953; *J. B. Ellis*, Newfield, **New Jersey**, October, 1887, N.A.F. Second series 1958 (cotype of *Byssosphaeria barbicincta* Ell. & Ev.).

The distinguishing feature of *N. barbicincta* is the position of setae. They arise from the lower wall of the perithecium and curve upward beyond its apex. In *N. exilis* (Alb. & Schw. ex Fr.) Winter, setae develop over the entire perithecial wall and are short and stiff. *N. exosporioides* (Desm.) Winter, is said (Mueller and von Arx, 1962) to be similar to *N. exilis* except for longer setae. The third species recognized by Mueller and von Arx, *N. crucipila* (Hoehnel) Mueller, has branched setae. The spores of all three species are smaller than are those of *N. barbicincta*. *N. exilis* is the correct name for the fungus I have reported previously as *N. pusilla* (Fr.) Schroet. from northern Quebec (Barr, 1959) and Gaspé Parc (Barr, 1961).

The genus *Niesslia* Auerswald is a representative of the Trichosphaeriaceae (Sphaeriaceae *ss. auct.*) with small, scattered, setose perithecia on scanty subiculum, and with thin-walled asci and hyaline, two-celled spores. It is closely related to *Eriosphaeria* Sacc., but differs in smaller, thin-walled perithecia and in lacking a thin stroma.

Phylleutypa wittrockii (Erikss.) Petrak, Ann. Mycol. **39**: 280. 1941. Page 302, figure 13.

Material examined: *Barr 3211*, *Linnaea borealis* var. *americana*, near Katahdin Stream Campground, Baxter State Park, **Maine**, June 25, 1962; *3757*, September 5, 1962; *Stuntz* and *Allen 1591*, Isle Royal, **Michigan**, September 13, 1901; *W. G. Farlow*, Shelburne, **New Hampshire**, September, 1886; *H. D. House*, Lake Placid, **New York**, September 9, 1917; Newcomb, Essex Co., July 18, 1922.

P. wittrockii is much less common than the prevalence of colonies of *Linnaea* in northern regions would imply. I have found only the two Maine collections to date. The remaining four collections are all in the Peck Herbarium at Albany (NYS). That collected by Farlow was cited both by Ellis and Everhart (1892) and Theissen and Sydow

(1915). Wehmeyer (1942) has reported a collection from Nova Scotia. In Europe the only record I have seen is from Sweden.

The collection made in Maine in June contained mature asci and spores as well as early infection and young stromata on living plants. The latter were blackened and distorted from the uppermost pair of leaves to tip of branch. The September collection, in the same locality, showed well-developed stromata. The perithecia were immature and lacked asci and spores.

Tubeufia cerea (Berk. & Curt.) Barr, *comb. nov.* Page 302, figures 4, 5.

Sphaeria cerea Berk. & Curt. Grevillea **4**: 108. 1875.

Calonectria cerea (Berk. & Curt.) Sacc. Syll. Fung. **2**: 551. 1883.

Dialonectria cerea (Berk & Curt.) Cooke, Grevillea **12**: 110. 1884.

Ophionectria cerea (Berk. & Curt.) Ell. & Ev. North Amer. Pyreno. p. 118. 1892.

Nectria fulvida Ell. & Ev. Journ. Myc. **1**: 140. 1885.

Calonectria fulvida (Ell. & Ev.) Berl. & Vogl. Add. Syll. Fung. p. 212. 1886.

Dialonectria fulvida (Ell. & Ev.) Ell. & Ev. Journ. Mycol. **2**: 122. 1886.

Ophionectria everhartii Ell. & Galw. Journ. Mycol. **6**: 32. 1890.

Ascostromata 150-160 μ in diameter, 120-130 μ high, superficial, scattered or grouped on surface of old pyrenomycete stromata and adjacent wood, yellowish brown, pulverulent, wall thin at base and lower sides, 10-11 μ wide, of several layers of polygonal cells, brownish to yellowish, thickened as a ring or collar at upper sides, the outermost layers of cells protruding from surface, inner layers of cells yellowish, compressed, apex minutely papillate, pore filled with yellowish tips of pseudoparaphyses.

Asci 66-74 × 9-11 μ, oblong, apex rounded, base foot-like, wall double and thickened above, pseudoparaphysate.

Spores 33-44 × 3-3.5 μ, greenish hyaline, fusoid to nearly cylindrical, ends tapered and narrowly rounded, straight to slightly curved, 7- to 9-septate, delicate, not constricted, each cell with a single globule, wall thin, smooth, in two overlapping fascicles in the ascus.

On old stromata of *Diatrype* spp. and *Hypoxylon* spp. and adjacent wood surfaces.

Material examined: *Barr 3337, Diatrype stigma* on white birch, Abol Field, Piscataquis Co., near Baxter State Park, **Maine**, July 6, 1962; *3360A, Hypoxylon* sp. on beech, Katahdin Stream Campground, Baxter State Park, July 10, 1962; *2160, Diatrype* sp. on birch, Lac Munroe, Mt. Tremblant Park, **Quebec**, July 28, 1957.

This species is a member of the Pleosporaceae with superficial ascostromata, bitunicate asci and pseudoparaphyses. Booth (1959) noted that *O. cerea* belonged in the genus *Tubeufia*, but did not make the combination. The shape of the ascostroma, with thickened ring-like upper wall, is most distinctive.

I have not examined the types of *Nectria fulvida* Ell. & Ev. and *Ophionectria everhartii* Ell. & Galw., but these names were placed in synonymy with *Ophionectria cerea* by Ellis and Everhart (1892). According to the description, *Calonectria belonospora* Schroet. (*Ophionectria belonospora* (Schroet.) Sacc.) is synonymous probably with *Tubeufia cerea*.

This fungus has been reported from Europe and North America. According to the literature, in North America it has been collected in South Carolina, New Jersey, Newfoundland, and Ontario. Although not rare, it is probably overlooked.

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A NEW STATION FOR THE MASSACHUSETTS FERN. — In September 1962 on a collecting trip with three of my faculty colleagues we stopped to open our lunch boxes in the old spring house at the Bradford Mineral Spring a short distance from the highway between Bradford Center and East Washington, New Hampshire. While exploring in the vicinity after lunch I came across a sizable, vigorous colony of *Dryopteris simulata* Davenport growing in damp mixed woods a short distance north of the spring. The only other station for this species in Merrimack County, represented by a specimen in the New England Botanical Club Herbarium, is in Contoocook near the middle of the county. The Bradford station is less than a mile east of the Sullivan County line. A station near the highway on Route 9 in South Stoddard in Cheshire County represents a more western extension for this species for this part of the state but the Bradford station is the most northerly to be reported except for an early collection in 1903 made by Timothy O. Fuller at Lake Wentworth in Carroll County. A specimen from the Bradford station has been deposited in the Jesup Herbarium at Dartmouth College, Hanover, N. H. Others have been sent to the University of New Hampshire Herbarium in Durham, N. H., and to the Gray Herbarium and the New England Botanical Club Herbarium in Cambridge, Mass.

JAMES P. POOLE, JESUP HERBARIUM, DARTMOUTH COLLEGE.

STREPTOPUS OREOPOLUS FERN., A HYBRID TAXON

DORIS LÖVE AND HINRICH HARRIES

In 1905, M. L. Fernald and J. F. Collins visited Mt. Albert on the Gaspé Peninsula in eastern Quebec. Above timberline they discovered on this mountain a remarkable *Streptopus* with deep claret-colored flowers. This plant proved to be a new taxon and was named by Fernald (1906) *Streptopus oreopolus*, the mountain-dwelling twisted-stalk.

Next summer, when Fernald and Collins botanized again in the mountains of the Gaspé, doubts entered Fernald's mind and he suggested (Fernald, 1907) that the new species might be a hybrid between *S. amplexifolius* (L.) DC. and *S. roseus* Michx. This hypothesis appeared to be supported by Fernald's observation that the fruits of *S. oreopolus* did not develop to maturity, though he considered also the possibility that the extremely dry weather during the early part of this particular summer might have been responsible for the sterile condition. There were also certain features of the plant and its occurrence which made Fernald hesitant in proposing his hypothesis (p. 107): "This uniform sterility of *S. oreopolus* throughout its known range suggests that it may not be a self-perpetuating species; yet, if this should prove to be the case, the profusion of the plant throughout the area and the constancy with which it maintains its characteristic pubescence and the color of its perianth is indeed remarkable."

In 1929, a review of the literature on *S. oreopolus* and a discussion of its taxonomic position and distribution were given by Marie-Victorin in his work on "les Liliiflores du Québec". By this time the taxon had been reported from northwestern Newfoundland (Fernald, 1926), the Mingan Archipelago (Marie-Victorin, 1929), the Shickshock Mountains (Fernald, 1906, 1907), Mt. Katahdin (Stebbins, 1929), and Mt. Washington (Fernald, 1927), and plants with apparently well-developed fruits had been found on two occasions (Fernald, 1926; Marie-Victorin, 1929). Marie-Victorin rejected the possibility of a hybrid origin for *S.*

oreopolus especially because of the dark red color of its flowers which he thought could not be the result of a hybridization between two parent species with respectively white and rose-colored flowers. Instead, he considered the taxon to be a good species which he classified (p. 98) "dans la catégorie des endémiques de la région non récemment glaciée qui entoure le golfe Saint-Laurent".

The taxonomic position of *S. oreopolus* was discussed again by Fassett (1935). From Fassett's description of the taxon, as from the previous paper by Marie-Victorin (1929), it is apparent that *S. oreopolus,* while intermediate between *S. amplexifolius* and *S. roseus* in certain vegetative features and in the character of the fruits, is much more similar to *S. amplexifolius,* especially with respect to the flowers. Fassett reached the conclusion that *S. oreopolus* is a mere variety of *S. amplexifolius* and closely related to the var. *denticulatus* which occurs in the Lake Superior area and in western North America. The latter variety, according to Fassett, approaches *S. oreopolus* in its denticulate leaf margins and in its occasionally pink or reddish flowers. Fassett agreed with Marie-Victorin in rejecting the possibility that *S. oreopolus* might be a hybrid. He reports as additional evidence against such an interpretation of the taxon his observation (p. 101), "that *S. oreopolus* has the perianth-segments conspicuously papillate within, while *S. amplexifolius* var. *americanus* rarely has well-developed papillae, and the representative of *S. roseus* occurring in that region lacks papillae of the type found in the purported hybrid". The distribution of *S. oreopolus* appeared to Fassett to be likewise in disagreement with the hybrid hypothesis because (pp. 101-102), "if *S. amplexifolius* and *S. roseus* can hybridize, why do they not do so in the many other places where their ranges overlap, instead of only in one limited region".

Fassett *(1.c.)* reported also the occurrence of a plant which appeared to be an intermediate or hybrid between *S. amplexifolius* and *S. oreopolus* (p. 102): "On Mount Washington, New Hampshire, just above Tuckerman's

Ravine, may be found a most interesting series of variations of *S. amplexifolius.* Var. *oreopolus* is abundant, and var. *americanus* can also be found. A third type of plant has denticulate leaves like those of var. *denticulatus.* Since its leaf-margin is intermediate between that of var. *americanus* and that of var. *oreopolus,* and, in addition, the lower leaf-surface is less glaucous than in the former, but more so than in the latter, it is considered as a hybrid of these two varieties. The flowers, which were just beginning to open when observed by the writer on June 27, 1934, were nearly white and conspicuously papillate within. . . . The expanded flowers should be observed, especially for correlation of perianth-color with degree of toothing on the leaf-margin, and the fruit-colors should be noted."

We ourselves have observed for several years the three kinds of *Streptopus* in the subalpine region of Mt. Washington. There, *S. amplexifolius* is represented by its var. *americanus* Schultes and *S. roseus* by var. *perspectus* Fassett. *Streptopus oreopolus* has been collected at the Lakes of the Clouds (No. 7512, July 25, 1958, in deep moss around the Lakes at 5100′ alt., coll. *A. & D. Löve*), along the Oakes Gulf Trail (No. 346, August 5, 1961, in subalpine birch-fir forest at 4300′ alt., coll. *H. Harries*), in the upper part of the Tuckerman Ravine headwall (August 28, 1962, in the subalpine *Alnus*-shrubbery around the trail, fruits coll. by *D. Löve*), and on the east slope of Mt. Clay (No. 347, July 18, 1961, at 5350′ alt., coll. *H. Harries*).

In the subalpine region of Mt. Washington, the three taxa occur mainly in sheltered locations on the northeast, east, and southeast slopes between 4500′ and 5500′ alt. where because of the thick and long-lasting snow cover the fir krummholz is replaced by a subalpine snowbed vegetation. In these localities, the three *Streptopus* forms grow associated with such snow-tolerant species as *Betula glandulosa, Vaccinium caespitosum, Calamagrostis canadensis* s.l., *Deschampsia flexuosa, Luzula parviflora* var. *melanocarpa, Veratrum viride, Clintonia borealis, Houstonia caerulea* var. *Faxonorum, Solidago macrophylla* var. *thyrsoidea,* and

Dryopteris spinulosa var. *americana.* On such sites, the snow cover was observed in spring 1961 to disappear between May 20 and June 13. In a few spots where the snow cover lingered into late June or early July, *Streptopus* was found to be lacking.

In their subalpine localities, *S. amplexifolius* and *S. oreopolus* grow mostly in the furrows which are frequently met with in snow bed areas on steeper slopes, and generally along drainage channels. In the forests of the lower altitudes, *S. amplexifolius* was encountered occasionally, mostly in close vicinity to a stream. *S. oreopolus* was found in such a habitat only once, namely in Oakes Gulf at 4300′ alt. where it was observed together with *S. amplexifolius* in a subalpine birch-fir forest along the margin of a small stream.

Streptopus roseus does not show such a pronounced preference for drainage channels but is of a more general distribution and is found even in some of the more luxurious kinds of heath vegetation. The species was noted by us in the Mt. Washington area only from subalpine localities and has not been observed in forest habitats, but it is cited by Pease (1924) for many low-altitude localities in the area.

Streptopus amplexifolius and *S. roseus* resemble each other in their wide altitudinal range which extends from the valley levels up into the subalpine region where both species reach their altitudinal boundary, according to our observations, between 5400′ and 5500′ alt. *Streptopus oreopolus,* on the other hand, was observed only between 4300′ and 5400′ alt. and appears to be a strictly subalpine taxon.

In the subalpine region of Mt. Washington, the three *Streptopus* taxa were found to flower between late June and early August. In 1961, the peak of the flowering fell for *S. amplexifolius* and *S. oreopolus* between July 10 and July 20; that of *S. roseus* was about a week earlier.

We noted in the subalpine region of Mt. Washington the color of the flower to be a good characteristic with all three taxa. The flowers of *S. amplexifolius* are creamy white with a dark purple streak at the base of each perianth lobe. The flowers of *S. roseus* are rose-colored with many irregularly scattered darker red streaklets. The flowers of *S. oreopolus* lack any kind of markings. They are white in the bud and become dark wine red at maturity (appearing almost black in herbarium specimens).

We now have chromosome counts of all three taxa from the Mt. Washington area. *Streptopus* roseus is diploid (2n=16, counted by Dr. S. Kawano on material collected at the Lakes of the Clouds in July, 1960). *Streptopus oreopolus* is triploid (2n=24, counted by A. & D. Löve on coll. No. 7512, Lakes of the Clouds, July, 1958), and *S. amplexifolius* is tetraploid (2n=32, counted by Dr. S. Kawano on material collected at the Lakes of the Clouds in July, 1960). The chromosomes are large and easily distinguishable. The triploid has distinctly three of each type in its karyogram, as can be seen in Fig. 1, where the smallest and largest chromosomes are indicated. The diploid and tetraploid numbers are in conformity with those previously counted by Therman (1956). The tetraploid number has been counted earlier by Matsuura and Sutô (1935), by Satô (1932), and by Mattick (in Tischler, 1950).

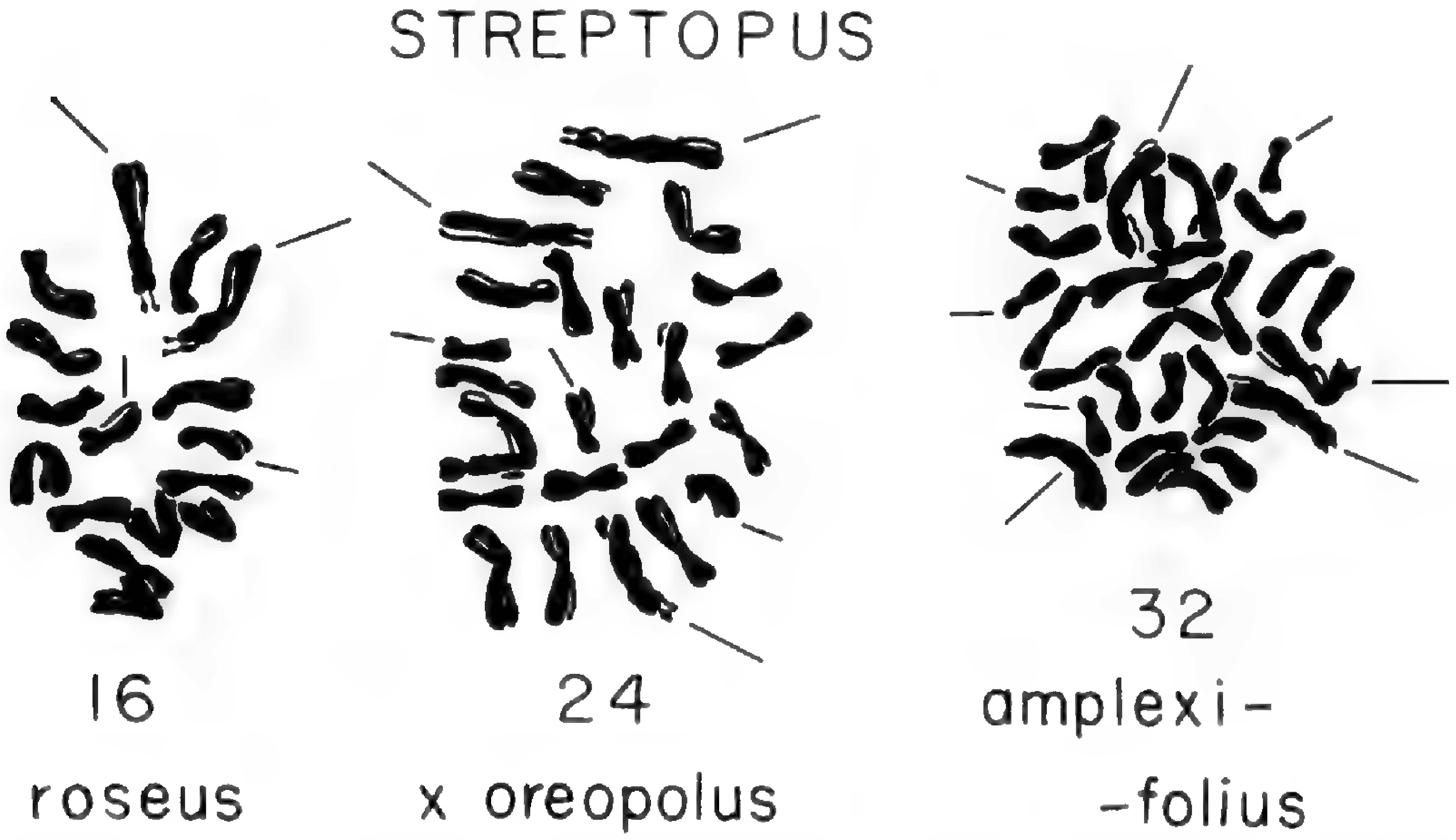

Fig. 1. Chromosomes of *Streptopus roseus, S. oreopolus,* and *S. amplexifolius.* In each karyogram the longest and the shortest sets, respectively, are indicated.

A further study of the plants collected on Mt. Washington showed that the pollen of *S. oreopolus* is completely sterile, whereas that of *S. amplexifolius* and *S. roseus* has 95% or more good pollen grains, when stained with aceto-orcein. In spite of the fact that all fruits collected looked mature and well-filled, the seeds of the *S. oreopolus* fruits proved to be shrivelled and infertile. All available herbarium material of *S. oreopolus* from Newfoundland, the Mingan Archipelago, and the Gaspé Peninsula was checked for these features and it can be stated with certainty that the taxon is sterile everywhere in its range.

The conclusion seems therefore unavoidable that Fernald (1907) was right in his suggestion that *S. oreopolus* might be a hybrid between *S. amplexifolius* and *S. roseus*. It remains to discuss those facts emphasized by Marie-Victorin (1929) and Fassett (1935) which might be considered as negative evidence against such an interpretation of the taxon.

Streptopus oreopolus differs from its two parent taxa by the dark perianth color and by the copiously papillate perianth segments. No explanation for the appearance of these features in the hybrid can be given but the possibility should be considered that the hereditary material of the tetraploid *S. amplexifolius* could contain recessive characters which might become apparent in its hybrid with *S. roseus*.

Neither in the field nor among herbarium material have we seen an intermediate or transitional type between *S. oreopolus* and either *S. amplexifolius* or *S. roseus*. The interpretation of the form observed by Fassett (1935) in the Tuckerman Ravine as a hybrid between *S. amplexifolius* and *S. oreopolus* appears to be incompatible with the observed complete sterility of *S. oreopolus,* and it seems likely that this plant might have been only a somewhat atypical specimen of either *S. oreopolus* or *S. amplexifolius.*

For a sterile hybrid taxon which can spread only by means of its rhizomes, the distribution of *S. oreopolus* is indeed a strange one. Whereas the ranges of the two parent species overlap over a wide area, the distribution of the hybrid is restricted to a few localities which are distinguished by their wealth of taxa with relict character and highly localized distribution. In these localities, *S. oreopolus* seems generally to be frequent or even common. According to Fernald (1927, p. 76), *S. oreopolus* is an "abundant species of subalpine woods and meadows of the Shickshock Mts. of Gaspé and . . . equally characteristic of subalpine slopes of northwest Newfoundland". On the wide expanse of Tabletop Mt. in the Gaspé, Fernald (1907, p. 106) found it to be "always more abundant than *S. roseus* and *S. amplexifolius*". Stebbins (1929, p. 142) observed *S. oreopolus* on Mt. Katahdin to be: "Abundant on damp slopes above timber line in both the North and South Basins". We ourselves found it on Mt. Washington to be only local in distribution and less frequent than the other two taxa.

It does not appear possible at present to give a well-founded explanation for the distribution of *S. oreopolus*. In the subalpine region of Mt. Washington, *S. amplexifolius* and *S. roseus* were observed by us in many localities growing in large numbers side by side. The flowering seasons of the two species were found also to be largely overlapping. *Streptopus oreopolus* was seen always in the vicinity of the two other taxa except for the occurrence along the Oakes Gulf Trail at 4300′ alt. where no *S. roseus* was observed. Similar conditions are indicated for the Shickshock Mts. by Fernald (1907). In agreement with the interpretation of *S. oreopolus* as a hybrid, the suggestion might therefore be made that the range of *S. oreopolus* represents simply areas of maximum possibilities for hybridization between *S. amplexifolius* and *S. roseus*. As an additional factor determining the distribution of *S. oreopolus* the possibility might be considered that the hybrid taxon represents a genotype which is especially well adapted for a subalpine or cool coastal environment.

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TALL WHEATGRASS, A NEW ROADSIDE SPECIES IN UTAH

During the 1940's the old world species, tall wheatgrass, *Agropyron elongatum* (Host.) Beauv., was considered promising for reseeding pastures at low elevations in the Intermountain Region although it was not readily available for use at that time (Stoddart and Smith 1943, Stoddart 1946). During the 1950's, tall wheatgrass was found to be one of the highest producers of forage on good sites on lowland and mountain brush areas, and it was recommended highly for reseeding in Utah (Stewart *et al.* 1951, Plummer *et al.* 1955, Stoddart and Smith 1955).

The use of tall wheatgrass for reseeding pastures in Utah County occurred as early as 1951, and tall wheatgrass has been seeded commonly during the last decade. In 1956 the author observed a few plants that had escaped cultivation along the roadside near Spanish Fork City, Utah County. Tall wheatgrass is now common along the roadsides in the vicinity of Spanish Fork and Springville, and it occurs occasionally along irrigation ditches. Only future observations will answer the following questions. Will tall wheatgrass continue to spread throughout the state along the roadsides and irrigation streams, and will tall wheatgrass also become established in the native vegetation of the lower elevations in Utah? EARL M. CHRISTENSEN, BOTANY DEPARTMENT, BRIGHAM YOUNG UNIVERSITY, PROVO, UTAH.

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A CHECKLIST AND KEY TO THE SPECIES OF CAMPANULA NATIVE OR COMMONLY NATURALIZED IN NORTH AMERICA

STANWYN G. SHETLER

INTRODUCTION

This short conspectus of *Campanula* in North America (including Greenland) was prepared in the course of biosystematic studies on the *C. rotundifolia* complex, as a means of better understanding the relationships of that complex to the whole genus. It is compiled in large part from the literature but includes a substantial number of original observations and measurements. The last conspectus of North American campanulas was published by Asa Gray in 1886 (Syn. Fl., ed. 2, vol. 2 (1) : 11-14, 395-96), in which 14 species were recognized. Six new species have been described since then, but there is at present no single source to which one can turn for even a simple listing, much less an inclusive key. The present conspectus is being offered, despite its brevity and compiled nature, in the hope that it will satisfy a practical need for many until an original revision can be completed.

I have made the key quite descriptive, more so than usual, because separate descriptions are not included in the checklist. Thus, while it is constructed primarily for flowering material, the condition in which campanulas are usually collected, one should be able to name most fruiting specimens bv careful comparison of the extra descriptive material in the various leads, including geographical and ecological data. Additional information beyond what is supplied here should be sought in one or more of the appropriate regional floras and manuals, cited in my bibliography.

In the key, size ranges are sometimes given statistically, e g.. 28-208 (118) cm., when new measurements have been made. Statistical ranges can easily be recognized by the fact that the parenthetic number lies *between* the other two values given. This number represents the arithmetic mean, i. e., the average, and the other two numbers represent a minimum-maximum range, derived by subtracting and adding two standard deviations from and to the mean. (All numbers have been rounded-off to the nearest whole number, so as to appear in the actual units of measurement.) These estimated ranges should include *approximately* 95% of the plants one will encounter. Owing to the tendency for size-distribution curves to be truncated below (no negative values) and asymptotically skewed above, a measurement as small as the estimated minimum will rarely if ever be found, and the transgressions of the estimated range that one will occasionally encounter will almost always be transgressions of the upper limit. Whenever possible, the statistical ranges were derived from samples of 25 or more, depending on the variability of the character, but limited material occasionally prevented samples this large.

Sometimes the parenthetic number is larger than the upper extreme, which means, according to customary procedure, that this value represents not an average but simply an uncommon upper extreme, and the min-max range represents observed values rather than statistical estimates. Observed values are given for relatively invariable or noncritical characters. In some cases the observed ranges were taken from the literature, but only after being verified personally.

Both the relative dimensions of the capsule and the relative position of the pores or slits of dehiscence can be extremely useful if not diagnostic in the determination of campanulas, and whenever possible collectors should take specimens with flowers *and* fruits. Not infrequently, however, one has only flowering material but really needs to use capsule characters for certain discrimination. While the relative dimensions (or shape) of the ovary are not likely to change significantly in the course of maturation, the position of the pores is virtually impossible to ascertain prior to actual dehiscence. However, the place of dehiscence tends, on a species basis, to be correlated with the width of the capsule, and more often than not the pores or slits will appear near the widest portion. This means that as a fairly safe rule-of-thumb one can assume that dehiscence will be near the top if the ovary is widest above the middle and will be near the middle or below if the ovary is widest here. This rule will work best after anthesis and the beginning of maturation, when the capsule will quickly assume its characteristic shape if it has not before, but sometimes the rule will mislead on a given plant or even throughout an entire species (e. g., *C. divaricata*). Although species are very constant in the position of dehiscence, they can be quite variable in their capsule dimensions; hence, it is advisable to ascertain the average shape from as many ovaries as possible before attempting to use this rule.

The inflorescence is basically cymose in most species of *Campanula*, but this fact is seldom obvious. Secondarily, it is usually spicate, racemose, or paniculate, and floristic writers usually describe bellflower inflorescences in these terms. Such practice is simpler and not seriously misleading, and I have therefore followed it in my key.

Previous workers have described infraspecific taxa for at least one-third of the 20 native species recognized here, and doubtless some of these taxa are good. In virtually all cases, however, thorough taxonomic investigation is needed before valid judgment can be made, and I have refrained from formal recognition of any infraspecific taxa in this conspectus.

Chromosome numbers, when known, have been given in the Checklist, and unless otherwise indicated these numbers have been taken from the Darlington and Wylie *Chromosome Atlas*.

ARTIFICIAL KEY TO THE SPECIES

1. Plants low or dwarf, 3-20 (35) cm. tall but mostly less than 15 cm., erect or decumbent perennials of alpine[1] or arctic situations, or erect, divaricately cymose-branched (pseudo-dichotomous), temperate annuals of low elevations. 2.
   2. Annuals, divaricately cymose-branched, without rosette; hypanthium glabrous. Temperate species of low elevations (usually below 1200 m.), on dry rocky or grassy ridges and slopes, sometimes in scrub or chaparral. 3.

3. Corolla rotate, cut nearly to the base into linear-lanceolate lobes; style conspicuously exserted; capsule subglobose, opening at or below the middle. Grassy slopes. Chinsegut Hill, Fla. (Rare endemic) .... C. ROBINSIAE

3. Corolla campanulate or funnelform, never rotate nor cut below the middle, the lobes broadly lanceolate or deltoid-ovate; style included or barely exserted; capsule various. 4.

 4. Corolla inconspicuous, 2-3.5 (2.5) mm.[2] long, about equaling length of calyx-lobes; stamens about 2 mm. long; leaves ovate, coarsely dentate; capsule urceolate, opening near the middle. Burns and disturbed places, Chaparral Zone. Mts. of N. Calif. (Endemic) .... C. ANGUSTIFLORA

 4. Corolla showy, 5-20 mm. long, conspicuously longer than calyx-lobes; stamens 4-6 mm. long; leaves oblanceolate or lanceolate to linear-lanceolate, remotely denticulate; capsule various. 5.

  5. Calyx-lobes usually 1/2-2/3 length of corolla; corolla 5-12 (9) mm. long; plants several times branched, often starting from a few cm. above base of stem; capsule urceolate, opening near the middle. Rocky ridges and talus, Chaparral Zone. Mts. of N. Calif. (Endemic) .... C. EXIGUA

  5. Calyx-lobes usually less than 1/2 length of corolla; corolla 5-17 (11) mm. long; plants profusely branched, usually starting at base of stem; capsule ellipsoid or obovoid, opening above the middle, from the top of the pore downward (unique; all other species open from bottom upward). Granite areas. Cent. Tex. (Endemic) .... C. REVERCHONI

2. Perennials, unbranched or with a few short lateral branches near the top, never appearing dichotomous, often with prominent rosette; hypanthium glabrous or pubescent. Temperate alpine (usually above 1500 m.) or arctic species, never in dry scrub or chaparral. 6.

 6. Hypanthium villous, sometimes sparsely or only in lines; stems unbranched, one-flowered or rarely short-branched above and few-flowered. High alpine or arctic fell-fields, barrens, screes, rubbles, cliffs, talus, alluvial fans, sandy and gravelly shores, turfy tundra slopes and plains, dwarf shrub-lichen heaths, etc. Low to high arctic species, reaching southward only in scattered high alpine situations, if at all. 7.

  7. Corolla large, showy, usually over 20 mm. long, tubular or deeply campanulate or funnelform, spreading or nodding[3]; anthers never under 4 mm. long; calyx-lobes entire or toothed, erect or spreading, but never connivent; rosette usually prominent; lower leaves broadly obovate, spatulate

or oblanceolate, uniformly crenate or serrate; plant not appearing fleshy; capsule broadly urceolate or obconic. 8.

8. Calyx with reflexed auricular appendages between the lobes, the lobes entire (rarely crenate-serrate); lower leaves broadly spatulate or obovate, crenate; capsule pendant, opening near the base. Alpine zone. Aleut. Is. (Amphi-Pacific) .... C. CHAMISSONIS

8. Calyx without appendages, the lobes with 1-several sharp teeth or laciniations; lower leaves broadly oblanceolate, remotely sharp-serrate or laciniate; capsule erect, opening near the top. Partial to rocky or gravelly sites. Widespread in Alaska from Aleut. Is. to Arctic Slope, eastward in scattered localities to Great Bear Lake, Mack. (NWT), southward in mts. to N. Wash. (Amphi-Pacific) .... C. LASIOCARPA

7. Corolla small, inconspicuous, seldom over 12 mm. long, funnelform, erect to nodding; anthers 1-3 mm. long; calyx-lobes entire, erect, appressed to corolla, sometimes connivent; rosette absent or few-leaved, not prominent; lower leaves narrowly obovate or spatulate, entire or less often irregularly crenate; plant appearing fleshy; capsule distinctively obovoid or clavate, usually broadest just above the middle, erect, opening near the top. Partial to calcareous, often turfy or alluvial, sites. Widespread but scattered, in Alaska from E. Aleut. Is. to Arctic Slope, eastward to Ellesmere Is. and Greenl., southward in Rocky Mts. to Utah and Colo. and to Shickshock Mts., Que. (Circumpolar, with large range gaps) .... C. UNIFLORA

6. Hypanthium glabrous, scabrellous or hirtellous; stems characteristically unbranched, one-flowered, but in some species rather frequently few-branched above. Habitats various. Temperate sub- and low alpine or arctic species. 9.

9. Hypanthium sparsely to densely scabrellous or hirtellous; plants rarely over 10 cm. tall; leaves mostly basal or nearly so; capsule urceolate, ellipsoid, or short-obconic, opening near the middle or above. Alpine fell-fields, screes and crevices. 10.

10. Leaves sharply and coarsely serrate or dentate; plants sparsely to densely scabrellous above, including hypanthium, glabrous below; calyx-lobes usually with 1-several sharp teeth. Olympic Mts., Wash. (Endemic) .... C. PIPERI

10. Leaves entire; plants uniformly scabrellous or hirtellous throughout, usually densely so; calyx-lobes entire. N. Calif. to Wash., eastward to Ida., W. Mont. (Endemic) .... C. SCABRELLA

9. Hypanthium glabrous; plants often much over 10 cm. tall; basal leaves frequently absent, cauline ones sometimes many; capsule various. 11.

  11. Corolla rotate or shallowly campanulate-spreading, cut well below the middle; style conspicuously exserted, often recurved; calyx-lobes usually with 1-several prominent teeth near base; leaves narrowly lanceolate or oblanceolate, remotely denticulate; capsule obconic, erect, opening near the top. Dry limestone talus and cliffs, alpine crevices and rocky places, gravelly streambanks, etc. South Slope of Brooks Range, Cent. Alaska, to Cent. Yuk. and S. W. Mack. (Endemic) .... C. AURITA

  11. Corolla shallowly to deeply campanulate or funnelform, never truly rotate, seldom cut below the middle; style shorter than to barely exceeding corolla, not recurved; sepals toothed or entire; leaves and capsules various. 12.

    12. Anthers 1-3 mm. long; corolla short-funnelform, seldom over 12 mm. long, erect to nodding; calyx-lobes erect, appressed to corolla, sometimes connivent, entire; plant appearing fleshy, one-flowered (very rarely few-flowered); lower cauline leaves entire or irregularly crenate; ovary and capsule distinctively obovoid to clavate, usually broadest just above the middle, erect, opening near the top. (Cf. No. 7 above for habitats and distrib.) .... C. UNIFLORA

    12. Anthers 3.5 mm. or mostly longer; corolla variously shaped, often much exceeding 12 mm. long, erect to nodding; calyx-lobes if erect and appressed never connivent, sometimes toothed; plant not appearing fleshy, frequently several-flowered (on short axillary branches above); lower cauline leaves usually sharp-toothed, at least remotely; ovary and capsule variously shaped but seldom broadest near the middle, erect or nodding, opening above or below. 13.

      13. Plants 2-14 (8) cm. tall, completely glabrous; longest cauline leaves 7-17 (12) mm. long, ovate or lance-oblong with cuneate base, sharply denticulate or serrate at least at apex; corolla shallowly funnelform, 9-15 (12) mm. long, cut nearly or quite to the middle, erect; capsule obconic, erect, opening near the top. Moist subalpine meadows and streambanks. Mts. of N. Calif. (Endemic) .... C. WILKINSIANA

      13. Plants mostly over 10 cm. tall and often to 20 cm. or more, usually pubescent below at least in lines or

with ciliate leaf bases; longest cauline leaves rarely under 20 mm. and usually much longer, linear- to ovate-lanceolate or oblanceolate, remotely serrulate or occasionally close-serrate; corolla variously shaped, seldom as short as 15 mm. or cut to the middle; capsule various. 14.

14. Plants glabrous except for ciliate bases of lower cauline and rosette leaves, *the cilia 0.5-0.7 (1.0) mm. long,* typically one-flowered but not infrequently with several axillary flowers above; corolla funnelform-spreading, erect; calyx-lobes erect, appressed to corolla, usually with several conspicuous denticulations near base; capsule obconic, erect, opening near the top. Subalpine meadows and open rocky or gravelly places. Rocky Mts.: Ariz. and N. Mex. to W. Mont., Cent. Ida., and Wenatchee Mts., Cent. Wash. (Endemic) .... **C. PARRYI**

14. Plants glabrous or more often hirtellous below at least in lines on stem and leaf-bases, but *hairs never longer than 0.2 mm.,* typically with 2-many flowers but sometimes reduced to 1 in extreme alpine situations; corolla deeply campanulate or funnelform to tubular, divergent or nodding; calyx-lobes if erect seldom appressed to corolla, always entire; capsule hemispherical or broadly urceolate, pendant (apparent in herbarium material by conspicuously arcuate pedicel), opening near the base. Subalpine to alpine and arctic meadows, fell-fields, screes, crevices and ledges, gravelly talus, alluvial fans, moist rocky shores, etc. Widespread, E. Aleut. Is. to S. Greenl., southward to Ore., Colo., Que., and Nfld. (Circumpolar) .... **C. ROTUNDIFOLIA** [Highly polymorphic species with extremely wide ecological amplitude. Only dwarf arctic-alpine specimens are intended to key out here; others should key out in next section.]

1. Plants tall, typically much over 20 cm. but occasionally shorter (cf. especially *C. scouleri* and the marsh species, which all key out here), erect, decumbent, or weak and reclining biennials or perennials, or if annual then not divaricately cymose-branched *(C. americana)*, only of temperate latitudes and low elevations (except *C. rotundifolia,* which keys out in both sections). 15.

15. Stem slender, weak and more or less reclining, sometimes retrorsely scabrous; inflorescence very lax, with terminal and

axillary flowers on slender pedicels; corolla rarely to 20 mm., usually much shorter; capsule short-hemispherical to subglobose, opening at or below the middle. Wet meadows, marshes, swamps, and bogs. 16.

- 16. Corolla rotate, cut almost to the base into linear-lanceolate lobes; stem and leaves glabrous; leaves narrowly lanceolate or oblanceolate, crenulate or crenulate-serrulate. Marshes, swamps, and wet borders and waysides. Fla. Peninsula. (Endemic) .... C. FLORIDANA
- 16. Corolla campanulate or funnelform, rarely cut below the middle, the lobes broadly lanceolate or deltoid-ovate; stem and leaves (midribs and margins) usually retrorsely scabrous; leaves various. 17.
  - 17. Leaves linear or narrowly lanceolate or oblanceolate (rarely ovate), mostly 3 cm. or longer, entire or remotely serrulate; corolla 6-12 mm. long; calyx-lobes entire or with a basal pair of denticulations. Wet meadows, marshes, swamps, and bogs. E. and Cent. U. S. and adjacent Can.: Sask. to Que., southward to Nebr., Mo., and Ga. (Endemic) .... C. APARINOIDES
  - 17. Leaves short-ovate, elliptic or obovate, to 2.5 cm. long, obscurely to prominently crenate-serrate at least above the middle; corolla 10-15 mm. long; calyx-lobes retrorsely scabrous on the margins near the base. Coastal freshwater swamps and bogs. Cent. Calif. (Endemic) .... C. CALIFORNICA

15. Stem slender to robust, firm, erect or decumbent (sometimes reclining or pendant in *C. rotundifolia*, but then without retrorse pubescence or rotate corolla), never retrorsely scabrous, though sometimes hispidulous with some reflexed hairs *(C. prenanthoides)*; inflorescence lax or strict; corolla various but often longer than 20 mm.; capsule various, sometimes opening near the top. Habitat dry to moist but never a marsh, swamp or bog. 18.

- 18. Style conspicuously exserted, often recurved; corolla short-campanulate or cut to the middle or beyond and funnelform-spreading or rotate; hypanthium glabrous; inflorescence various but flowers never in terminal head. 19.
  - 19. Corolla cut almost to the base, the lobes linear-lanceolate or broader, rotate or funnelform-spreading. 20.
    - 20. Corolla rotate, the lobes broadly lanceolate to deltoid-ovate; style uniquely declined and upcurved; inflorescence a spike of 1- 3(5)-flowered axillary cymes, usually very floriferous and wand-like; rank, more or less virgate annual (biennial), 28-208 (118) cm. tall, but seldom under 50 cm.; stem very robust; leaves

attenuate-acuminate, coarsely serrate; capsules slender-obconic, typically in triplets, stiffly erect on straight pedicels, opening near the top. Open woods, borders, shaded roadsides, and bottoms. Widespread, Long Is. through S. Ont. to Minn., southward to N. W. Fla., Miss., and Kan. (Endemic) .... C. AMERICANA

20. Corolla funnelform-spreading, the lobes linear-lanceolate; style often variously recurved but not regularly declined and upcurved; inflorescence spicate, racemose, or paniculate but not with 3-flowered cymes, few-flowered; slender, hardly virgate perennial (biennial), 20-80 cm. tall, but usually less than 50 cm.; leaves acute to short-acuminate, serrate; capsules hemispherical or urceolate, single or clustered but not in triplets, more or less pendant, on geniculate pedicels, opening at or below the middle. Dry open woods, Transition Zone below 1800 m. Southern B. C. to Cent. Calif., mostly west of Cascade Mts. (Endemic) .... C. PRENANTHOIDES

19. Corolla cut shallowly, sometimes to the middle but rarely beyond, short-campanulate or funnelform-spreading, the lobes broadly lanceolate to deltoid-ovate, never approaching linear. 21.

21. Inflorescence a profusely branched compound panicle, the flowers numerous; corolla short-campanulate, seldom cut to the middle, 6-8 mm. long; leaves coarsely, almost laciniately toothed; style straight; capsule ovoid to short-obconic, erect, on straight pedicel, opening near the base. Cliffs, dry rocky woods and waysides in Appalachian and Blue Ridge Mts., chiefly at low elevations. S. E. U. S.: Md. to Ga. and Ala., rarely adventive farther north. (Endemic) .... C. DIVARICATA

21. Inflorescence spicate or racemose, simple or few-branched, the flowers few; corolla funnelform-spreading, cut to about the middle; leaves serrate or crenate-serrate; style often recurved; capsule urceolate or ovoid, more or less pendant, on geniculate pedicel, opening near the middle. Open to dense woods, talus and outcrops, Transition Zone to about 1500 m. Alaska Panhandle to N. Calif., mostly west of Cascade Mts. (Endemic) .... C. SCOULERI

18. Style included or barely exserted, never recurved; corolla deeply campanulate or funnelform to tubular, rarely cut as deep as the middle; hypanthium frequently pubescent; flowers sometimes in a terminal head. 22.

22. Flowers sessile, in involucrate terminal heads and axillary glomerules; leaves elliptic or oblong to ovate, obtuse or

acute, crenate-serrate, petiolate below, often clasping above; capsule ovoid, erect, opening near the base. Waysides and waste places. Occasional escape from cultivation. (Eurasian) .... C. GLOMERATA

22. Flowers with short to long filiform pedicels, solitary or clustered in the axils or in loose to strict racemes or panicles; leaves variously shaped, acuminate, entire to sharply serrate, sessile or petiolate, but never clasping; capsule broadly hemispherical, urceolate, ovoid, or nearly globose, pendant, opening near the base. 23.

23. Hypanthium, calyx-lobes, and midveins outside unexpanded corolla bristly with white hairs, 0.5-1.5 (2.0) mm. long; lower cauline leaves deltoid or deltoid-ovate, distinctly petiolate, coarsely sharp-serrate or laciniate to crenate-serrate; flowers erect or spreading, in pedunculate axillary clusters or on slender pedicels, forming a loose raceme or panicle. Waysides and waste places. Frequent escape from cultivation. (Eurasian) .... C. TRACHELIUM

23. Hypanthium and calyx-lobes glabrous or hispidulous, the hairs to 0.2 (0.5) mm. long; unexpanded corolla glabrous on the midveins; lower cauline leaves linear or narrowly to broadly lanceolate, sometimes sessile, entire or toothed; flowers divergent or nodding; inflorescence various. 24.

24. Hypanthium and calyx-lobes glabrous; flowers on slender pedicels, terminal and axillary, sometimes forming loose raceme or panicle, never secund; lower cauline leaves linear or narrowly lanceolate, sessile or acuminately tapered to winged petiole, entire or remotely serrulate (infrequently close-serrate); stems slender, more or less delicate, virgate or lax and decumbent, sometimes reclining or pendant from cliffs and crevices; corolla blue. Rocky or sandy shores, cliffs, mesophytic canyons and bottoms, open woods, and subalpine meadows. Widely distributed from E. Aleut. Is. to Greenl., southward to northern Mex., W. Tex., Mo., and W. Va. (Circumpolar, wide-ranging from temperate to arctic regions; cf. 14 above) .... C. ROTUNDIFOLIA

[Many Alaskan specimens and occasional others have broadly lanceolate or ovate, distinctly petiolate, and often closely serrate leaves; otherwise the characters are the same.]

24. Hypanthium, calyx-lobes and pedicels usually his-

pidulous; flowers on short pedicels, often nearly sessile, forming a strict, secund, spicate raceme; lower cauline leaves ovate-lanceolate, abruptly tapered to distinct, wingless petiole, finely to coarsely crenate-serrate; stems robust, the plants coarse and strictly erect; corolla violet. Waysides and waste places. Very common escape from cultivation, often becoming naturalized. (Eurasian) .... C. RAPUNCULOIDES

[1] Unless specifically modified, the terms "alpine" and "arctic" are used broadly here, as is customary, including those habitats or regions that more properly should be called "subalpine" and "subarctic."

[2] This is an observed range, and the parenthetic number is the mode, the most frequently observed value, not the mean. For characters having such narrow ranges of variability as this, the mode is perhaps more useful than the mean.

[3] By "corolla . . . spreading or nodding" is meant, technically, "flower . . . spreading or nodding," here and in all similar places in the key.

CHECKLIST OF THE SPECIES

CAMPANULA L. Bellflowers, Bluebells, Campanulas, Harebells. (Species prefixed with an asterisk (*) are endemic to North America.)

*1. C. AMERICANA L. (*C. acuminata* Michx.; *Campanulastrum americanum* (L.) Small). Tall Bellflower. N = 51. Perhaps the most characteristic American species.

*2. C. ANGUSTIFLORA Eastw. Eastwood's Harebell.

*3. C. APARINOIDES Pursh. (Incl. *C. uliginosa* Rydb.). Eastern Marsh Bellflower. Rydberg's *C. uliginosa*, the large-flowered form of the eastern marsh bellflower, is in its extreme quite distinct and, while hardly a good species, probably merits recognition as a separate race.

*4. C. AURITA Greene. Yukon Bellflower.

*5. C. CALIFORNICA (Kell.) Heller. (*Wahlenbergia californica* Kell.; *C. linnaeifolia* A. Gray). California Swamp Harebell.

6. C. CHAMISSONIS Fëdorov. (*C.dasyantha* auct. pl., non M. á Bieb.; *C. pilosa* sensu A. Gray, non Pall. ex Roem. et Schult.). Aleutian Bellflower. N = 17.

*7. C. DIVARICATA Michx. (*C. flexuosa* Michx.). Appalachian Bellflower. N = 20.

*8. C. EXIGUA Rattan. Chaparral Campanula.

*9. C. FLORIDANA S. Wats. ex A. Gray. (*Rotantha floridana* (S. Wats. ex A. Grav) Small). Florida Campanula. This species may prove to be merely a southern race of the widespread *C. aparinoides*.

[C. GLOMERATA L. Clustered Bellflower. N = 17, 34. Introduced.]

10. C. LASIOCARPA Cham. Alaska Bellflower. In the Aleutians this

species frequently grows intermixed with *C. chamissonis*, and the two species are often confused by collectors and taken as one species, getting mounted on one herbarium sheet. Several good characters distinguish them, however, and only the most depauperate specimens should cause trouble (cf. key).

*11. C. PARRYI A. Gray. (*C. planiflora* Engelm., non Lam.; *C. langsdorffiana* sensu A. Gray, non Fischer ex A. DC.). Rocky Mountain Bellflower. N = 17 [Shetler, in manuscript]. Plants from Washington, Idaho, and Montana tend to differ from typical *C. parryi* by having entire calyx-lobes and leaves. The calyx-lobes and the corolla, which is borne on a shorter peduncle, are shorter on the average. In these characters and in the not infrequent puberulence of the hypanthium, the plants of this general region approach the otherwise quite distinct *C. scabrella*. McVaugh (1942) segregated these plants as var. *idahoensis* of *C. parryi*. Recent floristic workers in the Rocky Mountain region have generally followed him. While McVaugh's taxon seems distinct enough on the whole, at least as he originally circumscribed it, further study is required to determine its true affinities. Some evidence suggests that it may represent a hybrid series between *C. parryi* and *C. scabrella*, and again other pieces of evidence hint that var. *idahoensis* has become a catch-basket epithet for several discordant elements and that certain plants hitherto referred here might in fact represent an as yet undescribed species. Until this question is resolved, occasional plants will continue to turn up from the Pacific Northwest that can be relegated to *C. parryi*, as var. *idahoensis*, only with doubt. This is particularly true of plants from the Wenatchee Mountains of Washington and the mountains of southwestern Montana. Most of the plants from these areas presently available in collections are in the flowering condition, and what are urgently needed are mature capsules.

*12. C. PIPERI Howell. Olympic Bellflower. N = 17.

*13. C. PRENANTHOIDES Durand. (*Asyneuma prenanthoides* (Durand) McVaugh). California Harebell. By itself, this species strikingly resembles species of the Asiatic genus *Asyneuma*, to which McVaugh (1945) has referred it. But the degree to which *C. prenanthoides* shares its characters in varying combinations with other American campanulas is such that I find no compelling reasons at present for separating it from the other 19 species recognized here. Quite possibly intensive study will require a rather extensive realignment in the family Campanulaceae as a whole, but until more convincing and comprehensive data are available, isolation of this one American species seems premature.

[C. **RAPUNCULOIDES** L. Rover Bellflower. N – 51. Introduced. By far the most common garden escape. Widely adventive or naturalized along roadsides and borders, it is frequently confused with the native *C. americana*, which it only superficially resembles. Apart from the rank habit and sometimes similar habitat, these plants are wholly unlike.]

*14. C. **REVERCHONI** A. Gray. Texas Bellflower.

*15. C. **ROBINSIAE** Small. (*Rotantha robinsiae* (Small) Small). Despite the fact that Small (1933, p. 1508) put this species in the segregate genus *Rotantha*, which he erected, along with *C. floridana*, because they share the rotate corolla, these species are not at all closely related. As Small (1926) himself so aptly pointed out in his original description, *C. robinsiae* is most closely related to the Texan *C. reverchoni*. According to him (p. 36), "It differs conspicuously, however, in the glabrous leaves, the short hypanthium, the smaller calyx, the smaller corolla with a shorter tube, and the subglobose capsule." The distribution of this species is so restricted (Chinsegut Hill, Fla.) that one is led to raise certain questions about its origin. This part of Florida is not particularly noteworthy for local endemics, and in fact it is a bit hard to explain how this species or any other has come to survive only here. As one can readily see upon visiting Chinsegut Hill, the immediate vicinity has been disturbed by cultivation and plantings for a considerable period of time, and the possibility must not be ruled out that *Campanula robinsiae* represents a pre-1926 Eurasian introduction, perhaps accidental.

16. C. **ROTUNDIFOLIA** L. s.l. (Incl.: *C. r.* var. *alaskana* A. Gray; *C. heterodoxa* auct., non Vest in Roem. et Schult.; *C. intercedens* auct., non Witasek; *C. latisepala* Hult.; *C. linifolia* auct., non Scop.; *C. macdougalii* Rydb.; *C. petiolata* A. DC., *C. rotundifolia* × *latisepala* sensu Hult.; *C. sacajaweana* Peck; *C. scheuchzeri* auct., non Vill.). Harebell, Bluebells-of-Scotland. N = 17, 28, 34. This species is extremely polymorphic in North America, as throughout the Old World, and is comprised of several geographic races, which I have been studying. For the purposes of this synopsis, I have united the numerous biotypes under the single taxon, *C. rotundifolia*, which thereby becomes by far the most cosmopolitan North American campanula. It is the only species known from Mexico, where it has been collected in the states of Coahuila, Nuevo León, and Tamaulipas.

Owing to its extreme variability, it is from time to time confused with almost every other American species. In the Rocky Mountain region, particularly, it is often confused with *C. parryi*, which however is amply distinct. The two species are distinguishable at a glance when mature capsules are present, but good floral and vegetative characters also exist (cf. key).

*17. C. SCABRELLA Engelm. Downy Alpine Bellflower.

*18. C. SCOULERI Hook. ex A. DC. Scouler's Harebell. In addition to the means provided in the key, it can be distinguished from *C. prenanthoides*, to which it is most similar, as follows. While the latter is usually quite leafy below the inflorescence, having 12 or more leaves which are sessile, *C. scouleri* tends to have fewer than 10 leaves which are mostly petiolate. The lowest cauline leaves of *C. scouleri* are also more broadly ovate, often nearly rotund.

[C. TRACHELIUM L. Nettle-leaved Bellflower, Throatwort. N = 17. Introduced. Of the species included here, it is more similar to *C. rapunculoides*, from which it can readily be distinguished by the pubescence.]

19. C. UNIFLORA L. Arctic Campanula. The only truly high alpine-high arctic campanula in North America. Single-flowered specimens of *C. parryi* and *C. rotundifolia* are mistaken for it frequently in the Rocky Mountain region, but there is little excuse for this. The much rarer *C. uniflora* is quite distinct and has no close relatives here. On the average it occurs at higher elevations than either of the other species. Typically, the hypanthium has long white trichomes, as *C. chamissonis* and *C. lasiocarpa*, but in the Colorado Rockies plants with a glabrous hypanthium are common. Perhaps they should be segregated as a separate geographic race, but further study is needed.

*20. C. WILKINSIANA Greene. Wilkins' Harebell. An endemic of Mt. Shasta and the Trinity Mountains in California, this campanula is surely quite close to the Olympic Mountain endemic of Washington, *C. piperi*.

DOUBTFUL AND EXCLUDED SPECIES

C. DASYANTHA M. á Bieb. (*C. pallasiana* Vest in Roem. et Schult.; *C. pilosa* Pall. ex Roem. et Schult.). An Asian species (not the *C. dasyantha* of American authors, cf. *C. chamissonis*) that does not to my knowledge occur in North America, despite the range statement of Fëdorov in "Flora SSSR" (vol. **24**: 278), including Canada.

C. RENTONAE Senior. Described from plants grown in culture from seed originating in the Wenatchee Mountains of Washington. It seems to belong to the *Parryi-Scabrella* series usually referred to *C. parryi* var. *idahoensis*, but needs more study.

COMMENTS

The single most striking fact deriving from this conspectus is that of the 20 species recognized as native to North America 16 (80%) are endemic, sometimes to a very localized area of the continent. The specific differences among the 20 species, though in some cases quite small, are nonetheless remarkably stable, and few taxonomists would dispute the discreteness of these species. If anything, the inclination might be to split several of them into two or more smaller species. Perhaps significantly, the endemics are confined largely to unglaciated parts of North America — areas south of maximum ice advance, refugial islands within the continental ice sheet, or areas where discontinuous montane glaciers might have left sufficient nunataks for hardy species, like some of the Western endemic alpine bellflowers, to survive. Species illustrative of these three types of survival areas would be *C. divaricata* (Appalachians), *C. aurita* (Yukon Tablelands), and *C. parryi* (Rockies), respectively. Although two widespread Eastern endemics, *C. americana* and *C. aparinoides*, presently occur inside the southern margin of the glaciated region, this distribution probably represents a post-Pleistocene invasion from the south. Whether these and other endemic species occupied much greater areas of the glaciated region prior to Pleistocene times is hard to say, but it is very doubtful that any have done so in recent times. Greenland is without endemic species. Only *C. rotundifolia* and *C. uniflora,* both circumpolar, occur there as also in the Canadian Eastern Arctic.

So highly endemic and localized is the North American campanula flora that one is tempted in constructing a key to to ignore the morphological characters and use geographical and ecological criteria for the primary dichotomies. The utility of geography is at once apparent from the following breakdown, in which I have divided North America into a number of arbitrary, though partially natural, regions and listed under each those species of *Campanula* native throughout or in some part of that region. For highly localized species, the exact area is listed in parenthesis after the species. Any given species may appear in more than one regional list, but the endemics, which are starred (*), are generally confined to one of the regions. If not, they are starred only in the region of their principal range (cf. _C. americana_). Thus, by observing asterisks one can quickly grasp the relative distribution across North America of the 16 endemic species.

ALASKA AND NORTHWEST CANADA

*_C. aurita_
C. chamissonis (Aleutians)
C. lasiocarpa
C. rotundifolia
C. scouleri (Alaska Panhandle)
C. uniflora

CANADIAN EASTERN ARCTIC AND GREENLAND

C. rotundifolia
C. uniflora

PACIFIC STATES AND ADJACENT BRITISH COLOMBIA

*_C. angustiflora_ (Calif.)
*_C. californica_ (Calif.)
*_C. exigua_ (Calif.)
C. lasiocarpa (N. Wash., S. B.C.)
C. parryi (C. Wash.)
*_C. piperi_ (Wash.)
*_C. prenanthoides_
C. rotundifolia
*_C. scabrella_
*_C. scouleri_
*_C. wilkinsiana_ (Calif.)

ROCKY MOUNTAIN REGION (Northern Mex. to C. Alta.)

C. lasiocarpa (Alta.)
*_C. parryi_
C. rotundifolia
C. uniflora

NORTHCENTRAL AND NORTHEASTERN U. S. AND ADJACENT CANADA

*_C. americana_
*_C. aparinoides_
C. rotundifolia
C. uniflora (Gaspé)

SOUTHCENTRAL U. S.

(All species infreq. and scattered or very localized)

C. americana
C. aparinoides
*_C. reverchoni_ (C. Texas)
C. rotundifolia

SOUTHEASTERN U. S.

C. americana
C. aparinoides
*_C. divaricata_
*_C. floridana_ (Fla.)
*_C. robinsiae_ (Fla.)

Any thoroughgoing consideration of relationships is not possible at present and speculation is premature; nevertheless, the following species-groups are patent even to the casual student:

- I. DWARF ANNUAL ENDEMICS
  - *C. angustiflora*
  - *C. exigua*
  - *C. reverchoni*
  - *C. robinsiae*
- II. ARCTIC-ALPINE ENDEMICS
  - *C. aurita*
  - *C. parryi*
  - *C. piperi*
  - *C. scabrella*
  - *C. wilkinsiana*
- III. MARSH-SWAMP-BOG ENDEMICS
  - *C. aparinoides*
  - *C. californica*
  - *C. floridana*
- IV. PACIFIC COASTAL FOREST ENDEMICS
  - *C. prenanthoides*
  - *C. scouleri*
- V. AMPHI-PACIFIC ARCTIC SPECIES
  - *C. chamissonis*
  - *C. lasiocarpa*

In conclusion, it should be emphasized again that this synopis is not in any way offered as a revision of *Campanula* in North America. At the same time there is little reason to expect that such a revision, when it does appear, will alter the present alignment of species greatly if at all. But while the *species* are reasonably well defined, the story at the lower levels is somewhat different. Insofar as the New World is concerned, the problems of *Campanula* have to do mainly with infraspecific variation and the question of geographic races within several of the more widespread and polymorphic species (e. g., *C. aparinoides, C. rotundifolia*).

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To Drs. Olga Lakela, Univ. of South Florida, and Velva Rudd, Smithsonian Institution, I am grateful for information supplied on the exceedingly rare *C. robinsiae*, and to Dr. Daniel B. Ward, Univ. of Florida, I tender sincere

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SMITHSONIAN INSTITUTION

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ALPINE ZONE OF THE PRESIDENTIAL RANGE[1]

This attractive booklet describes certain aspects of the geology, climate and organisms of the Presidential Range of New Hampshire. There is a brief section on mammals, birds and insects, but most of the space is devoted to plants. Included is a checklist of plants of the alpine zone with photographs, descriptions and discussions of a number of them. There is also an interesting discussion of the ecology of the region, a topic on which Dr. Bliss speaks with authority.

The descriptions and photographs of the plants should be helpful to a beginner to the area. However, the ranges of many of the plants are much more extensive than is indicated. For example, *Salix Uva-ursi* is stated to be "common in Alpine Garden near some of the streams and also on the summits of Mts. Franklin and Pleasant." Actually this plant, as noted by Pease in his "Vascular Flora of Coos County," is common throughout the alpine region, extending from Mt. Madison to Mt. Clinton and descending quite low on open ridges and ravines.

The booklet contains a number of errors and omissions. Of *Potentilla Robbinsiana*, the most interesting plant in the Range, it is stated "that the only place in the world it occurs . . . is at the east end of Mt. Monroe cone." Actually it also occurs on the Franconia Range and is represented from there by a number of collections. He states of *Geum Peckii* "restricted to the Presidential and Franconia Ranges of the White Mountains." It occurs at several lowland stations between these ranges, on Cannon Mt., for example, and also on Brier Island, Nova Scotia, as is noted in Gray's Manual of Botany 8th Edition.

The most notable omission in the checklist of plants found in the alpine zone is *Rhinanthus borealis,* but there are a number of others, examples of which are *Claytonia caroliniana, Ribes glandulosum* and *Viburnum edule.* Plants typical of the subalpine spruce-fir forest are noted with an asterisk, whereas alpine plants are not thus designated. However, there is some confusion in this procedure. Thus we find *Carex atratiformis,* known from New Hampshire in only one limited locality near Mt. Monroe, indicated as characteristic of the spruce-fir forest while *Carex brunnescens* is designated as limited to the alpine zone. *(Carex brunnescens* var. *sphaerostachya* is found at low elevations. It would have been better to list the Alpine plant as *C. brunnescens* var. *brunnescens.)*

The booklet has a good index, and if the above limitations are kept in mind, should be most useful to anyone wishing an introduction to the flora of the Presidential Range.

FREDERIC L. STEELE, ST. MARY'S-IN-THE-MOUNTAINS
LITTLETON, N. H.

[1] Alpine Zone of the Presidential Range, L. C. Bliss, Urbana, Ill., 67 pages, 58 photographs, $1.25.

CHROMOSOME NUMBERS IN SOME NORTH AMERICAN SPECIES OF THE GENUS CIRSIUM[1]

GERALD B. OWNBEY AND YU-TSENG HSI

As part of a comprehensive review of the systematics of *Cirsium*, the senior author, with the assistance and collaboration of the junior author, has accumulated data on chromosome number in a number of species. In this genus, it appears that chromosome data can contribute significantly to an understanding of its taxonomy. The present report records those data accumulated during the past three years and it is hoped will represent only the first in a series of reports treating this subject.

To date, chromosome numbers for eleven species of American cirsiums have been published, viz., *C. discolor* and *C. muticum* (Ownbey, 1951; Frankton & Moore, 1963), *C. cernuum (C. nivale)* and *C. subcoriaceum* (Stoutamire & Beaman, 1960), *C. flodmanii* and *C. undulatum* (Frankton & Moore, 1961), *C. horridulum* (Turner, Ellison & King, 1961), *C. edule* and *C. brevistylum* (Moore & Frankton, 1962b), *C. skutchii* (Beaman & Turner, 1962), and *C. altissimum* (Frankton & Moore, 1963). Twelve additional species are reported upon in the present paper. Counts for the total of twenty-three species are summarized in Table 1, and further details for the twelve newly reported and five previously reported species are given in the body of the text.

Chromosome numbers in sporophytic cells of American *Cirsium* species so far examined vary from eighteen to thirty-four. Evidently, the gametic number of chromosomes forms a continuous series from nine to seventeen. One or two extra chromosomes have been observed in somatic cells of several species. The data indicate that all American species of *Cirsium* are diploids, although Frankton & Moore (1963) report a possible instance of triploidy in *C. muticum*. Chromosome numbers for a large number of Eurasian and

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Japanese species of *Cirsium* have been recorded. In all of these species the base or *x* number equals 17. All of the Eurasian species except two are diploids and these are tetraploids. In Japan, however, triploid, tetraploid, and hexaploid species have been reported by Aishima (1934) and Arano (1957). For a recent tabulation of chromosome numbers in Eurasian *Cynareae* the reader should refer to Moore & Frankton (1962a).

It has been suggested by Frankton & Moore (1961) that many American species of *Cirsium* may have arisen through the same process of reduction in chromosome number known to have occurred in other Compositae. In brief, this is accomplished by successive translocations from a chromosome to non-homologous chromosomes. When a centric segment has lost all genetic material essential to the viability of the race, the centric itself may be lost through meiotic accident without detriment to the survival of the race. The present writers see nothing inconsistent with this hypothesis in the data presented here and in fact the situation in the series *Undulata*, for which data are more nearly complete, affords abundant support for the hypothesis.

Morphology of the individual chromosomes of *Cirsium* species leaves much to be desired if this is to contribute substantially to the taxonomy of the genus. Due to the small size of the chromosomes, it is very difficult to pinpoint the location of the centromere on all or even a majority of the chromosomes of a given cell, even in good preparations. In gross size, the chromosomes in all species we have examined form a closely graded series from smallest to largest. One pair of satellite chromosomes probably is present in all species examined and one or two additional satellite chromosomes were clearly visible in some preparations. In all cases the satellite was part of a medium or large-sized chromosome.

A useful method of making chromosomal comparisons between closely related species of *Cirsium* has been adopted by Frankton & Moore (l.c.). By carefully measuring the length of each chromosome of a diploid cell at metaphase, a total length of chromosomes for the cell can be established. In practice, several cells are studied and an average figure calculated. This figure can be compared with that of other related species and certain probable relationships inferred.

Nomenclature of the subgeneric taxa above the species level adopted here follows exactly that of Petrak (1917). In this paper he treated a majority of the species which occur north of the Mexican border. The species found in Mexico and Central America were treated by the same author in earlier papers (Petrak, 1910, 1911).

Petrak placed all of the American species of *Cirsium* in the subgenus *Eucirsium*. The subgenus for North America is divided into six sections. A very large majority of our species are assigned to a single section, the *Onotrophe*. The section *Onotrophe* is taxonomically complex. It is divided into eleven subsections, many of which are further broken down into named assemblages of species which presumably represent series. In Table 1 and elsewhere through the paper, twenty-one species of the *Onotrophe* are mentioned. Chromosome counts have also been made on one species of the section *Cirsiopsis* and on one species of the section *Erythrolaena* as shown in the table. The remaining three sections of North American cirsiums are not mentioned in this paper. It is not our intent here to evaluate Petrak's subgeneric classification of *Cirsium*, nor would it be possible to do so without more exhaustive knowledge of the genus. For the present Petrak's system provides a useful and, undoubtedly to a high degree, accurate framework upon which to base further studies of the genus.

In the accompanying Table 1, it has been necessary to interpolate a few species which were unknown to Petrak or not fully treated by him. The species include *C. brevistylum*, *C. foliosum*, *C. hillii*, certain *Undulata* and *C. skutchii.*

METHODS

Almost all of our counts have been made from root-tip squashes. Seeds are scarified by chipping off part of the pericarp from the distal end and side, then laid on moist filter paper in covered petri dishes. The embryos begin to imbibe water immediately and within 24 hours the pericarp can be removed and discarded. The embryo is then placed in another sterile dish, allowed to grow for another 24 hours and then sterilized for three minutes in dilute potassium permanganate solution. It is then washed in distilled water and grown under sterile conditions as above for 4-7 days. Valuable seedlings may be lost if the cultures are allowed to become contaminated with fungi. When the primary root is of sufficient length (ca. 15 mm.) the tip is excised and placed immediately in .0025 mol./liter aqueous oxyquinoline solution where it remains for 3-4 hours. It is then transferred to Warmke's solution for 4-5 minutes and preserved in Carnoy's solution No. 2. Root tip squashes stained with acetocarmine are prepared according to standard procedures. We have made most of our preparations permanent.

The effect of pretreating with oxyquinoline is to cause maximum contraction of the chromosomes at metaphase and this makes for easier and more accurate counting. In our materials, however, a certain amount of morphological detail is lost in the maximally contracted chromosomes and this has some disadvantages for karyotypic analysis. Furthermore, as a consequence of unusual shortening of the chromosomes, it will be found that the measurements of length dimension are somewhat less than are reported by other workers.

Removal of the tip of the primary root for cytological purposes in no way injures the seedlings. They are permitted to remain in the sterile dishes until the cotyledons turn green and the branch rootlets appear well started. They are then planted in sand-filled flats and fed with a balanced aqueous nutrient solution. The plants can be transferred to a regular soil mix in individual pots or flats when they begin to show vigorous growth. If proper records are maintained, it is possible to grow the seedlings from which chromosome data has been obtained to maturity and to collect voucher specimens from them. In practice, we have often grown seedlings only to a stage sufficient to establish their specific identity for certain so as to eliminate undetected human errors in handling the materials.

All of the species examined in the course of these studies belong to the section Onotrophe.

Subsection STENANTHA:

Cirsium mexicanum DC. **n = 10; 2n = 22.**

MEXICO. CHIAPAS: About 1 mile east of Teopisca, along Route No. 190, *R. M. King, No. 2855* (MIN). **2n = 22.** OAXACA: About 8 miles northwest of Nochistlán, along Route No. 190, *R. M. King, No. 3532* (MIN, TEX). **n = 10.** Count made by B. L. Turner, W. L. Ellison and R. M. King, in 1960 and published by permission of Dr. Turner. TAMAULIPAS: Rancho del Cielo, 5 miles northwest of Gómez Fariás, alt. 3300 ft., *B. E. Harrell, No. 258* (MIN). **2n = 22.**

One and probably two pairs of chromosomes with satellites were observed in *No. 2855.* If our understanding of this species is correct, it is the most common and widespread *Cirsium* in Mexico. Superficially it appears to be a member of the *C. undulatum* alliance, but the presence of crisped hispidity in varying degrees on the upper leaf surfaces mitigates against its placement there. Petrak (1917) placed it in another subsection, the *Stenantha*, of the *Onotrophe.*

An inconsistency exists between the chromosome number communicated to the senior author by Dr. Turner and our own observations on other collections identified as the same species. Possibly this variation in number actually exists.

Subsection ACAULIA:

Cirsium drummondii T. & G. **2n = 34.**

CANADA. MANITOBA: Riding Mountain National Park, about 5.5 miles north of Wasagaming, Highway No. 10, *G. B. Ownbey, No. 2879* (MIN).

SOUTH DAKOTA. Pennington Co.: 4.6 miles south of Hill City, *G. B. & F. Ownbey, No. 2861.* (*C. coccinatum* Osterh.) (MIN).

Two pairs of chromosomes with satellites were observed with some certainty in the South Dakota material. Only one pair was observed in the Canadian material, but another pair could easily have been obscured in the preparation.

C. drummondii has been confused with *C. foliosum* (Hook.) DC. by one of the present writers (GBO) and others in the past, but we are now convinced that the two are fully distinct although closely related species. The presence of *C. drummondii* in the Black Hills of South Dakota represents an important disjunction from its primary Canadian range. Plants collected from the two localities cited above are, however, morphologically indistinguishable. The Black Hills plant was described as *Cirsium coccinatum* by George

E. Osterhout in 1934. Evidently, Osterhout was unfamiliar with *C. drummondii*, but at the same time recognized the distinctness of the Black Hills specimens from the omnipresent *C. foliosum* of the western mountainous areas.

Cirsium foliosum (Hook.) DC. **2n = 34, 36?**

COLORADO. JACKSON Co.: 1.3 miles north of Walden, *G. B. and F. Ownbey, No. 1497* (MIN). **2n = 34.** LA PLATA Co.: 21.9 miles east of Durango, U. S. Highway No. 160, alt. ca. 7200 ft., *G. B. Ownbey & Y. Hsi, No. 2642* (MIN). **2n = 34, 36?** MONTANA. POWELL Co.: 5 miles southwest of Avon, U. S. Highway No. 12, alt. ca. 4800 ft., *G. B. Ownbey & Y. Hsi, No. 2908* (MIN). **2n = 34, 36?**

One pair of chromosomes with satellites was observed in most cells at mitotic metaphase. This variable, wide-ranging species is in need of extensive cytotaxonomic analysis.

No. 2908 is the segregate species described as *Carduus kelseyi* Rydb.

Subsection ODORATA: Series PUMILA:

Cirsium hillii (Canby) Fern. **2n = 30.**

MINNESOTA. HENNEPIN Co.: Near Veteran's Hospital, Fort Snelling, *G. B. Ownbey, No. 2857.* (MIN).

One pair of chromosomes with satellites was observed.

C. hillii is perennial by means of root and crown sprouts and this has been and still remains the most useful way to distinguish it from its closest relative, *C. pumilum* (Nutt.) Spreng., a biennial.

Cirsium pumilum (Nutt.) Spreng. **2n = 30.**

CONNECTICUT. NEW HAVEN Co.: Vicinity of New Haven, *J. R. Reeder, s.n.*

No chromosomal peculiarities were observed. Plants were grown in the garden from seeds provided by Dr. Reeder.

Subsect. ACANTHOPHYLLA: Series MUTICA:

Cirsium muticum Michx. **2n = 20.**

MINNESOTA. HENNEPIN Co.: 5 miles southwest of Edina, U. S. Highway No. 212, *G. B. Ownbey & Y. Hsi, No. 2859.*

No chromosomes with satellites were observed in our preparations. They are, however, almost certainly present.

Frankton & Moore (1963) have recently reported somatic numbers of 20, 22, 30 and 31, in *C. muticum*. The two higher counts were obtained from materials originating in Florida. Earlier somatic counts by Ownbey (1951) and the number reported here have not deviated from the regular number of 20 for the species as it occurs in north-central United States. Further chromosome studies of this wide-ranging plant should prove of great interest.

Series ALTISSIMA:

Cirsium altissimum (L.) Spreng. **2n = 18, 20.**

IOWA. BOONE Co.: 3 miles east of Boone, *G. B. Ownbey, No. 2863* (MIN). **2n = 18, 20.** WISCONSIN. BARRON Co.: About 9 miles east of Cameron, 0.4 mile west of Rusk-Barron Co. line, U. S. Highway No. 8, *G. B. & F. Ownbey, No. 2855 in part* (MIN). **2n = 18.**

One pair of chromosomes definitely had satellites, and there was a suggestion of a second pair which could not be confirmed. The fully contracted chromosomes measured 0.8 to 1.5 microns in length.

No. 2855 consisted of a mixed population of *C. altissimum* and *C. discolor* together with many putative hybrids. The counts were from seedlings of a "pure" *C. altissimum* plant.

No. 2863 was the segregate called *C. iowense* (Pammel) Fern. in some manuals. We consider *C. iowense* to be either synonymous with *C. altissimum* or a hybrid derivative of that species and *C. discolor*. The type locality of *Cnicus iowensis* Pammel is the Ledges, a short distance south of Boone. In 1959 one of us (GBO) visited the Ledges and searched carefully but without success for Pammel's segregate but found only typical *C. discolor*. However, numerous plants of undoubted *C. iowense*, i.e., *C. altissimum* in the broad sense, were found along a railroad embankment east of Boone. A few viable seeds were obtained. Because of the lateness of the season it was impossible to form any opinion about the fertility of the naturally occurring plants. Four plants grown from seeds, however, proved to be fully fertile.

The cytology of *C. altissimum* has been examined recently by Frankton & Moore (1963). No deviation from a somatic number of 18 was found in the two collections studied.

Cirsium discolor (Muhl.) Spreng. **2n = 20.**

WISCONSIN. BARRON Co.: About 9 miles east of Cameron, 0.4

miles west of Rusk-Barron Co. line, U. S. Highway No. 8, *G. B. & F. Ownbey, No. 2855 in part* (MIN).

Growing with *C. altissimum* and numerous putative hybrids. The counts were made from seedlings of a "pure" *C. discolor* plant. At least one and possibly two pairs of chromosomes with satellites were observed. Length of the fully contracted chromosomes varied from 1.0-1.7 microns.

An extra chromosome was reported in one seedling of *C. discolor* by Frankton & Moore (1963). Counts by the present authors and by the senior author in a previous report (1951) have not deviated from 20.

Series UNDULATA:

Cirsium brevifolium Nutt. **2n = 22.**

IDAHO. LATAH Co.: Moscow, *G. B. Ownbey, No. 2661* (MIN).

One and possibly two pairs of chromosomes with satellites were observed. Length of the fully contracted chromosomes varies from 1.0-1.5 microns.

Cirsium canescens Nutt. **2n = 34, (36).**

COLORADO. JACKSON Co.: 1.3 miles north of Walden, *G. B. & F. Ownbey, No. 1496* (MIN). **2n = 34.** NEBRASKA. CHERRY Co.: 18.6 miles southwest of Merriam, *G. B. Ownbey & Y. Hsi, No. 2601* (MIN). **2n = 34.** SOUTH DAKOTA. BUTTE Co.: 17.0 miles northeast of Newell, U. S. Highway No. 212, *G. B. Ownbey & Y. Hsi, No. 2507* (MIN). **2n = 34.** SOUTH DAKOTA. FALL RIVER Co.: 9.0 miles north of Delrichs, S. Dak. Highway No. 79, *G. B. Ownbey & Y. Hsi, No. 2600.* **2n = 34.** WYOMING. ALBANY Co.: 0.8 mile northwest of Centennial, alt. 8100 ft., *G. B. & F. Ownbey, No. 1307* (MIN). **2n = 34.** WYOMING. ALBANY Co.: Veedavoo Glen, ca. 20 miles southeast of Laramie, a short distance east of U. S. Highway No. 30, *G. B. Ownbey & Y. Hsi, No. 2611* (MIN). **2n = 34** (3 plants), **36** (1 plant).

At least one and probably two pairs of chromosomes with satellites are present in this species. Fully contracted chromosomes measured from 0.5-1.2 microns in length. Two extra chromosomes were observed in one plant of *No. 2611.* Other less reliable figures not recorded here indicate an unusual degree of instability in the normal diploid number for this species. Possibly this is due to unbalanced genomes resultant from hybridization with other species, an hypothesis for which we have considerable observational evidence.

The characteristic monocarpic form of this species native to the sand hill areas of Nebraska has been accorded species rank as *Cirsium plattense* (Rydb.) Cock. ex Daniels by some authors. This robust form intergrades imperceptibly to the west and north with a more branched and sometimes longer-lived form with smaller heads. It is to this latter phase of the species that Nuttall's type specimen belongs.

Plants of *No. 2611* collected in the wild were not typical of the species and genetic contamination from some other species was suspected. *No. 1496* came from a mixed population of *C. canescens* and *C. foliosum* (Hook.) DC. and putative hybrids of these two.

Cirsium canescens Nutt. × **C. foliosum** (Hook.) DC. **2n = 34.**

COLORADO. JACKSON Co.: 1.3 miles north of Walden, *G. B. & F. Ownbey, No. 1497a* (MIN).

The count was made from a seedling grown from seed of a putative natural hybrid.

Cirsium flodmanii (Rydb.) Arthur **n = 11; 2n = 22 (24).**

NEBRASKA. DIXON Co.: 14.1 miles east of Laurel, U. S. Highway No. 20, *G. B. Ownbey & Y. Hsi, No. 2487* (MIN). **n = 11; 2n = 22.** NORTH DAKOTA. WILLIAMS Co.: 7 miles east of Ray, *M. Ownbey, No. 3228* (MIN). **2n = 22, 24.** WYOMING. CROOK Co.: 6 miles west of Alladin, *M. Ownbey, No. 3215* (MIN). **2n = 22.**

One and probably two pairs of chromosomes of this species bear satellites. Length of the fully contracted chromosomes of *No. 2487* varied from 0.8-1.4 microns. The presence of two extra chromosomes in one plant of *No. 3288* was fully verified. Haploid counts of *No. 2487* were made from PMC squashes. Only one satellite-bearing chromosome was visible in this preparation.

Frankton & Moore (1961) report a maximum number of four satellite chromosomes in *C. flodmanii.* They found no variation from the somatic number of 22 chromosomes in a large number of collections from southwestern Canada and Montana.

Cirsium ochrocentrum Gray **2n = 32 (30, 31, 32)**

ARIZONA. COCONINO Co.: 16.7 miles south of Grand Canyon City, Ariz. Highway No. 64, *G. B. & F. Ownbey, No. 1822* (MIN). **2n = 30, 31, 32.** YAVAPAI Co.: 3.8 miles east of Seligman, *M. & G. B. Ownbey, No. 3001* (MIN). **2n = 32.** COLORADO. MONTROSE Co.: 7.1 miles south of Montrose, U. S. Highway No. 550, alt. ca. 6200 ft., *G. B.*

Ownbey & Y. Hsi, No. 2635 (MIN). **2n = 32.** SOUTH DAKOTA. FALL RIVER CO.: 14.3 miles north of Ardmore, *G. B. Ownbey & Y. Hsi, No. 2504* (MIN). **2n = 32.**

One and almost certainly two pairs of chromosomes with satellites are present in this species. Fully contracted chromosomes in *No. 2504* were found to vary from 0.5-1.0 micron in length. Of the four collections studied, only *No. 1822* showed any plant to plant variation from the usual 16 pairs of chromosomes characteristic of this species.

Collection numbers *2504* and *2635* represent the typical phase of this species ranging from the Great Plains westward to Wyoming, eastern Utah and New Mexico. This phase normally has strongly decurrent leaves and pale reddish-lavender corollas. Numbers *1822* and *3001* represent the phase found in Arizona southward and eastward to New Mexico, Sonora and Chihuahua. These plants have less strongly decurrent leaves with often broad and semi-clasping bases and bright scarlet-red corollas. Further study may indicate that the latter plants should be recognized nomenclatorially as a distinct subspecies or species but for the present we are leaving them with the typical form.

Cirsium pitcheri (Torr.) T. & G. **2n = 34.**

WISCONSIN. DOOR CO.: near White Fish Bay (northeast of Sturgeon Bay), *G. B. Ownbey & Y. Hsi, No. 2655* (MIN).

One pair of chromosomes with satellites was observed. Maximally contracted chromosomes varied from 0.5-1.2 microns in length. *C. pitcheri* is one of the comparatively few flowering plant species having a Great Lakes distributional pattern. It is fully distinct from, but in its vegetative morphology similar to, *C. canescens* Nutt. They appear to have similar ecological requirements to the extent that *C. pitcheri* is confined to the areas of partially stabilized sand back of the shore lines whereas over much of its range *C. canescens* is a characteristic component of the Sand Hills flora. Both the Sand Hills *C. canescens* and *C. pitcheri* are monocarpic. We think that *C. pitcheri* may be a derived species and its very narrow ecological spectrum and morphological homogeneity may indicate an advanced stage of depletion of its genetic variability.

Cirsium subniveum Rydb. **2n = 32.**

UTAH. UTAH CO.: 22.4 miles southeast of Thistle, U. S. Highway No. 6-50, alt. ca. 7000 ft., *G. B. Ownbey & Y. Hsi, No. 2660* (MIN).

One pair of chromosomes with satellites was observed. Maximally contracted chromosomes measured 0.5-1.2 microns in length. Although we have compared our collection with the type of *C. subniveum* and the similarity between the two is close, there is still a small residuum of doubt as to the correct identification of our specimens. We place *C. subniveum* in the series *Undulata* of the subsect. *Acanthophylla* with hesitation. Its closer affinities may lie elsewhere.

Cirsium tracyi (Rydb.) Petrak **2n = 24.**

COLORADO. DELTA CO.: 1.8 miles southeast of Paonia, *G. B. Ownbey & Y. Hsi, No. 2631* (MIN). (*Carduus acuatus* Osterh.) EAGLE CO.: Wolcott, alt. ca. 7000 ft., *G. B. Ownbey & E. Hsi, No. 2623* (MIN). (*Carduus floccosus* Rydb.) MONTEZUMA CO.: 2 miles northwest of Pleasant View, alt. ca. 6800 ft., *G. B. Ownbey & Y. Hsi, No. 2647* (MIN). MONTROSE CO.: Cimarron, alt. ca. 7000 ft., *G. B. Ownbey & Y. Hsi, No. 2633* (MIN). UTAH. SAN JUAN CO.: Elk Mountain road (Elk Ridge), 2.0 miles north of its junction with the Natural Bridge National Monument road west of Blanding, alt. ca. 8400 ft., *G. B. Ownbey & Y. Hsi, No. 2657* (MIN).

One pair of chromosomes with satellites was observed. The maximally contracted chromosomes measured from 0.8-2.4 microns long. The type locality of *Carduus acuatus* Osterhout is Paonia, the point of origin for our *No. 2631.* Comparison of the types establishes this species as a synonym of *C. tracyi.* Similarly, the type locality of *Carduus floccosus* Rydb. is Wolcott, the source of our *No. 2623,* and a comparison of the type of *C. floccosus* with that of *C. tracyi* convinces us that they are synonymous. A search was made for specimens of *C. tracyi* at the type locality, Mancos, Colorado, but none was found there. We collected the species at its nearest occurrence to the westward, near Pleasant View, Colorado, our *No. 2647.* A study of the chromosomes of these three collections and two additional ones revealed no data inconsistent with combining the several proposed species under a single binomial, which in accorddance with the International Rules must be *Cirsium tracyi* (Rydb.) Petrak.

Cirsium undulatum (Nutt.) Spreng. **n = 13; 2n = 26.**

MONTANA. LAKE CO.: 4.5 miles northwest of Polson, U. S. Highway No. 93, *G. B. Ownbey & Y. Hsi, No. 2900* (MIN). MINERAL CO.: 7.6 miles west of Alberton, U. S. Highway No. 10, alt. ca. 3000 ft., *G. B. & F. Ownbey, No. 2663* (MIN). NEBRASKA. BOX BUTTE CO.: 21.8 miles south of Crawford, Nebr. Highway No. 2, *G. B. Ownbey & Y. Hsi, No. 2503* (MIN). SHERIDAN CO.: 10.9 miles east of Alliance, Nebr. Highway No. 2, *G. B. Ownbey & Y. Hsi, No. 2499* (MIN). SOUTH DAKOTA. CUSTER CO.: 14.3 miles south of Custer, U. S. Highway No. A85, *G. B. & F. Ownbey, No. 1297* (MIN). WASHINGTON. ADAMS CO.: 16 miles east of Washtucna, Wash. Highway No. 118, *G. B. & F. Ownbey, No. 2662* (MIN). **n = 13; 2n = 26.** WYOMING. CROOK CO.: 0.5 mile east of summit of Bearlodge Mountains, on road between Alva, Wyo. and Belle Fourche, S. Dak., *G. B. Ownbey & Y. Hsi, No. 2917* (MIN). CROOK CO.: 7 miles northwest of Hulett, *M. Ownbey, No. 3213* (MIN).

One pair of chromosomes with satellites was seen in nearly every preparation. When fully contracted the chromosomes measured from 0.7-1.5 microns in length.

Frankton & Moore (1961) report a maximum of four satellite chromosomes in *C. undulatum*. A constant number of 26 chromosomes was found in a large number of collections from southwestern Canada and from Montana, South Dakota and Idaho in the United States.

This species is the most common and widespread *Cirsium* in western United States. It is found in the Great Plains from southern Canada to northern Mexico and westward across the mountains to the Pacific Northwest. Some variation in the species from region to region can be detected and it was thought that some variation in chromosome number or morphology might also occur. The species has, however, proved to be surprisingly constant to date, but more studies are indicated.

Cirsium wheeleri (Gray) Petrak **2n = 28.**

ARIZONA. NAVAJO CO.: 0.2 mile southeast of Showlow, *G. B. & F. Ownbey, No. 1806* (MIN).

At least one pair and possibly two pairs of chromosomes bear satellites. The fully contracted chromosomes measured from 0.5-1.2 microns in length.

DISCUSSION

It is probably premature to make any sweeping generalizations about the chromosomal situation in American cirsiums. It has been, however, of some interest to bring together all of the literature reports available to us at this time and to combine them in tabular form with those presented for the first time in this paper. Of the twenty-three species listed in Table 1, several have been examined repeatedly from widely separated parts of their ranges. The need for subjecting all of the wide ranging species to this form of analysis should be emphasized.

In contrast to the stability in chromosome numbers of Old World species of *Cirsium*, exclusive of the polyploid series in Japan, the American species exhibit an astonishing prevalence of reduction in numbers. As previously noted, diploid numbers at all levels of 18 through 34 have been found in one or more species. This fact will inevitably weigh heavily in the future development of any hypothetical phyletic sequences within groups of related species. We find in the series *Undulata* an excellent example of a reduction series that may find its counterpart in other alliances of related species within the genus. If we hypothesize that in the *Undulata* the more primitive species from the standpoint of chromosome numbers are those with 34 somatic chromosomes, then the other species in the series are derived. It does not follow, however, that the 34-chromosome species, namely, *C. canescens* and *C. pitcheri* are, in a morphological or physiological sense, *necessarily* more primitive than the other members of their group. The junior author has examined the correlations of chromosome numbers and morphological features of the *Undulata* to some extent (Hsi, mss., 1960). It is expected that a revised version of these observations will appear in a separate report, however, and they will not be detailed here. Probably changes in chromosome number are no more than a secondary pathway by which genetic diversity and subsequent morphological diversity can be achieved. Such changes are significant, particularly if numerous simple and reciprocal translocations of small chromosome segments are involved, in providing genetic recombinations not attainable by any other means. These rearrangements comprise a part, although probably not the most important part in any case, of the raw materials upon which selection operates. In the case of American cirsiums, chromosomal rearrangements concomitant with reduction in numbers may have played an unusually important role in speciation.

SUMMARY

Chromosome counts for seventeen species of American cirsiums are reported. Twelve of these species are recorded for the first time; five species for which published records exist are verified. American species examined by all authors to date total twenty-three. All species so far examined appear to be diploids and all possible genomes from nine through seventeen occur in at least one species. One or two extra chromosomes are sometimes found in individual plants. One or two pairs of satellite chromosomes were observed by the present authors in almost all species examined and it is suspected that they are universally present in the American species of the genus. A trend toward reduction of chromosome numbers in related groups of species is noted, the series *Undulata* being the best documented example of this trend. Chromosome morphology by itself has not provided any criteria of taxonomic value in distinguishing species or species groups to the present writers, but the work of others indicates that total length of the somatic chromosomes at metaphase, i.e., the sum of the lengths of the individual chromosomes, may ultimately provide useful comparative data.

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Table I. Summary of Counts of North American *Cirsium* Species.

Nomenclature	Author	Gametophytic	Sporophytic
Subgenus EUCIRSIUM			
Sect. CIRSIOPSIS			
C. nivale (Kunth) Schz.-Bip. (*C. cernuum* Lag.)	Stoutamire & Beaman (1960)	17	
Sect. ONOTROPHE			
Subsect. MINUTIFLORA			
C. brevistylum Cronq.	Moore & Frankton (1962)		34
C. edule Nutt.	Moore & Frankton (1962)		34
Subsect. STENANTHA			
Series MEXICANA			
C. mexicanum DC.	Ownbey & Hsi		22
	Turner, Ellison & King	10	
Subsect. ACAULIA			
C. drummondii T. & G.	Ownbey & Hsi		34

C. foliosum (Hook.) DC.	Ownbey & Hsi		34 (36?)
C. skutchii Blake	Beaman & Turner (1962)	17	
Subsect. ODORATA			
Series PUMILA			
C. hillii (Canby) Fern.	Ownbey & Hsi		30
C. pumilum (Nutt.) Spreng.	Ownbey & Hsi		30
Series HORRIDULA			
C. horridulum Michx.	Turner, Ellison & King (1961)	16	
Subsect. ACANTHOPHYLLA			
Series MUTICA			
C. muticum Michx.	Ownbey (1951);		20
	Frankton & Moore (1963)		20, 22, 30, 31
	Ownbey & Hsi		20
Series ALTISSIMA			
C. altissimum (L.) Spreng.	Frankton & Moore (1963)		18
	Ownbey & Hsi		18, 20
C. discolor (Muhl.) Spreng.	Ownbey (1951)		20
	Frankton & Moore (1963)		20, 21
	Ownbey & Hsi		20
Series UNDULATA			
C. brevifolium Nutt.	Ownbey & Hsi		22
C. canescens Nutt.	Ownbey & Hsi		34, 36
C. flodmanii (Rydb.) Arthur	Frankton & Moore (1961)		22
	Ownbey & Hsi	11	22, 24
C. ochrocentrum Gray	Ownbey & Hsi		32, 30, 31
C. pitcheri (Torr.) T. & G.	Ownbey & Hsi		34
C. subniveum Rydb.	Ownbey & Hsi		32
C. tracyi (Rydb.) Petrak	Ownbey & Hsi		24
C. undulatum (Nutt.) Spreng.	Frankton & Moore (1961)		26
	Ownbey & Hsi	13	26
C. wheeleri (Gray) Petrak	Ownbey & Hsi		28
Sect. ERYTHROLAENA			
Subsect. CONSPICUA			
C. subcoriaceum (Less.) Schz.-Bip.	Stoutamire & Beaman (1960)	17	

NEW SPECIES OF DIGITARIA AND TRICHACHNE

Jason R. Swallen

Some time ago Dr. Richard A. Howard sent me two grasses from the West Indies for identification. They appeared to be common species of Digitaria and Trichachne, but on closer examination they proved to be undescribed. It is a coincidence that both species have a similar (geographical) distribution, and differ from the related species in essentially the same characters.

Trichachne affinis Swallen, *sp. nov.*

Culmi graciles 60-70 cm. alti; laminae planae, laxae, usque ad 18 cm. longae, 7-9 mm. latae; racemi adscendentes, 8-10 cm. longi; spiculae 4 mm. longae, acuminatae; lemma sterile 5-nervium, glabrum, marginibus dense villosum.

Perennial; culms 60-70 cm. tall, slender, erect, or decumbent at the base, the cataphylls densely villous; innovations extravaginal, sometimes appearing like short rhizomes; sheaths mostly longer than the internodes, glabrous or very sparsely hispid; ligule a thin membrane about 2 mm. long; blades lax, flat, attenuate, as much as 18 cm. long, 7-9 mm. wide, glabrous, the margins scabrous; inflorescence 13-18 cm. long, composed of few to several erect or ascending racemes about 8-10 cm. long; spikelets in pairs, 4 mm. long, ovate, acuminate; first glume 0.5 mm. long, nerveless, obtuse; second glume narrow, 3-nerved, acuminate, as long as the fruit, glabrous between the nerves, long-villous on the margins; sterile lemma as long as the fruit, ovate, acuminate, 5-nerved, glabrous between the nerves, long-villous on the margins, the hairs extending about 1 mm. beyond the spikelet; fruit as long as the second glume and sterile lemma.

Type in the U. S. National Herbarium No. 1556826, collected along roadsides at Quinigua, Valle del Cibao, Province de Santiago, Dominican Republic, October 21, 1930 by *E. L. Ekman* ("Mus. Botan. Stockholm" No. *H-16090*).

This species is most closely related to *Trichachne insularis* (L.) Nees and *T. sacchariflora* (Raddi) Nees with which it has been confused. It is readily separated from both, however, by the ovate, strongly 5-nerved sterile lemma which is glabrous between the nerves but densely villous on the margins with pale straw-colored or usually white hairs. The plants are also more slender with relatively narrower blades, although no clear differentiation can be made on these characters.

The type was selected as an average specimen and the description drawn up from it. Depauperate specimens occur which are only 10-20 cm. tall with blades 2 mm. wide (Redonda, *Howard 15234*), while others are as much as 15 dm. tall (Peru, *Allard 21150*). Specimens from Mexico and South America usually have larger spikelets, 5 mm. long, and a longer more pointed fruit.

West Indies and Mexico south to Bolivia and Brazil.

Representative specimens:

WEST INDIES: PORTO RICO, *Hess 428;* ST. KITTS, *Box 129;* TRINIDAD, *Freeman 7513;* REDONDA (Leeward Islands), *Howard 15234.* MEXICO: QUINTANA ROO, Tancah, *Swallen 2775;* NUEVO LEON, Monterrey, *Mueller 376, Harvey 1072;* SAN LUIS POTOSI; Xititla, *Sohns 1441.* GUATEMALA: Escuintla, *Hitchcock 9008.* PANAMA: Point Chamé, *Hitchcock 8156.* COLOMBIA: VAUPÉS; Río Kuduyarí, *Schultes 17867;* TOLIMA; Armero, *Cuatrecasas 10497.* VENEZUELA: Cristobal Colon, *Broadway 334;* CARABOBO, Lake Valencia, *Chase 12341.* PERU: HUÁNUCO; Río Azul, *Ferreyra 12758;* JUNIN, Colonia Perené, *Hitchcock 22079;* SAN MARTÍN, Tingo María, *Allard 21150.* BOLIVIA: Santa Cruz, *Steinbach 5221, 6638;* Mapiri, *Rusby 246;* Chulumani, Sur Yungas *Hitchcock 22665.* BRAZIL: RIO GRANDE DO SUL, São Leopoldo, *Dutra 566;* Pelotas, *Costa Sacco 86;* SANTA CATARINA: Itajaí, *Reitz & Klein 3365.*

Digitaria diversiflora Swallen, *sp. nov.*

Culmi decumbentes 15-45 cm. longi; laminae 4-5 cm. longae, 3.5-5 mm. latae, sparse papilloso-hispidae; racemi divergentes, 4-8 cm. longi; spiculae 2.7-3 mm. longae, binae, biformes, spiculae inferioris lemma sterile glabrum, spiculae superioris lemma sterile inter nervos lateralis dense pilosum.

Annual; culms erect or decumbent spreading and rooting at the lower nodes, 15-45 cm. long; sheaths shorter than the internodes, sparsely to rather densely papillose hispid, especially toward the base and along the margins; ligule membranaceous about 1.5 mm. long; blades 4-5 cm. long, 3.5-5 mm. wide, sparsely papillose hispid near the base with long coarse hairs; inflorescence composed of 2 to several digitate spreading racemes, 4-8 cm. long, the rachis nearly 1 mm. wide, scabrous along the margins; spikelets in pairs, 2.7-3 mm. long, the lower spikelet of each pair distinct from the upper; lower spikelet oval, acute, the first glume broad, obtuse, 0.2-0.3 mm. long, the second narrow, 3-nerved, 2/3 as long as the spikelet, the sterile lemma glabrous (rarely with a few short hairs on the margin), strongly 5-nerved, the nerves equidistant; upper spikelet usually a little longer than the lower, lanceolate, the second glume pilose between the nerves, the sterile lemma 5-nerved, the lateral nerves approximate, densely fimbriate on the margins and between the lateral nerves; fruit acuminate, pale or straw-colored.

Type in the U. S. National Herbarium *No. 927914*, collected in open ground along road, Black River, Jamaica, October 22, 1912, by *A. S. Hitchcock (no. 9636)*.

The type was filed under *Digitaria sanguinalis* (L.) Scop., which does not occur in the Tropics. The species is closely related to *D. adscendens* (H.B.K.) Henr., differing, however, in the biform spikelets, the shorter obtuse first glume, and the strong equidistant nerves of the glabrous sterile lemma of the lower one of a pair of spikelets.

Florida, Texas and the West Indies to Colombia and Venezuela.

Representative collections:

FLORIDA: Key Largo, *A. A. Eaton 446;* Cocoanut Grove, *Small & Carter 605.* TEXAS: Corpus Christi, *Hitchcock 5345;* Sarita, *Hitchcock 5440;* Kingsville, *Swallen 10264.* MEXICO: BAJA CALIFORNIA; San Jose del Cabo, *Brandegee 41;* Ribera, *Wiggins 5647;* SONORA; Alamos, *Rose et al. 12983;* SINALOA; Rosario, *Rose 1541*: VERACRUZ; Veracruz, *Hitchcock 6566:* YUCATAN; *Gaumer 1029.* GUATEMALA: IZABAL: Quirigua, *Blake 7704.* PANAMA: CANAL ZONE; Gamboa, *Pittier 4440; Standley 28504;* Balboa Heights, *Killip 4255;* San Jose Island, *Johnston 991.* CUBA: ISLE OF PINES; *Herradura 43161;* PINAR DEL RIO: Los Palacios, *Shafer 11794.* PORTO RICO: Juana Diaz, *Sargent 3210.* DOMINICAN REPUBLIC: Ciúdad Trujillo, *Allard 13,091, 15,010;* Samaná Peninsula, *Abbott 499.* HAITI: Port de Paix, *Leonard 11,190.* MONTSERRAT; Plymouth, *Potter 5529.* COLOMBIA: Cartagena, *Hitchcock 9905;* ANTIOQUIA; Puerto Berrio, *Archer 1413.* VENEZUELA: FALCÓN; Caro, *Tamayo 790.*

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A STRANGE FORM OF HYPERICUM CANADENSE — The recent report of *Hypericum gentianoides* L. from Great Wass Island, Maine (Rhodora 65: 285) is in error. What looked to me like that species actually was an odd assemblage of plants of *H. canadense* L. growing on or about a granite ledge. The herbarium material of these consists of 24 plants varying from 8-13 cm in height. They are stiffish, slender and entirely unbranched plants with very short and subappressed ascending leaves. From a short distance away, when first observed in the field, they seemed to be essentially leafless. The minimum leaf length in Gray's Manual, 8th edition is given as 1 cm except for the var. *galiiforme* Fernald from southeastern Virginia with leaves down to 5 mm long but possessing other features that hardly match our material. The largest leaf on any of our 24 specimens is about 1 cm long, the width being slightly more than 1 mm. Leaf length, in general varies directly with the height of plant, the shorter specimens having leaves not more than 5 mm long. Like many annuals *H. canadense* exhibits very different growth responses under different conditions. Many years ago in early September I collected a series of very unusual specimens of this St. John's-wort at the water's edge in a nearly depleted reservoir in Somersworth, New Hampshire (Hodgdon No. 7984). These also showed a marked response, but of a somewhat different kind from the plants of Great Wass Island. It would seem desirable to revise the description of the species to include extremes such as these but it would not seem to be wise to give formal names to individual deviant populations in such a plastic polymorphic species.

Preston Adams (Rhodora **64:** 241, 1962), commenting on the *Hypericum canadense* complex, questions the status of the varieties *magninsulare* and *galiiforme*. The analyses of the Great Wass Island and Somersworth collections seem to support Dr. Adams' doubts. The sepal lengths of specimens from the Great Wass Island collection vary from 2.2-3.2 mm, the mean being 2.68. The comparable data based on 18 plants of my Somersworth collection is 1.5-2.5 mm long the mean being 2.17. It is also of interest that flowers on the same plant may have very different lengths of sepals. When one considers the wide latitude of these sepal measurements and the great diversity in vegetative growth, it becomes increasingly evident that these constitute very poor taxonomic characters in the species.

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SOUTHEASTERN LIMIT OF CHAMAECYPARIS THYOIDES

DANIEL B. WARD

The Atlantic white-cedar, *Chamaecyparis thyoides* (L.) BSP., has long been understood to extend from southern Maine along the Coastal Plain through northern Florida and west to southern Mississippi (Rossbach, 1936; Little, 1953). At the southeastern limit of its range, Atlantic white-cedar was mapped by Korstian (1931), by Munns (1938), and by Brush (1947), as occurring throughout northern Florida and extending down the eastern half of the peninsula to just beyond Cape Canaveral. More recently, James (1961) has mapped *Chamaecyparis* in the Southeast and, although showing a gap in distribution between northeastern and western Florida, indicates six stations for the species in the northeastern part of the state.

Atlantic white-cedar does grow in western Florida, often forming dense stands in cool stream bottoms from Liberty County to the western edge of the state. Additional stations are known in Georgia; James records four. But south of the Georgia line and east of Liberty County, Florida, *Chamaecyparis* is one of the rarest of native trees. Herbarium records and confirmable published descriptions support the existence of only a single station of white-cedar in all of Florida east of Liberty County. A second station is now known, and the source of the erroneous published records has been traced.

For many years it has been common knowledge among botanists in Florida that there was a small stand of *Chamaecyparis* 4 miles south of Interlachen, Putnam County. West and Arnold (1946) apparently were the first to publish a note on the presence of the species in this area. Specimens from this station have been widely distributed and form the basis for James' southernmost record. This stand has recently been re-investigated and found to be much more extensive than previously thought. Scattered trees, and occasionally denser groupings, occur for several miles along a small clear stream known as Cabbage Creek almost to its mouth on the Oklawaha River. The number of trees is considerable, but few individuals exceed 15 to 18 inches in diameter at breast height, and all parts of the area show evidence of cutting and other disturbance.

In January, 1962, Ranger Paul Bielling of the U.S.D.A. Forest Service called the attention of the author to a stand of *Chamaecyparis thyoides* in the Ocala National Forest, Marion County, Florida. Several trips have since been made to the area, and observations have been recorded both for the *Chamaecyparis* and for the associated flora. This newly discovered station is virgin timber and is believed to terminate the range of white-cedar in the southeastern United States.

The Ocala National Forest is an extensive region covered in large part with a "scrub" characterized by sand pine, *Pinus clausa*, a species adapted to excessively drained and nutritionally deficient sands. Only in small "islands" of different soil type is there any appreciable growth of the more important commercial species such as longleaf pine, *Pinus palustris*. The region, therefore, was slow to become attractive to lumbering interests, and several small areas of great botanical interest have survived in an undisturbed state.

The stand of Atlantic white-cedar extends along the stream bottom of a clear and cool spring-fed brook which enters Juniper Run, the outlet of Juniper Springs, one of the large ever-flowing springs in which north-central Florida abounds. The stand may best be reached by Forest Service road #71, an intractable "ball-bearing sand" fire trail off Florida Highway 19 at a point about 5 miles northeast of the Juniper Springs Recreation Area, itself 24 miles east of Ocala. The white-cedar is found along the stream for a distance not to exceed one-half mile, in an area of less than 10 acres. The trees are common, but nowhere approach the dense single-species stands characteristic of white-cedar in the Atlantic coastal swamps. Thirty-nine of the larger trees have been measured, and averaged 18.9 inches in diameter.

Five of these were greater than 24 inches in diameter, with the largest attaining 34.2 inches.

Since none of the larger trees has been cut, estimation of their age is difficult. Two small trees cut by campers, with trunk diameters between 4 and 5 inches, were 42 and 75 years old, suggesting a minimum age for the larger trees of perhaps 250 to 350 years.

Recently Li (1962) has described white-cedar from Mississippi, Alabama, and western Florida as a distinct species under the name *Chamaecyparis henryae.* Li (in correspondence with the author) has identified a specimen from the Ocala Forest stand as typical *Chamaecyparis thyoides.* Li has cited many differences in bark, in foliage, and in male and female cones between what he considers the two species and suggests that the Mississippi to west Florida variant be more closely related to *Chamaecyparis nootkatensis* of the West Coast than to the true *Chamaecyparis thyoides.* Such speculations merit further investigation.

Associated with the *Chamaecyparis* in the Ocala Forest stand are several species of interest and of limited distribution. Among the most curious is the anomalous *Pieris phillyreifolia,* an ericaceous vine whose stems burrow upward beneath the bark of the white-cedar and then, at heights up to 7 meters, burst through to form apparently angiospermous branches on the gymnospermous trunk. The local *Illicium parviflorum* and the needle palm, *Rhapidophyllum hystrix,* are common in parts of the white-cedar swamp. There are several small trees of the very distinctive and very little known *Salix floridana* which, interestingly, has for another of its few stations the *Chamaecyparis* stand south of Interlachen.

Among the more prominent of the herbaceous species associated with the white-cedar are numerous vigorous plants of *Parnassia grandifolia* at its only known station in Florida. This species is customarily assumed to extend into Florida and was specifically cited for the state by Wherry (1935), yet no prior supporting records exist. Wherry has suggested (correspondence) that the basis for the thenspurious records was confusion by himself and J. K. Small with *Parnassia caroliniana* which occurs locally in western Florida.

Similar perpetuation of an original misinterpretation has been responsible for the published records of *Chamaecyparis* blanketing northern Florida and extending in quantity down the peninsula. The southernmost of the six northeast Florida stations reported by James was soundly based upon the Interlachen stand, but the remaining five were obtained from W. H. Duncan who, in turn, had received them from E. L. Little. Little (correspondence) had taken his information from an old map for white-cedar prepared by G. B. Sudworth, which had served as the source for the maps published by Korstian, by Munns, and by Brush. Little was able to trace the erroneous records to their source when he consulted Sudworth's card file of locality records, and there found them to be taken from R. M. Harper's *Geography and Vegetation of Northern Florida* (1914: 324, 334, 342). But no discredit falls to Harper; when he failed to observe a major forest tree in a particular area, and yet could not claim that no individuals were present, he customarily listed it under the conservative heading, "rare or absent." Sudworth chose to put the emphasis on the first possibility and thus began a belief in the Florida range of *Chamaecyparis* that is only now in part being substantiated.

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UNIVERSITY OF FLORIDA, GAINESVILLE

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COMMELINA COMMUNIS IN NEW HAMPSHIRE — In early October 1963 a specimen of Dayflower, *Commelina communis* L. from Concord, New Hampshire, parasitized by a smut, was brought to Dr. Avery Rich, Plant Pathologist at the University of New Hampshire. Because the smut proved to be of particular interest, I checked through our herbarium to determine if any of our specimens were similarly affected. To my surprise I found no collections from New Hampshire and on referring to our Manuals discovered that *C. communis* has not been reported as naturalizing northeast of Massachusetts. Certainly I am quite familiar with this species in the field having run across it a number of times in New Hampshire in recent years and have always assumed in fact that it was common enough not to merit much attention.

Apparently the only herbarium record from New Hampshire is my No. 6432 collected in 1949 as a garden weed at my former home in Durham. It is interesting to report that several vigorous plants were observed at this same place as recently as October 9, 1963, still not stricken by frost. Collections were made at this time (Hodgdon & Pike No. 12754).

A recent conversation with Mr. Carroll Durfee who had found the diseased Concord specimens revealed the interesting fact that these plants were also entirely naturalized, behaving much as those in Durham, growing each year from seeds and giving every indication of continuing to make themselves at home. Specimens of these recent collections from Durham and Concord, New Hampshire, are deposited in the Herbarium of the University of New Hampshire.

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NOTE ON LOMATOGONIUM — When Fernald (1919) discussed the taxonomy of the genus *Lomatogonium* it had not been reported in eastern North America south of the Magdalen Islands in the Gulf of St. Lawrence although the species *L. rotatum* (L.) Fries was well known along the coasts further north to Labrador and Western Greenland. Ten years later G. L. Stebbins, Jr. (1929) reported collecting this plant on August 4, 1928 at Schoodic Peninsula, Winter Harbor, Hancock County, Maine. Since 1919 there has been no other mention of *Lomatogonium rotatum* in Rhodora even in the exhaustive lists of Newfoundland and Labrador plants until it was reported from the Wolf Islands (Pike and Hodgdon 1963). This collection was made by A. R. Hodgdon 15 August 1960 on the northeast side of South Wolf near the beach of a small cove, since named Lomatogonium Cove. One dense clump formed a single station for this plant and only a few specimens were taken for the record. These have been deposited in the herbarium of the University of New Hampshire. The most careful search of this cove for the past three seasons has failed to reveal a single additional specimen. The site where the collection was made was a turfy bank vulnerable to northeast storms not far above the tide mark. A northeast gale occurred in the Bay of Fundy during the winter of 1960-61 at a period of high tides causing severe erosion on exposed shores. Thus, the site may have been washed away. However, it hardly seems credible that all the seeds of this profusely seeding annual plant would have been destroyed or eliminated. As some members of the Gentian family have seeds with long delayed dormancy it is hoped that this attractive gentian-like plant may reappear on the Wolves.

While hunting for *Primula laurentiana* along the Maine coast (Pike 1963) on September 15 of this past season I found *Lomatogonium rotatum* growing on two islands in Englishman's Bay off Jonesport in Washington County. These islands are nearly midway between the Stebbins station at Schoodic Point and that on the Wolf Islands in New Brunswick. My first collection was on Water Island which is hardly more than a large granite ledge some 15 or 20 feet above high water with humus deposits and pools in protected depressions. One of these depressions on the shoreward side of the island was covered with a dense mat of *Potentilla anserina* or *P. Egedei* var. *groenlandica* (positive identification of which has not yet been made) throughout which were scattered plants of *Lomatogonium rotatum* in full bloom. Specimens for the plant press and the greenhouse were both collected leaving a large proportion of the colony for reproduction. Later the same day this rare plant was found on nearby Mistake Island again growing in turf in crevices of the granite ledges close to Moose Peak Light. Associated with it in this case were *Primula laurentiana, Sagina procumbens,* and *Plantago juncoides.* The stature of the plants was considerably less here than on Water Island, some of them being less than an inch high yet in full bloom.

Fernald (1929) chose *Lomatogonium rotatum* as one of four species to illustrate epibiotic flora that in his opinion escaped the last glaciation. Hultén, (1955) in discussing the isolation of the Scandinavian Mountain Flora, cites *Lomatogonium rotatum* as one of a group ". . . of mountain plants with very wide gaps in their area" which ". . . have long been recognized as being very isolated in the Fenno-scandian mountains." He also regards the distribution pattern of this plant as due to escape from glaciation.

The occurrence of these four stations raises some interesting questions concerning the history of the flora of the Maine Coast and Bay of Fundy and indicates the desirability of close scrutiny of other headlands and outlying islands.

Specimens of these collections are deposited in the Herbaria of the New England Botanical Club and of the University of New Hampshire.

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A BUTTRESSED ELM FROM ONTARIO — Buttressing is a feature commonly associated with tropical trees, although *Ulmus americana L.* as a street tree sometimes shows a tendency toward buttress roots, occasionally (Washington, D. C., Amherst, Mass.) producing tiny buttresses 3-5 dm high. In 1958, during a brief visit to Rondeau Provincial Park, Ontario, on the north shore of Lake Erie, I was surprised to see a great elm, about 30-35 m tall and with a trunk 6-7 dm thick, which had wide buttresses about 2 m high. This tree was in the central part of the park, in deep beech-maple forest with a scattering of other trees, including elms and an enormous *Populus deltoides,* taller and much thicker than the buttressed elm. It was not possible to be positive as to which species of *Ulmus* the buttressed tree belonged, but its form suggested *U. americana.* Examination showed that most of the trees in the immediate area had some slight development of buttresses. The area is low and rather swampy, with very low parallel ridges of sand. *Boehmeria cylindrica, Collinsonia canadensis,* and *Onoclea sensibilis* were the common herbs, forming a dense ground cover.

In the tropics buttressing is frequently associated with swampy ground, but is by no means confined to trees in such habitats. In *Ceiba pentandra,* at least, it has been shown to be genetic (according to H. G. Baker, in talk given August 26, 1963 at Amherst, Mass.), rather than directly ecological in origin. It would be interesting to know how general the tendency toward buttressing is in the elms, and if it is more pronounced in swamps.

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New scientific names and combinations are printed in bold face type