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Plate 1198. Fronds of *Polystichum: P. acrostichoides* on the left; hybrid in the middle; *P. lonchitis* on the right.

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A NATURAL HYBRID OF POLYSTICHUM LONCHITIS AND P. ACROSTICHOIDES FROM THE BRUCE PENINSULA

W. H. WAGNER, JR. AND DALE J. HAGENAH

Polystichum lonchitis, the northern holly-fern, is a circumboreal species which occurs in eastern North America in Quebec, Cape Breton Island, Ontario, and northern Michigan. The endemic *P. acrostichoides*, the familiar Christmas fern, occurs in these areas too, but it also extends southward into Texas, Florida, and Mexico. In the Bruce Peninsula, Ontario, the writers found these two species growing in close proximity near Cape Croker. *P. lonchitis* is prevalent here on a rocky, dolomite hillside above a swamp, while *P. acrostichoides* abounds locally along the swamp margins, and the two species intermingle in certain places. In hope that a hybrid of these two ferns might be discovered, a special search was made at this locality. Although no hybrid has been previously recorded between these two ferns, such a plant would be of special interest in regard to the genetic effect of combining the features of a fern (*P. acrostichoides*) with strongly dimorphic pinnae, the fertile ones sharply distinguished morphologically from the sterile, with the features of a fern (*P. lonchitis*) with monomorphic and undifferentiated pinnae. The only previously reported *Polystichum* hybrid in eastern North America is *P. braunii* × *P. acrostichoides* (Thompson and Coffin 1940), but the anatomical features of the fertile pinnae of this hybrid were not investigated.

Our search for a hybrid was rewarded by finding a single, extremely large plant of obviously intermediate morphology, the spores of which are abortive, i.e., the sporangia contained bodies of irregular sizes and shapes. The previous year's fronds of the two parents bore normal spores, where these were present. A number of fronds were collected for the study of the hybrid and the parent species growing near it, both in the spring of 1952 and in the fall of 1953, but the hybrid plant was left growing. The intermediate is considerably larger than either of its parents, and is obviously extremely vigorous in growth. When we first observed it the previous year's fronds were still bright green, and a large number of nearly uncurled crosiers of this year's leaves were evident.

The hybrid was found at the west edge of the Cape Croker Indian Reservation, Bruce County, Ontario, at approximately 44° 52′ North and 81° 4′ West. The station is on the southeastern slope of a rocky hill at the top of the Niagara escarpment, here present as a series of terraces instead of the bold cliffs found close to Georgian Bay. The height of the plateau here is approximately 950 feet above sea level. Along the south side of the hill the dolomite of the Niagara formation is exposed in small bluffs up to 30 feet high, rising abruptly from the edge of a swamp. On the southeast the slope is more gentle, and an old pasture comes nearly to the foot of the slope. The second-growth woods which covers the hill is chiefly sugar maple and basswood, while elms grow in the swampy area. *Polystichum acrostichoides* is abundant and luxuriant along the swamp margin, and a few plants were also found near the edge of the woods along the old pasture. *P. lonchitis* is common along the rocky top of the hill, and is found on ledges and slopes along the hillside. Other ferns found in these woods are *Dryopteris filix-mas, D. intermedia, D. marginalis, Adiantum pedatum,* and *Botrychium virginianum.* Among the herbs are *Geranium robertianum, Viola canadensis, Maianthemum canadense, Polygonatum biflorum,* and *Hepatica acutiloba.* The hybrid fern is at the base of a low hummock about 20 yards from the edge of the woods along the old field. The nearest plants of *P. acrostichoides* are about 10 yards away, while plants of *P. lonchitis* are about 5 yards away.

Examination of Plate 1198 will reveal some of the salient features of the hybrid. In aspect it is intermediate between the two parents, although larger in over-all dimensions than either, and the pinna number of the hybrid, which averages 55.5 pairs

(53–59) is greater than *P. lonchitis* with 41 pairs (35–47) and much greater than *P. acrostichoides* with an average of 31 pairs (26–34). In all probability the excessively high number of pinnae of the hybrid is correlated with the obviously more vigorous growth and larger size of the plant in comparison with its parents.

In our later study of the hybrid the question arose whether it might not, in fact, be merely a monstrous form of the polymorphic *P. acrostichoides*, of which Fernald (1950, pp. 38–39) in Gray's Manual, 8th Ed., gives seven forms, and Brooks (1947, p. 24) described an eighth which "differs from the typical form of the species in having fronds strongly resembling *P. lonchitis* . . ." With regard to the last, it was possible to compare our plant with *P. acrostichoides* var. *lonchitoides* Brooks, through the kindness of Dr. Brooks, and the Herbarium of the University of West Virginia. This variety, which was collected in the neighborhood of French Creek, Upshur County, W. Va., is a much smaller plant than ours, and differs from the hybrid in having more leathery texture, shallowly and coarsely dentate pinna margins, and conspicuously dimorphic pinnae. Examination of the other obvious features of var. *lonchitoides* reveals that it is undoubtedly merely another of the forms of *P. acrostichoides* as it was originally considered to be. The number of pinna pairs is like that in typical *P. acrostichoides*, but the shortness of the pinnae gives the frond an unusually narrow appearance, and thus a resemblance to *P. lonchitis*.[1] In our plant, on the other hand, numerous obvious points of comparison show it to be a true intermediate between the putative parents.

The petiole-length: blade-length ratio in *Polystichum acrostichoides* is approximately 1 : 2.7, while that of *P. lonchitis* is 1 : 7.7. In the hybrid it averages about 1 : 6.4. One of the most distinctive contrasts in the parents is in respect to the lowest pinnae: in *P. acrostichoides* specimens from the Cape Croker locality the lower pinnae are but little reduced in size, as is typical of this

[1] The brief description of *P. acrostichoides* var. *lonchitoides* Brooks may be expanded here as follows: A narrow form of *P. acrostichoides*, with linear-oblong fronds, 30–45 cm. long, 2.6–3.6 cm. broad; the pinnae coriaceous, slightly crenate to coarsely and shallowly dentate, short-oblong-ovate, obtuse or rounded at the tips, 12–18 mm. long, 5–8 mm. broad, with the anterior basal auricle usually separated by a deep sinus from the rest of the pinna; the stipes densely fulvous-scaly; lower pinnae deflexed but not reduced in length more than one-half the length of the largest median pinnae; fertile pinnae contracted and pinnatifid. Type: French Creek, Upshur Co., W. Va., December 26, 1934. Maurice Brooks. (in Herb. Univ. W. Va.).

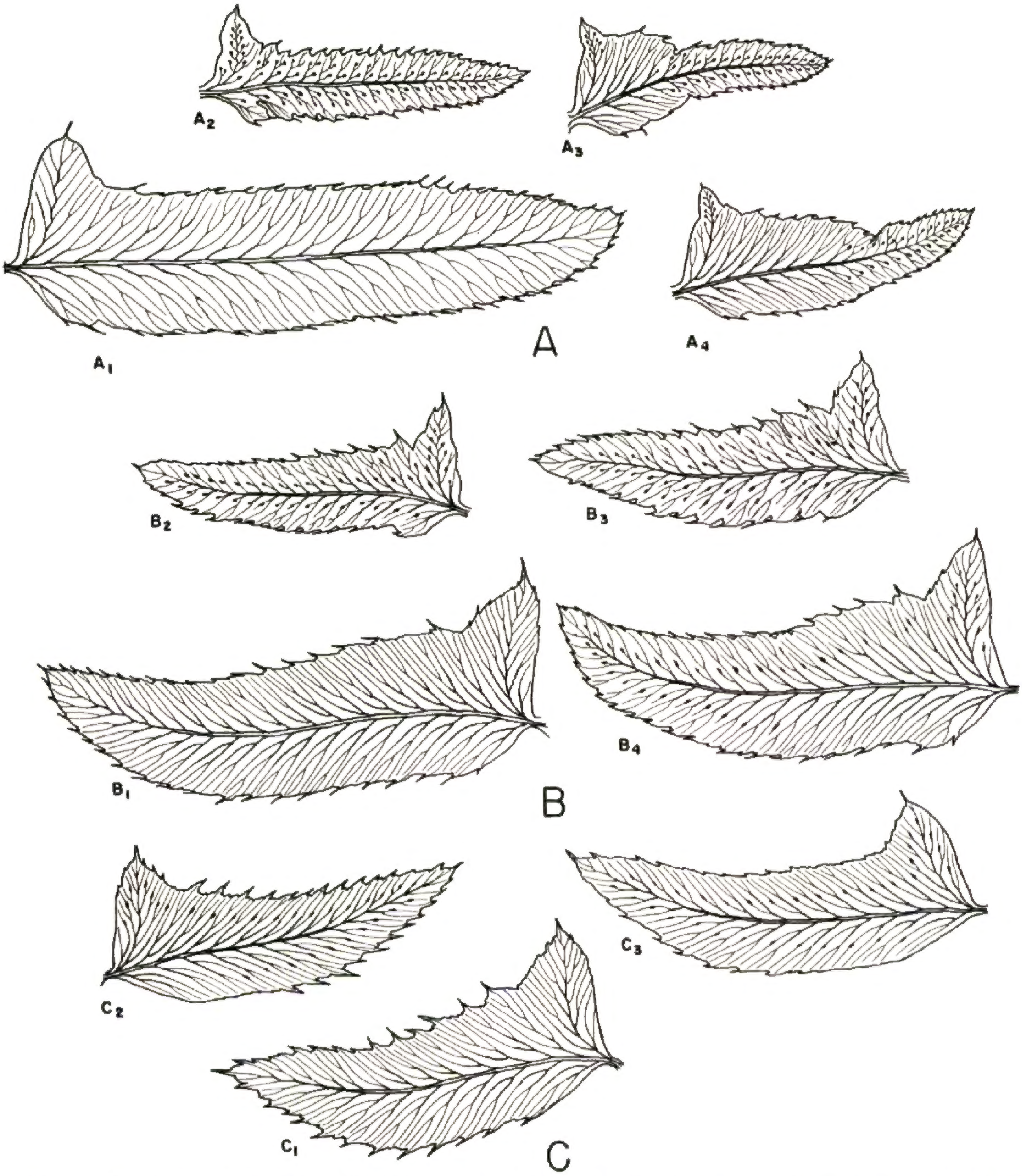

Fig. 1. Pinnae of *Polystichum* (Specimens from Cape Croker, Bruce Co., Ontario, except a_1 from Orange Co., N. Y., *Raup 7300*): A. *P. acrostichoides;* B. hybrid; C. *P. lonchitis.*

species, but the *P. lonchitis* specimens show much-reduced basal pinnae. In the former the ratio of length of the lowest pinnae to the length of the largest median pinnae is 4.4 (2.9–5.6) cm.: 5.1 (4.0–6.9) cm., and in the latter it is 1.0 (0.7–1.2) cm.: 2.4 (2.0–2.8) cm. In the hybrid the ratio is 1.7 (1.3–2.1): 3.5 (2.8–

3.9) cm. As shown in Fig. 1 the pinnae of *P. acrostichoides* are more distant than in either the hybrid or *P. lonchitis*. In *P. acrostichoides* the median pinna bases average 1.3 cm. distant from each other, in the hybrid 1.1 cm., and in *P. lonchitis* 0.9 cm. In the pinna outlines, likewise, the new plant is intermediate, not quite as oblong as in *P. acrostichoides* nor as obliquely falcate as in *P. lonchitis.*

The anatomical features of the fertile pinnae of the hybrid possess unusual interest because they combine two sharply distinct types of fertile veins. The fertile pinnae of *P. acrostichoides* differ from those of more typical species of this genus, not only in being strongly dimorphic, but in having a distinctive type of soral relationship to the veins. This relationship in *P. acrostichoides* differs from Copeland's (1947, p. 108) generic description: while the sori of *P. lonchitis* conform to his description of "sori dorsal on the veins," the sori of *P. acrostichoides* are *terminal* on modified veinlets, as shown in Fig. 1, A, where the sori have been removed to expose the club-like "fertile veins" which subtend each sorus. Every fertile vein in this species terminates abruptly at the position of the sorus, so that the sorus is terminal on the veinlet, in contrast to the situation in *P. lonchitis,* where the special mass of tracheids which subtends the sorus is a dorsal enlargement of an otherwise unmodified, and continuous, vein which extends to the margin of the pinna. (Fig. 1, C_2 and C_3).

The fertile pinnae of the hybrid are strikingly intermediate in respect to the fertile-vein structures of the parents. Fig. 1, B_2-B_4, illustrates different degrees of sorus production on several pinnae, B_2 and B_3 being the most soriferous. It will be observed that some of the fertile tracheid masses subtending sori are dorsal on the veins as in *P. lonchitis,* while others are terminal on the veins as in *P. acrostichoides.* But there is considerable irregularity in this respect, as some of the fertile veins have slender prolongations that extend only a short distance toward the margin, others have thicker ones which run all the way to the margin, and some have no distal projections at all.[2] Thus

[2] Morphogenetically one point especially should perhaps be stressed concerning the fertile veins of this hybrid, namely that the soral positions are regular and symmetrical in relation to the whole pinna. In theories of soral evolution stress has been laid by Bower and others on whether sori are on vein endings or on the sides of veins; considerable importance has been attached to the relationship of the sorus to

there is illustrated here in the minute anatomy of the fertile pinnae the sort of "irregularity phenomenon" which is observed elsewhere in the over-all leaf cutting of fern hybrids, where the parents have widely different leaf-forms (e.g., *Camptosorus* × *Asplenium* and *Dictyoxiphium* × *Tectaria*).

The contraction of the pinnae of the hybrid is so subtle that it does not show as well in the patterns of individual fertile and sterile pinnae as it does on the whole fronds. Examination of Plate 1198 will show that there is indeed a contraction of the fertile pinnae of the hybrid, although it is not nearly so conspicuous as in *P. acrostichoides*. In *P. lonchitis*, by contrast, the fertile pinnae tend actually to be slightly larger than the lower, sterile pinnae, but otherwise match them in almost every detail.

Examples of the hybrid described here will be deposited in the Gray Herbarium, National Herbarium, University of Michigan Herbarium, and the Herbarium of the Cranbrook Institute of Science.—University of Michigan and Cranbrook Institute of Science.

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its vein. Dickason (Ohio Journ. of Sci. **46:** p. 98, 1946) wrote that "A distinction between sori which are apical on veins and those which are lateral on them is far more fundamental than a distinction between sori which are marginal and those which are 'superficial' on the abaxial surface, inasmuch as sori apical on veins may be either marginal or superficial," and he divides fern genera into two great groups on this basis. Holttum (Biol. Rev. **24:** 271–272, 1949) says that "by more than one series of [evolutionary] changes the sorus may have become dorsal instead of terminal on its vein . . ." and thus again stresses the vein-sorus relationship.

One might expect, then, if vein-sorus relationship were the governing one in sorus position that the present hybrid might show various soral positions—sori terminal on long veins, terminal on short veins, dorsal on long veins, and dorsal on short-veins, and thus have an irregular soral pattern in relation to the whole pinna. But such is not the case: the sori themselves are symmetrical in position; the only variable is the veins themselves. The veins fluctuate around fixed sori.

THE CHROMOSOMES OF TRAGOPOGON[1]

MARION OWNBEY AND GILBERT D. MCCOLLUM

ALTHOUGH interspecific hybrids have been known in the Old World genus *Tragopogon* (Compositae) for nearly two centuries, the realization that this genus furnishes unusually favorable materials for the study of evolutionary relationships has been slow to develop. In his classic pioneer study, Winge (1938) worked out some of the cytogenetic relationships between *T. porrifolius* and *T. pratensis*, and Ownbey (1950) has given an account of the recent origin of two amphiploid species through natural hybridization. The present authors (1953) have summarized the evidence for cytoplasmic inheritance in the genus and have reported briefly on a number of interspecific crosses yet to be considered in detail. This paper records the karyotypes of fifty collections representing eight species of the genus assembled in our laboratory from various sources.

Among previous studies, only that of Winge (1938) considers in any detail the morphology of the somatic chromosomes of any species. Winge found *Tragopogon porrifolius* and *T. pratensis* each to have six pairs of chromosomes differing between the species significantly with respect to over-all length of some of the corresponding members of the two sets, the position of the primary constriction, and the presence or absence of a second satellite. Aside from the work of Winge, chromosome numbers of five species have been reported by Poddubnaja-Arnoldi *et al.* (1935) as follows: *T. brevirostris*, $2n = 12$; *T. cupani*, $2n = 24$; *T. major* (*dubius*), $2n = 12$; *T. marginatus*, $2n = 12$; and *T. porrifolius*, $2n = 12$. From meiotic studies, Ownbey (1950) confirmed the above reports for *T. dubius*, *T. porrifolius*, and *T. pratensis*, and added *T. mirus* ($2n = 24$) and *T. miscellus* ($2n = 24$) to the list of species which have been studied.

MATERIALS AND METHODS.—The sources of the materials used in these studies are given by species in the following table. We are grateful for the kind assistance of the collectors and correspondents mentioned. Except when otherwise indicated, the localities are in North America where *Tragopogon* has been introduced in post-Columbian time.

[1] This investigation was supported in part by funds provided for biological and medical research by State of Washington Initiative Measure No. 171.

Species	Garden Number	Race Name	$2n$	Fig.	Source
T. dubius	1	Pullman	12	1	Washington. Whitman Co.: 1 mi. s. of Pullman, *M. Ownbey*
T. dubius	16	Colton	12	2	Washington. Whitman Co.: w. of Colton, *M. Ownbey*
T. dubius	18	Rowena	12	3	South Dakota. Minnehaha Co.: 2½ mi. w. of Rowena, *M. Ownbey*
T. dubius	19	Douglas	12	4	Washington. Douglas Co.: near Douglas, *M. Ownbey*
T. dubius	20	Hulett	12	5	Wyoming. Crook Co.: 7 mi. n. w. of Hulett, *M. Ownbey*
T. dubius	21	Dardanelles	12	6	Washington. Chelan Co.: near Dardanelles, *M. Ownbey*
T. dubius	22	Rugby	12	7	North Dakota. Pierce Co.: 1 mi. s. w. of Rugby, *M. Ownbey*
T. dubius	23	Reliance	12	8	South Dakota. Lyman Co.: 3 mi. s. w. of Reliance, *M. Ownbey*
T. dubius	24	Vancouver	12	9	British Columbia. Vancouver Island: about 20 mi. n. of Victoria, *M. Ownbey*
T. dubius	28	Twin Falls	12	10	Idaho. Twin Falls Co.: e. of Twin Falls, *M. Ownbey*
T. dubius	35	Bloomington	12	11	Indiana. Monroe Co.: 2 mi. s. of Bloomington, *D. M. Smith*
T. dubius	36	Fortville	12	12	Indiana. Hancock Co.: 1.4 mi. s. w. of Fortville, *D. M. Smith & C.B. Heiser*
T. dubius	37	Jefferson	12	13	Indiana. Jefferson Co.: near junction, highways 3 and 256, *D. M. Smith*
T. dubius	43	Aurora	12	14	Kansas. Cloud Co.: Aurora, *Rev. S. V. Fraser*
T. dubius	45	Blewett	12	15	Washington. Kittitas Co.: s. approach to Blewett Pass, *D. L. Goodwin*
T. dubius	47	Guelph	12	16	Ontario. Guelph, *F. H. Montgomery*
T. dubius	61	Eugene	12	17	Oregon. Lane Co.: 4 mi. n. of Eugene, *M. Ownbey & S. J. Preece, Jr.*
T. cupani	68	Catania	12	18	Italy. Sicily: Catania, *Dr. G. Rodio*
T. cupani	70	Florence I	12	19	Italy. Seeds mixed with those of *T. porrifolius* from the Instituto Botanico della Universitá di Firenze, *Dr. A. Chiarugi*
T. cupani	72	Florence II	12	20	Italy. Seeds mixed with those of *T. pratensis* from the Instituto Botanico della Universitá di Firenze, *Dr. A. Chiarugi*
T. porrifolius	2	Pullman	12	21	Washington. Whitman Co.: Pullman, *M. Ownbey*
T. porrifolius	25	Victoria	12	22	British Columbia. Vancouver Island: Victoria, *M. Ownbey*
T. porrifolius	27	Twin Falls	12	23	Idaho. Twin Falls Co.: e. of Twin Falls, *M. Ownbey*

Species	Garden Number	Race Name	$2n$	Fig.	Source
T. porrifolius	34	Madison	12	24	Indiana. Madison Co.: s. w. of junction, highways 67 and 232, *C. B. Heiser & D. M. Smith*
T. porrifolius	44	Grangeville	12	25	Idaho. Idaho Co.: Grangeville, *M. Ownbey*
T. porrifolius	50	Guelph	12	26	Ontario. Guelph, *F. H. Montgomery*
T. porrifolius	62	Eugene	12	27	Oregon. Lane Co.: 4 mi. n. of Eugene, *M. Ownbey & S. J. Preece, Jr.*
T. porrifolius	63	Weed	12	28	California. Siskiyou Co.: 4 mi. n. of Weed, *M. Ownbey & S. J. Preece, Jr.*
T. porrifolius	65	Ferry-Morse	12	29	Distributed by Ferry-Morse Seed Company as "Mammoth Sandwich Island Salsify"
T. porrifolius	66	Corvallis	12	30	Oregon. Benton Co.: Corvallis, *M. Ownbey & S. J. Preece, Jr.*
T. pratensis	3	Moscow	12	31	Idaho. Latah Co.: Moscow, *M. Ownbey*
T. pratensis	26	Seattle	12	32	Washington. King Co.: 85th Street, near Aurora, Seattle, *M. Ownbey*
T. pratensis	31	Michelbach	12	33	Germany. Württemburg: Michelbach an der Bilz, *Dr. H. Scheerer*
T. pratensis	32	Uppsala	12	34	Sweden. Uppsala, *H. J. Brodie*
T. pratensis	33	Madison	12	35	Indiana. Madison Co.: s. w. of junction, highways 67 and 232, *C. B. Heiser & D. M. Smith*
T. pratensis	48	Guelph	12	36	Ontario. Guelph, *F. H. Montgomery*
T. pratensis	49	Waterdown	12	37	Ontario. Near Waterdown, *F. H. Montgomery*
T. pratensis	64	Mt. Shasta	12	38	California. Siskiyou Co.: Mt. Shasta (city), *M. Ownbey & S. J. Preece, Jr.*
T. pratensis[2]	71	Florence	12	39	Italy. Seeds from Instituto Botanico della Universitá di Firenze, *Dr. A. Chiarugi*
T. longirostris	46	Jerusalem	12	40	Israel. Jerusalem, *Dr. N. Feinbrun*
T. orientalis	77	Michelbach	12	41	Germany. Württemburg: seeds mixed with those of *T. pratensis*, Michelbach a. d. Bilz, *Dr. H. Scheerer*
T. orientalis	59	Graz	12	42	Austria. Botanischer Garten der Universität, Graz, *Dr. F. Widder*
T. orientalis	60	Königstuhl	12	43	Austria. Ostalpen, Norische Alpen, Voralpenwiesen zwischen Kleinem und Grossen Königstuhl, *Dr. F. Widder*
T. orientalis	67	Glashütten	12	44	Austria. Lavanttaler Alpen, Koralpe, Wiesen unter Glashütten, *Dr. F. Widder*

[2] Of the collections listed, this one alone has not flowered, and the original determination has been accepted without further verification. All other collections are represented by voucher specimens preserved in the Herbarium of the State College of Washington.

Species	Garden Number	Race Name	2n	Fig.	Source
T. mirus	4	Pullman	24	45	Washington. Whitman Co.: Pullman, *M. Ownbey*
T. mirus	5	Palouse	24	46	Washington. Whitman Co.: Palouse, *M. Ownbey*
T. mirus	29	Tekoa	24	47	Washington. Whitman Co.: Tekoa, *M. Ownbey*
T. miscellus	6	Moscow I	24	48	Idaho. Latah Co.: Moscow, *M. Ownbey*
T. miscellus	7	Moscow II	24	49	Idaho. Latah Co.: Moscow, *M. Ownbey*
T. miscellus	30	Moscow III	24	50	Idaho. Latah Co.: Moscow, *M. Ownbey*

The seeds were germinated on moist filter paper in Petri dishes at 15° C., and the young seedlings transferred to soil in pots when the primary root appeared. They were then grown at prevailing temperatures (in August) until ready to transplant to the garden at an age of about three weeks. The lowered temperature is necessary for the initiation of germination, but after growth is started higher temperatures produce no ill effects. At an age of about three weeks, the potted plants were placed in a refrigerator and chilled over night at just above 0° C. This treatment shortens and straightens the chromosomes which, when fixed without chilling, are long and tangled. Maximum contraction, however, is not desirable as often it obscures such morphological features as satellites and secondary constrictions, although enhancing the primary constriction. Fixation was in Belling's modified Navashin's fluid, after which the root tips were embedded in paraffin, sectioned at 15 microns, and stained with iodine-crystal violet. After careful study, one or more of the most representative plates from each collection were selected, and camera lucida drawings made at a magnification of 2700 diameters (reduced to 2000 × in reproduction).

Observations.—The chromosome base number of *Tragopogon*, as previous studies have shown, is six, with the chromosome sets of the different species with much in common. There is considerable variation in the over-all length of the individual chromosomes of a set, most species clearly having three long and three short pairs. For convenience in discussion, the chromosomes of each set are lettered from A to F generally according to over-all length. Chromosomes assigned the same letter are not necessarily homologous in different species, but that appears

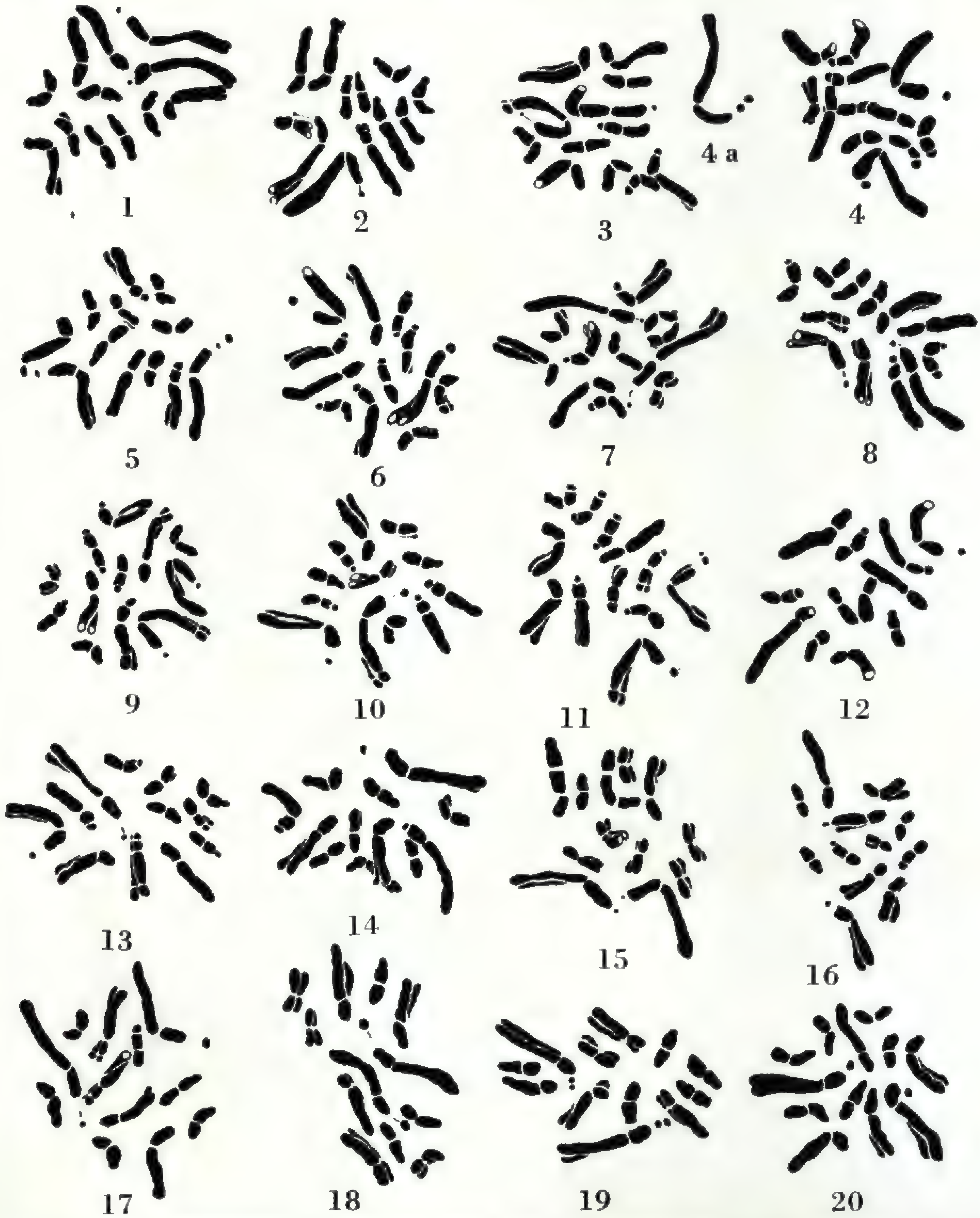

Fig. 1–20. Chromosomes of *Tragopogon*.—Fig. 1–17. *T. dubius* ($2n = 12$). —Fig. 18–20. *T. cupani* ($2n = 12$). $\times$ 2000. Additional explanation in text.

to be the usual situation. In general, the chromosome sets of different races of a single species resemble each other more closely than do those of races belonging to different species. There is more variation, however, between different races of a single species than has generally been supposed. The most usual intraspecific variation noted is found in the satellites, although there is some evidence that the relative lengths of the arms of a particular chromosome may vary within a species. The variation in the satellites is complicated by the fact that these structures may appear double (in tandem), single, or not at all in the same root tip or even in the same cell. Our studies, however, have been extensive enough to show clearly that the differences reported between races in these respects are probably real differences. Where the material is ample, it is possible to demonstrate these features even though they may not show clearly in every instance. What is said about satellites applies with even greater emphasis to secondary constrictions. In those races in which secondary constrictions occur, they can be seen with sufficient frequency that there is no question about their occurrence; in those races in which secondary constrictions are not reported, there has been adequate opportunity in most instances to observe them if they were there.

Tragopogon dubius.—Seventeen races of this species have been studied from localities scattered from Ontario and Indiana to the Pacific Ocean. All have twelve somatic chromosomes (fig. 1–17). There is considerable morphological and some chromosomal variation among the races. The chromosome set consists of three long and three short chromosomes. The longest chromosome "A" has very unequal arms and usually a single satellite. The second longest chromosome "B" also has very unequal arms as does the third, "C." The short arm of the "B" chromosome is shorter than the short arm of the "C" chromosome. The three short chromosomes have submedian primary constrictions and are nearly indistinguishable. One of them, "D," is often of greater over-all length than the other two, and in one race (Colton, fig.2) its primary constriction did not appear to be quite submedian. The three short chromosomes are often characterized by terminal knobs set off by subterminal secondary constrictions. The total number of knobs is usually not clear, but it appears that in at least some of the races all three of the short chromosomes have knobs at both ends. A similar knob occurs on the short arm of the "C" chromosome in most of the races. Somewhat longer segments are cut off by secondary constrictions on the long arm of the "A" chromosome in four races (Rowena, fig. 3; Vancouver, fig. 9; Twin Falls, fig. 10; Bloomington, fig. 11), on the long arm of the "B" chromosome in two races (Vancouver fig. 9; Twin Falls, fig. 10), and on the long arm of the "C" chromosome of two races (Vancouver, fig. 9; Jefferson, fig. 13). These constrictions are obscure and may have been overlooked in other races. A prominent secondary constriction in the middle of the long arm of the "B" chromosome appears in one race (Blewett, fig. 15). This would not have been overlooked had it occurred elsewhere. Tandem satellites on the short arm of the "A" chromosome were found in two races (Douglas, fig. 4a; Hulett, fig. 5). In the former, one of the plants studied showed this feature clearly at times, but it could not be found in any of the material of a sister plant (this line has been selfed for two generations).

Tragopogon cupani.—All three of the collections of this species studied have twelve somatic chromosomes (fig. 18–20). Each chromosome set consists of three long and three short members, and the positions of the primary constrictions are the same as in *T. dubius.* There is some indication of a terminal knob on at least the "D" chromosome, but no other indication of a secondary constriction. In one of the collections (fig. 19), definite tandem satellites are evident on the short arm of the "A" chromosome. In the other two collections, only a single satellite could be discerned with certainty. The material, however, was not as ample as could have been desired, and in one of the latter collections there was some suggestion that the satellite might actually be two.

These observations do not agree with the previous report of $2n = 24$ in *T. cupani* (Poddubnaja-Arnoldi, *et al.*, 1935), and that report must remain uncertain until it can be confirmed in material of certain identity. The identity of our material, also, is subject to further scrutiny.

Tragopogon porrifolius.—Ten collections of this species have been studied, nine from localities scattered from Indiana and

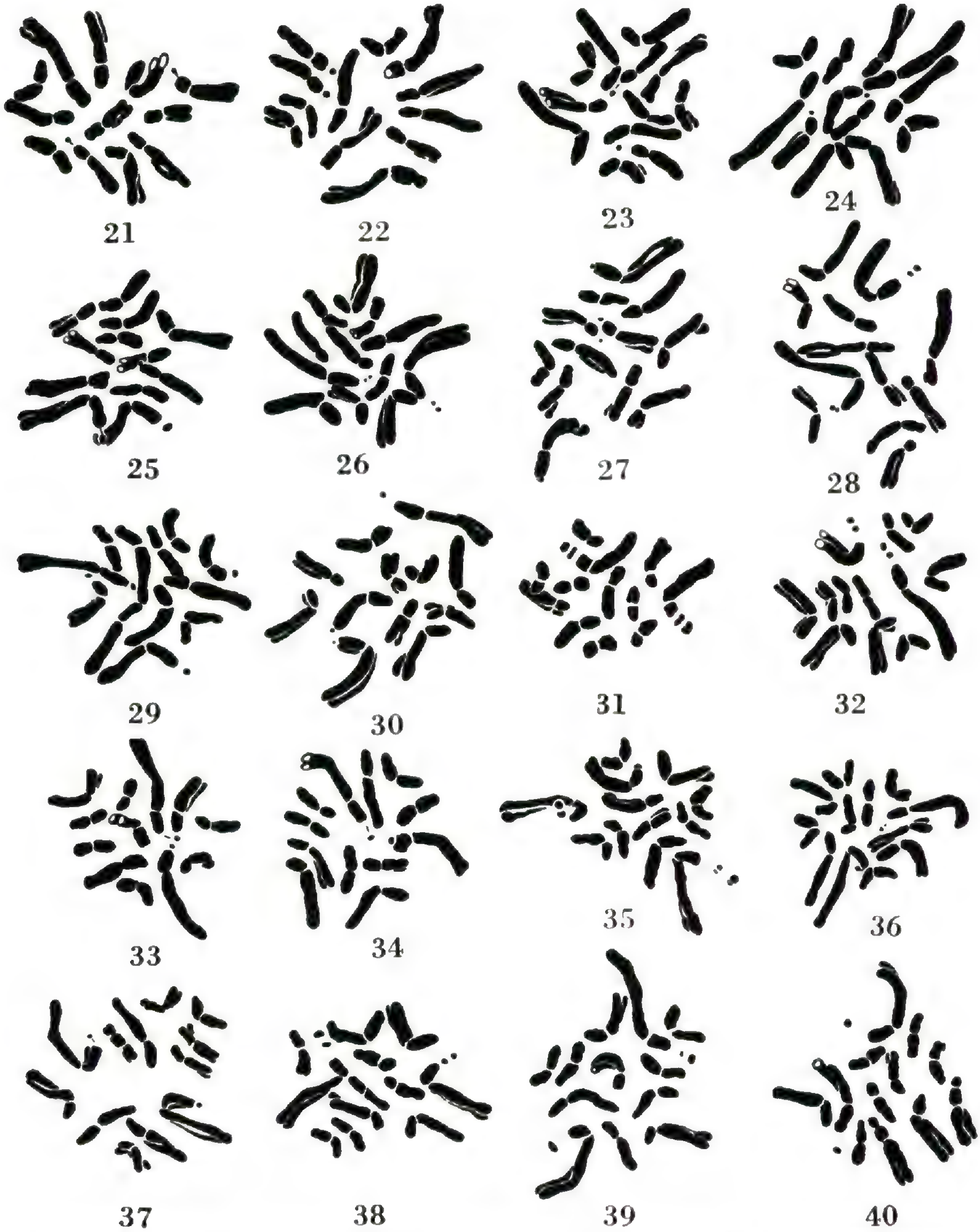

Fig. 21–40. Chromosomes of *Tragopogon*.—Fig. 21–30. *T. porrifolius* ($2n$ =12). —Fig. 31–39. *T. pratensis* ($2n$ = 12). —Fig. 40. *T. longirostris* ($2n$ = 12). × 2000. Additional explanation in text.

Ontario to the Pacific Ocean, and one from cultivation. All have twelve somatic chromosomes (fig. 21–30). Among the races, there is considerable morphological and some chromosomal variation. The chromosome set consists of three long and three short chromosomes, but the longest short one is about as long as the shortest long one. In none of the chromosomes is the primary constriction strictly median, although in the shortest one it might be termed submedian. The four longest chromosomes have very unequal arms, and as in *T. dubius* the short arm of the "C" chromosome usually is longer than the short arm of the "B." The satellites are small and often difficult to find. There is reason to believe that both the "A" and "D" chromosomes are regularly with satellites, but both have not been found with satellites in every collection. Tandem satellites occur on the "A" chromosome in two collections (Guelph, fig. 26; Weed, fig. 28). It is perhaps significant that no satellite was found on the "D" chromosome in either of these collections. Secondary constrictions and terminal knobs are absent or obscure in *T. porrifolius.*

The above results agree closely with those of Winge (1938). Although he found no difference between the "B" and "C" chromosomes in his material, and he found the "F" chromosome to have a median primary constriction, it is possible to interpret some of our material in exactly the same way.

Tragopogon pratensis.—Nine collections of this species have been studied, six from localities scattered from Ontario and Indiana to the Pacific Ocean, and one each from Sweden, Germany, and Italy. All have twelve somatic chromosomes (fig. 31–39). The considerable morphological variation among the races may be correlated with chromosomal variation. The chromosome set consists of three long and three short chromosomes. The three long chromosomes have very unequal arms, with the short arm of the "C" chromosome longer than the short arm of the "B." Sometimes the "C" chromosome has a greater over-all length than the "B." The short chromosomes are of two types. In the "D" chromosome, the arms are unequal, but in the "E" usually and in the "F" chromosomes, the primary constriction is submedian or nearly so. In two races (Mt. Shasta, fig. 38; Florence, fig. 39), the arms of the "E" chromosome are unequal.

Secondary constrictions and knobs—although they occur—have not been found to be dependably characteristic of any race. A most conspicuous feature in five of the races (Moscow, fig. 31; Seattle, fig. 32; Madison, fig. 35; Mt. Shasta, fig. 38; Florence, fig. 39) is the presence of tandem satellites on the short arm of the "A" chromosome. In the four remaining races, the satellite on the "A" chromosome is single (Michelbach, fig. 33; Uppsala, fig. 34; Guelph, fig. 36; Waterdown, fig. 37). These four races may all belong to the taxon *minor* which different European botanists have assigned a rank varying all the way from forma to species. If this is true, however, the taxon *minor* will be very difficult to characterize morphologically, which is undoubtedly the reason for the uncertainty concerning its rank.

Winge's material (1938) belonged to the taxon *minor* and differed slightly from any race which we have studied. The "A" chromosome possessed a single satellite. The "B" chromosome was shorter than the "C," and only the "F" chromosome showed a submedian primary constriction. All of these features have been found in our material, but not in this combination. The basis for the report of $2n = 14$ in *T. pratensis* ssp. *pratensis* (Clapham, *et al.*, 1952) is completely obscure.

Tragopogon longirostris.—Only a single race of this species has been available for study (Jerusalem, fig. 40). It has twelve somatic chromosomes, each set consisting of three long and three short ones. The three longest chromosomes have very unequal arms, and the short arm of the "B" is shorter than the short arm of the "C." A single satellite is found on the short arm of the "A," and a rather prominent knob is set off by a secondary constriction on the short arm of the "C." The longest of the short chromosomes "D" also has unequal arms, but the arms of the remaining two are subequal in length. Indistinct knobs occur on some of the short chromosomes.

Tragopogon orientalis.—This taxon is often considered to represent only a subspecies of *T. pratensis* to which it is undoubtedly closely related. Unlike the latter, however, our plants are self-sterile, leading us to the belief that two species are actually involved. Hybrids between the two are easily obtained, but they are highly sterile—about as much so as the F_1 hybrid between *T. pratensis* and *T. porrifolius.* Self-sterility is dominant in the F_1.

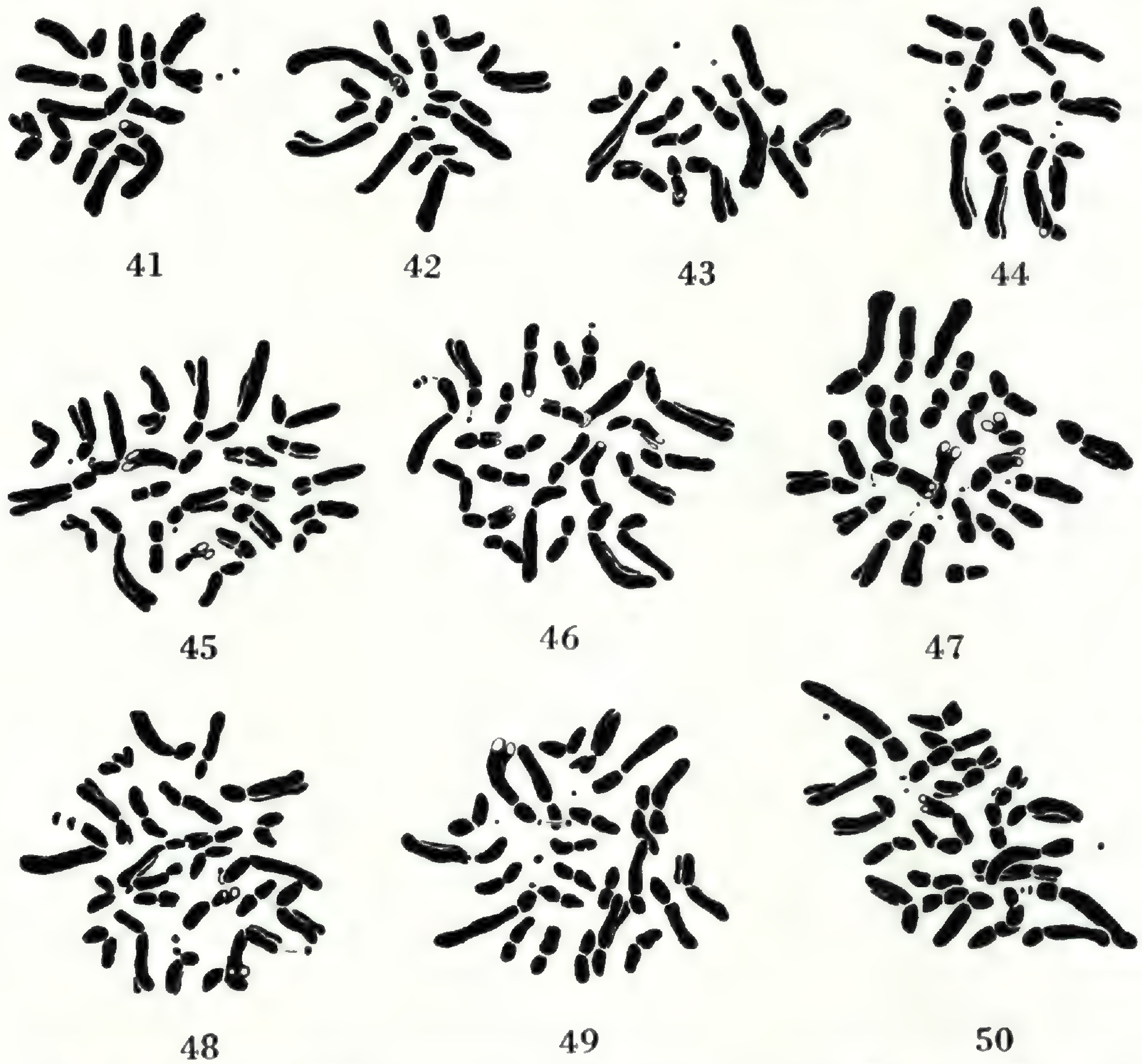

Fig. 41–50. Chromosomes of *Tragopogon*.—Fig. 41–44. *T. orientalis* ($2n = 12$).—Fig. 45–47. *T. mirus* ($2n = 24$).—Fig. 48–50. *T. miscellus* ($2n = 24$). $\times$ 2000. Additional explanation in text.

Four races of this species have been studied, all from Germany and Austria. All have twelve somatic chromosomes (Fig. 41–44), and the chromosome set consists of three long and three short members. The three long chromosomes have very unequal arms, with the short arm of the "B" shorter than the short arm of the "C." In two of the races (Graz, fig. 42; Königstuhl, fig. 43), the satellite on the short arm of the "A" chromosome is solitary. In the other two races (Michelbach, fig. 41; Glashütten, fig. 44), two satellites occur in tandem in this position. The "D" chromosome in all races has unequal arms, and in one, Graz, shows a secondary constriction in the middle of the long arm. In the remaining two chromosomes, the primary constriction is median or submedian in position.

From the above it is evident that there are no clear chromosomal distinctions between *T. pratensis* and *T. orientalis*, an observation which is in accord with the idea based on external morphology that the two are closely related. However, if the self fertility of the first, the self sterility of the second, and the sterility of the hybrids between them are considered to be valid differences, the two are clearly distinct species.

Tragopogon mirus.—In addition to the two localities previously reported (Ownbey, 1950), this tetraploid species is now known from Tekoa, Washington. The newly discovered colony is the most extensive one yet found, and the several thousand individuals comprising it are, on the average, significantly more fertile than are those of the other two colonies. From morphological and distributional data, it seems clear that the three colonies represent three independent instances of the origin of *T. mirus*. The chromosomal and fertility data also support this conclusion.

Inasmuch as the chromosome sets of the diploid *T. dubius* and *T. porrifolius* differ in a number of respects, the chromosomes of *T. mirus* should provide exceedingly critical evidence in support of its origin from these species through hybridization and amphiploidy. This evidence has been obtained. Where the chromosomes of the diploid species differ, a pair of each type is found in the tetraploid; where the diploid chromosomes are alike, four of a kind are present. Stronger evidence supporting the amphiploid origin of *T. mirus* can be obtained only by its artificial synthesis. Because of the larger number of chromosomes present in the tetraploid, it has not been possible to show all of the evidence in the single metaphase plate of each collection selected for illustration. Most complete is figure 47 (Tekoa), in which all six satellited chromosomes have been identified. It will be recalled, however, that in the Pullman race of *T. porrifolius*, satellites are difficult to find on the "A" chromosomes (they are so rare that one could not be found on a metaphase plate suitable for illustration). It is not surprising, therefore, that they were not found with any greater frequency on the "A" *porrifolius* chromosomes in the tetraploid derived from the Pullman race (fig. 45). The same is true of Palouse *mirus* (fig. 46), and it may be assumed that *T. porrifolius* in Palouse (which was not studied) is like the Pullman race in this respect. The satellites which are shown on the "A" chromosomes of Palouse *mirus* are sometimes clearly in tandem (fig. 46). These chromosomes must have come from a race of *T. dubius* in which tandem satellites occur. This means that the race of *T. dubius* entering into the formation of Palouse *mirus* must have been a different one than the one entering into the formation of Pullman *mirus*. Similarly, the presence of single satellites on all four "A" chromosomes in Tekoa *mirus* indicates that the race of *T. porrifolius* entering into its makeup was different from that entering into either of the other races of *T. mirus*. This evidence is in strong support of the independent origin of the three races of *T. mirus*.

Tragopogon miscellus.—In addition to the two Moscow localities previously reported (Ownbey, 1950), this tetraploid species was found at a third Moscow locality[3] at which it has now been destroyed by the building of a house and the planting of a lawn (the race, however, brought into the garden, has not been lost). This race appears to represent the reciprocal of the ones first discovered (Ownbey & McCollum, 1953), and like Tekoa *mirus* is significantly more fertile, on the average, than either of the other two races. Its independent origin seems clear.

As in the case of the previous tetraploid, the chromosome sets of the two diploid species, *T. dubius* and *T. pratensis*, from which *T. miscellus* is believed to have originated, differ in a number of respects. The "A" chromosome of *T. pratensis* (Moscow race) has tandem satellites; that of *T. dubius* usually has a single satellite. The "D" chromosome of *T. pratensis* has unequal arms; that of *T. dubius* has a submedian primary constriction. *T. miscellus* (fig. 48–50) conforms to expectations and has two chromosomes of each type, the remaining chromosomes being in fours. Thus the chromosomal evidence provides strong support for the origin of *T. miscellus* from *T. dubius* and *T. pratensis* through hybridization and amphiploidy.

DISCUSSION.—Evolution in the genus *Tragopogon* evidently has been preceded or accompanied by extensive repatterning

[3] In June, 1953, *T. miscellus* was found growing at two additional well-separated localities near Sheridan, Wyoming. As at the Moscow localities, *T. dubius*, *T. pratensis*, and the F_1 hybrid between them were found with the amphiploid.

of the chromosomes, which has resulted in chromosomal races within a species as well as chromosomal differences between the species. This situation is by no means unique; an even more extreme example, inasmuch as different chromosome base numbers also are found, is presented by the genus *Holocarpha* (Clausen, 1951), and indications are found in numerous genera that this is an important mechanism of speciation. It is to be expected, of course, that any repatterning of the chromosomes, particularly that which involves the translocation of a segment from one chromosome to another, will result in the establishment of at least a partial sterility barrier between races so differentiated. Furthermore, subsequent repatterning will build a cumulatively higher and higher barrier leading to the complete or nearly complete isolation commonly characteristic of species, perhaps unaccompanied by any other kind of evolutionary divergence. This possibility has been realized in *Holocarpha,* where interracial hybrids, when they can be obtained, are usually nearly or completely sterile, but the parental races are so much alike in external morphology that few would think of setting them up as distinct species on the basis of genetic isolation alone. Clearly, chromosome rearrangements, like incompatability genes, are merely the blocks from which barriers to gene interchange are built. It is not the height of the barrier nor the kind of a barrier which is important from an evolutionary standpoint, but the divergence which it permits.

The importance of hybridization in hastening the erection of barriers to interbreeding is not yet clear. Certainly in the initial stages, hybridization between races homozygous for different chromosome rearrangements, in a frequently self-pollinated genus like *Tragopogon,* could result in the production of a race homozygous for both. Should this in itself confer a selective advantage on the race so endowed, or should a favorable mutation occur in it and not in the parental races, any further strengthening of the barrier to gene exchange would be of great selective value. It is possible, of course, that the repatterning of the chromosomes in *Tragopogon* species is not a primary phenomenon, but is the result of hybridization between existing species. A situation of this kind would be of exceedingly great evolutionary interest and significance.

SUMMARY

The somatic chromosomes of fifty races representing eight species of the genus *Tragopogon* are described and figured. Although there is much in common between the chromosome sets of the different species, most species can be recognized by the morphology of the chromosomes. Even within a single species, however, considerable chromosomal variability occurs among different races. The chromosome number was found to be $2n = 12$ in the following species: *T. cupani* (3 races), *T. dubius* (17 races), *T. longirostris* (1 race), *T. orientalis* (4 races), *T. porrifolius* (10 races), and *T. pratensis* (9 races). In *T. mirus* and *T. miscellus*, it is $2n = 24$. The origin of *T. mirus* through hybridization and amphiploidy between *T. dubius* and *T. porrifolius* is confirmed by its chromosome morphology, as is the origin of *T. miscellus* through hybridization and amphiploidy between *T. dubius* and *T. pratensis*. The independent origin of the three known races of *T. mirus* also is confirmed by chromosomal evidence.—STATE COLLEGE OF WASHINGTON, PULLMAN.

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A New Species of Carex (Section Phyllostachyae) from Oklahoma.—In the spring of 1951 a peculiar species of Carex was collected by the author in the Ouachita Mountains of southeastern Oklahoma. Although too immature for determination, it obviously belonged to the section Phyllostachyae since the lower pistillate bracts were broad and leaflike, exceeding the inflorescence, and the staminate scales of the single androgynous spike were basally united. The following spring a student, Walter Blinn, collected a sheet of the same species in Beaver Bend State Park, about 12 miles southeast of the find of the preceding year. In the spring of 1953 the author found abundant material near the site of his original collection.

The proposed new species differs from *C. Willdenowii* Schkuhr and *C. Jamesii* Schwein. in having broad leaf-like lower pistillate bracts which conceal the perigynia. It is, therefore, more nearly related to the remaining two species of this section, *C. Backii* Boott and *C. saximontana* Mackenzie. The former species has all the pistillate scales leaf-like according to Mackenzie.[1] This is not the case in the new species. *C. saximontana* has 2 or 3 enlarged, leaf-like, lower pistillate bracts, 0.7–3.5 cm. long and 2–6 mm. wide, with the upper ones scale-like and shorter than the perigynia; the perigynia are 2–5 in number, 4 mm. long and 2 mm. broad, with the body 2.5–3 mm. long and the beak about 1 mm. long; the orifice is entire and truncate; the staminate part of the spike is about 3 mm. long and 0.5–1 mm. wide, consisting of about 3 flowers. In the new species there are 5 flat leaf-like pistillate bracts. The outermost (and lowest) of these is 4–5.5 cm. long, and 4–10 mm. wide; the succeeding ones become progressively smaller, until the fifth one may be no more than 15 mm. long and 1.5–3 mm. wide, barely exceeding the style in length, and sometimes narrower than the perigynium. The remaining 2 or 3 pistillate scales are short, one-half to one-third the length of the body of the perigynium; the lower ones are broadly oblong, the upper almost orbicular. These shorter, upper pistillate scales are papery and whitish, with a brown line extending around them about 0.5–0.7 mm. inside their margins. The perigynia are 7–9 in number, some of the lower ones often not developing. The length of the perigynia is 8–9 mm.; their bodies are about 5 mm. long and 2.5 mm. thick; their beaks are 3–4 mm. long, the upper 2.5–3 mm. of them being about 0.5 mm. wide. The orifice is adaxially truncate, to rounded, to minutely retuse; abaxially it has a narrow v-shaped slit 1.2–2 mm. long; the style is about 7 mm. long. The staminate part of the spike is about 4–5 mm. long and 2 mm. wide; it is 4–5-flowered. This taxon, then, is described as a new species.

[1] Mackenzie, Kenneth Kent. *Cariceae*, N. Amer. Flora 18: 176–177. 1935.

Carex latebracteata Waterfall, sp. nov., *C. saximontana* simillima; 5 bracteis foemineis inferioribus latis, planis; bracteis infimis 4.5–5 cm. longis, 4–10 mm. latis; 4 bracteis inferioribus proximis parvioribus; 2–3 bracteis foemineis superioribus 3–4 mm. longis, lato-oblongis vel orbiculatis; perigyniis 8–9 mm. longis, corpus ca. 5 mm. longum et 2.5 mm. latum, rostrum 3–4 mm. longum; orificio rostri oblique secto 1.2–2 mm. alto; partibus spicae superioribus masculinis 4–5 floribus, 4–5 mm. longis et ca. 2 mm. latis; seminibus 4 mm. longis et ca. 2.5 mm. latis.

C. latebracteata can easily be differentiated from *C. saximontana* by the larger, broader, more numerous lower leaf-like pistillate scales, by the larger perigynia which have an orifice with a v-shaped slit extending down one side of the rostrum of each one, and by the larger staminate part of the spike which has more flowers. The TYPE is *Waterfall 11380*, on the east side of a rocky wooded ridge, 16.4 miles north of Broken Bow, McCurtain County, April 19, 1953. It is deposited in the Herbarium of Oklahoma A. and M. College. ISOTYPES will be sent to the Gray Herbarium, the New York Botanical Garden and the Missouri Botanical Garden. Additional material seen includes *Blinn 43*, rocky wooded hillside, one-fourth mile west of Beaver Bend State Park, McCurtain Co., April 25, 1952.

C. saximontana (according to Mackenzie, l. c.) extends from Manitoba to western Nebraska and British Columbia to Colorado. *C. latebracteata* is, at present, known only from the Ouachita Mountains of southeastern Oklahoma. It grows on rather steep slopes in rich woods, not on open xeric slopes, and is usually found in cracks or depressions where rich soil and humus have accumulated.—U. T. WATERFALL, DEPARTMENT OF BOTANY AND RESEARCH FOUNDATION, OKLAHOMA A. & M. COLLEGE, STILLWATER, OKLA.

PUTTY-ROOT AND LESSER CELANDINE IN WESTERN PENNSYLVANIA.—On April 4, 1953, I made an early field trip to a spot along Ten-Mile Creek, three miles east of Waynesburg, Greene County, in Southwestern Pennsylvania, to check on winter leaves of some plants of Putty-root (*Aplectrum hyemale* (Muhl.) Torr. which we had found the previous spring, but which had failed to bloom. There were 22 winter leaves showing, but only one of the plants subsequently bloomed. In

Bedford County, where a similar clump of leaves was found last spring, none bloomed.

The plant must be very rare in our area, for the above two stations are the only ones we have been able to find in ten years' rather intensive botanizing in Western Pennsylvania. The few specimens in the Carnegie Museum Herbarium, Pittsburgh, are all over fifty years old.

Along the flood-plain of Ten-Mile Creek, in the same region, I found also Lesser Celandine (*Ranunculus Ficaria* L.), rather rare generally, and previously unreported for Western Pennsylvania. Our only other specimen was from Montgomery County, in Eastern Pennsylvania.

The plants grew in clumps, a foot or so across, and were scattered along the creek in alluvial soil for a couple of miles down the stream—as far as I traveled. They seemed to be well established. It may be that the plant is often overlooked, for it blooms quite early, and disappears completely above ground by early summer.

Specimens of both plants were deposited in the Herbarium of Carnegie Museum.—W. E. Buker, Pittsburgh, Pa.

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NOTES ON NORTH TEXAS GRASSES

Lloyd H. Shinners

These notes have accumulated in the course of work on a *Flora of North Central Texas*, now nearly completed. Since many of them concern plants of the "Manual range," their presentation in Rhodora may be justified. The area of primary concern is 34 counties (out of 254 in the state) surrounding Dallas and Fort Worth. Their combined area, 27,552 square miles, is about a tenth that of Texas, and about ¾ that of Indiana; it is larger than any of the nine smallest eastern states. Loblolly and shortleaf pine enter the eastern counties; *Echinocereus Reichenbachii* and *Ephedra antisyphilitica* the westernmost. Within the city of Dallas, Canada moonseed (*Menispermum canadense*) and Mexican buckeye (*Ungnadia speciosa*) reach their southwestern and northeastern limits respectively. Endemics are numerous, some common and weedy, like *Cirsium terrae-nigrae;* some fairly common in a few places, like *Dalea Hallii, Silphium albiflorum,* or *Mirabilis dumetorum;* at least two probably extinct—*Dalea Reverchonii* and *Vernonia vulturina.* As might be expected, the grass flora is a rich one, with 229 recognized species. Indiana, with an area a third larger, is credited by Deam with 211. It is worth mentioning that little more than 3% of the local flora is introduced, counting even casual waifs. On the same basis, the percentage of aliens in the northeastern states would be ten times as great.

All specimens cited or mentioned as having been seen are in the Herbarium of Southern Methodist University, unless otherwise stated. I am grateful to Jason R. Swallen, Head Curator, U. S. National Herbarium, for the loan of selected specimens,

and for information regarding certain others; to Dr. Robert E. Woodson, Jr., Curator of the Herbarium, and Dr. G. B. Van Schaack, Honorary Curator of Grasses, for many courtesies on several visits to the Missouri Botanical Garden; to Dr. B. C. Tharp, Director of the Herbarium, for many courtesies on visits to the University of Texas; to Dr. F. W. Gould, Curator of the Tracy Herbarium, Texas A. & M. College, for permission to publish a manuscript name, and for observations on several species; and to Miss Marjorie W. Stone, Librarian and Bibliographer of the Gray Herbarium, for copies of the original descriptions of *Agrostis clandestina* and *Vilfa Drummondii.*

Bromus commutatus Schrad. Reported by Silveus from Palestine, Anderson County; the collection (*Tharp s.n.*, June 7, 1920; US) is *B. japonicus* Thunb. var. *porrectus* Hackel. Another collection, from Hillsboro, Hill County (*Harvey 834*, June 12, 1939; US), is *B. secalinus* L. So far as known, *Bromus commutatus* does not occur in Texas.

Eragrostis cilianensis (All.) Hitchcock, Contrib. U. S. Nat. Herb. **21:** 86, 1919 (*nomen nudum*); ibid. **25:** 84, 1925. Incorrectly attributed to Link (ex Lutati); later (*Man. Grasses* ed. 2) incorrectly attributed to Lutati. Fernald (*Manuel* ed. 8) retains the universally accepted name (outside the U. S.) *E. megastachya* (Koel.) Link, remarking "*E. cilianensis* sensu Vignolo-Lutati, apparently not *Poa cilianensis* All." Lutati (1904), in eight pages of inflated discussion, states essentially that nearly all authors who have investigated the matter consider *Poa cilianensis* a stunted form of *Eragrostis megastachya,* and that a probable type specimen does belong to the latter species. Certainly the plate in Allioni's *Flora Pedemontana* can be referred to it with little question—not typical, but a quite common form with few-flowered spikelets. I see no reason to dispute Lutati's conclusion that the two are the same. Unhappily, instead of settling the nomenclature in simple and logical fashion, Lutati left it more snarled than it was. At the end of his article he points out (again) that the name *cilianensis* is older, and goes on to say (as I interpret his Italian) ". . . strictly, it appears necessary to make a substitution, and to write consequently *Eragrostis Cilianensis* (All.) Lk. However, as Ascherson and Graebner have rightly observed, we cannot decide to accept [literally, prefer] the name of *Cilianensis,* although older, because it represents an atypical form. Besides, I should believe it more convenient, in order to avoid future confusion [sic!], that such a denomination, conserved, if desired, in indexes of synonyms, need not appear in our flora as a synonym of *E. megastachya;* however, to the description of this, I add some small corrections relating in particular to the characters of its not-well-developed panicles. *Obs. in Eragrostidem megastachyam* Lk.: . . ." To sum up, Lutati (and the numerous earlier and contemporary botanists whom he cites) correctly identified *Poa cilianensis* All. with

Eragrostis megastachya, but did not accept the necessary new combination, which therefore was not validly published until accepted by Hitchcock, incorrectly attributed to Link or Lutati. In the second edition of Fiori's *Flora Analitica d'Italia*, the name *E. megastachya* is still retained, with "E. cilian. Vignolo-Lutati" given as a synonym under var. *major*. Hegi's *Illustrierte Flora von Mittel-Europa* likewise lists *E. cilianensis* in synonymy. It is possible that some other author than Hitchcock accepted the latter name as valid and published it with proper basonym before 1925. But regardless of who the second author may be, the required combination is *Eragrostis cilianensis*.

Eragrostis poaeoides (L.) Beauv. The only Texas record of this species is a collection made by Gustav Jermy, without date or locality, labeled as from Texas (US). Jermy was a Hungarian who collected both plants and animals chiefly in Bexar and Gillespie counties prior to 1900. His herbarium (now at the Missouri Botanical Garden) included much European material. It is entirely possible that the supposed Texas collection was actually a European one mislabeled. The early date and the lack of any other record are grounds for suspicion.

Eragrostis pectinacea (Michx.) Nees. Including *E. diffusa* Buckley. The key differences given in Hitchcock's Manual are quite elusive and inconstant, and the weak morphological differences are not helped by the alleged geographic separation: "chiefly east of the 100th meridian" for *E. pectinacea*. The type locality of *E. diffusa*, "Northern Texas," was somewhere between Mason and Young counties; both are east of the 100th meridian, not west of it.

Eragrostis trichodes (Nutt.) Nash. Under this name I am provisionally leaving some of the most puzzling grasses in our flora, including those referred to *E. pilifera* Scheele. In addition to the two extremes and intergrades, there are specimens with spikelets reduced to a single floret (*Muller 8615*, Hall County; *Muller 8750*, Palo Pinto County; also *K. C. Bennett 126* from Rogers County, Oklahoma). These were at first filed under *Sporobolus*, as a possibly undescribed species, until in the course of periodic reëxaminations spikelets were found with two and finally three florets. Comparison with normal specimens of *Eragrostis trichodes* failed to reveal any convincing differences other than the reduced number of florets.

Tridens flavus (L.) Hitchcock, var. **Chapmanii** (Small) Shinners, comb. nov. *Sieglingia Chapmanii* Small, Bull. Torr. Bot. Club **22:** 365. 1895. (Originally spelled *Chapmani*. I follow Recommendation 82C (b) of the International Code in doubling the *i*. It is to be observed that this recommendation provides neither a royal road to learning nor a safe short-cut around it for those ignorant of Latin. Names which have a Latin form must adhere to it; hence *Andropogon Gerardi* cannot be altered to *Gerardii*, since there is the Latin form *Gerardus* for Gerard. But this is late Latin, not ancient, and the rules do not say when or by whom a Latin form is legitimately coined.) Here may be inserted a Florida endemic: *T. flavus* var. **aristatus** (Scribn. & Ball) Shinners, comb. nov., based on *Triodia seslerioides* var. *aristata* Scribn. & Ball, U. S. D. A. Div. Agrost. Bull. **24:** 45, 1901 (Jan. 9; bottom of title page dated 1900). Both Fernald and Gleason retained *Triodia* for the American species. Reasons for adopting *Tridens* instead are very briefly noted in the appendix of ed. 2 of Hitchcock's *Manual* (p. 997). More extended explanations have been given by C. E. Hubbard (1937) and Burbidge (1946), who consider the Australian arid-land *Triodia* amply distinct morphologically from *Tridens.*

Tridens muticus (Torr.) Nash, var. **elongatus** (Buckley) Shinners, comb. nov. *Uralepis elongata* Buckley, Proc. Acad. Nat. Sci. Phila. **14:** 89. 1862. *Triodia elongata* (Buckley) Scribner. *Tridens elongatus* (Buckley) Nash. Var. *muticus* is common in Trans-Pecos Texas, extending eastward very rarely to Denton County in north central Texas. Var. *elongatus* is rather common in central and northern Texas, occasional in the Trans-Pecos. The two are sometimes very difficult to distinguish.

Agropyron repens (L.) Beauv. Reported by Silveus from Gainesville, Cooke County. The specimen in the University of Texas Herbarium is *A. Smithii* Rydb., or *Elymus Smithii* (Rydb.) Gould.

Elymus **trachycaulus** (Link) Gould, ined. *Triticum trachycaulum* Link, Enum. Pl. Hort. Reg. Berol. Altera **2:** 189. 1833. *Elymus pauciflorus* (Schweinitz) Gould, 1947; not Lamarck, 1791. Known in Texas from the Panhandle. The orthography follows that of Link, using second declension endings instead of the more usual third declension form—*caulis.*

Elymus canadensis L., var. **villosus** (Muhl.) Shinners, comb. nov. *E. villosus* Muhl. ex Willd., Enum. Pl. Hort. Reg. Berol. **1:** 131. 1809. As I knew the plants in the Middle West, *E. villosus* and *E. canadensis* were quite distinct. In Texas it is another story altogether. In the local flora, some forms of var. *brachystachys* (Scribn. & Ball) Farwell are almost impossible to distinguish from var. *villosus.* Similar situations were encountered in *Sporobolus* (see below), *Carex, Juncus,* and other genera, in which species quite distinct farther east or north run hopelessly into each other when they occur in Texas.

Danthonia sericea Nutt. Not recorded from Texas in Hitchcock's *Manual,* but entering the northeastern corner of the state. bowie co.: 1 mile west of Corley, *V. L. Cory 55951,* May 11, 1949.

Agrostis Elliottiana Schultes f. **molesta** Shinners, f. nov. Lemmatibus exaristatis. type: sandy upland pine woods 2.7 miles east of Mineola, Wood Co., Texas, *Shinners 14372,* April 23, 1953. The species ordinarily is very distinct and easily recognized by the very long, delicate awns of the lemmas; an awnless form may well be called troublesome. Only the type collection has been seen.

Sporobolus vaginiflorus (Torr.) Wood, var. vaginiflorus. This is the most common and widespread race in Texas, in a wide zone down the central part of the state, from Franklin and Montgomery counties on the east to Montague and Kerr counties on the west.

SPOROBOLUS VAGINIFLORUS, var. INAEQUALIS Fernald. Said by Fernald to extend southwestward to Missouri, Nebraska, and Arizona; found also, rather surprisingly, in the Pine Belt of northeastern Texas. CAMP CO.: 4.4 miles north of Pittsburg, *Shinners 16117*, Sept. 16, 1953. GREGG CO.: 5.5 miles north of Longview, *Shinners 16029*, Sept. 16, 1953.

SPOROBOLUS VAGINIFLORUS, var. **neglectus** (Nash) Shinners, comb. nov. *S. neglectus* Nash, Bull. Torr. Bot. Club **22:** 464. 1895. Reported from Texas on the basis of specimens collected at Austin, Travis County (*R. H. Painter 58* and *69*, Nov. 22, 1922; US). These have pubescent lemmas, though the spikelets are only 2–2.6 mm. long. I consider them late-season atypical individuals of var. *vaginiflorus*. But authentic *neglectus*, with glabrous lemmas and small spikelets, can still be credited to Texas. ARCHER CO.: 1.5 miles south of Windthorst, roadside, one plant, *Shinners 16402*, September 27, 1953 (SMU, US).

To complete the roster, one extra-limital variety may be added: *S. vaginiflorus* var. **ozarkanus** (Fernald) Shinners, comb. nov. *S. ozarkanus* Fernald, RHODORA **35:** 109. 1933.

SPOROBOLUS ASPER (Michx.) Kunth. Fernald recognizes four species and one named variety in the complex group of this species; Hitchcock accepts two species (plus a third not found in the area covered by Fernald) and two named varieties. In northern Texas, where all but one of the various entities are found (that one not accepted by Hitchcock even as a variety), there is so much intergradation, overlap, and parallel variation that I regard them all as belonging to a single species with four varieties, distinguished very imperfectly as follows:

1a. Plant with horizontal creeping rhizomes; stems not in dense clumps . . . var. *macer*.
1b. Plant without rhizomes; stems solitary or in dense clumps
  2a. Uppermost leaf with blade 0.7–6 cm. long, sheath 5–12 cm. long; inflorescence 3–6 mm. thick
    3a. Lemmas glabrous; spikelets 3–5 mm. long . . . . var. *Hookeri*.
    3b. Lemmas pubescent, at least toward base; spikelets 3.8–6 mm. long . . . var. *canovirens*.
  2b. Uppermost leaf with blade (1.7)5.5–23 cm. long, sheath 8–22 cm. long; inflorescence 5–18 mm. thick; spikelets 4.5–6.1 mm. long, with glabrous lemmas . . . . var. *asper*.

SPOROBOLUS ASPER var. ASPER. Occasional through northeastern Texas, in such diverse habitats as open pine woods and roadsides in prairie areas, mainly in lower or richer ground than var. *Hookeri*.

SPOROBOLUS ASPER, var. **macer** (Trin.) Shinners, comb. nov. *Vilfa macra* Trinius, Mem. Acad. Sci. St. Petersb. VI. Sci. Nat. 4 (1): 79. 1840. *S. macer* (Trin.) Hitchcock. In the field, this is the only easily recognized variety. Rather rare, and limited to the Pine Belt. GREGG CO.: 5.5 miles north of Longview, *Shinners 16234*, Sept. 18, 1953. RED RIVER CO.: Clarksville, *C. L. York*, Sept. 14, 1941.

SPOROBOLUS ASPER, var. HOOKERI (Trin.) Vasey. Including var. *pilosus* (Vasey) Hitchcock. Common, chiefly on dry uplands in the prairie areas, rarely eastward in the Pine Belt.

Sporobolus asper, var. **canovirens** (Nash) Shinners, comb. nov. *S. canovirens* Nash ex Britton, Man. p. 1042. 1901. Closely resembling var. *Hookeri* in general appearance, and like it often found in dry prairie habitats, but occurring more frequently than in woodland areas, with about the same local geographic distribution as var. *asper*. Here may be inserted an extra-limital variety, not distinguished from this by Hitchcock. *Sporobolus asper* var. **clandestinus** (Biehler) Shinners, comb. nov. *Agrostis clandestina* Biehler, Pl. Nov. Herb. Spreng. Cent. 8. 1807.

Gramineae, Tribe Stipeae Nees. This was very justly reinstated by Elias (1942), in a work that has been generally ignored by systematists, despite a favorable review by Stebbins (1943). Morphological and cytological criteria for distinguishing the Stipeae as a tribe separate from the Agrostideae are discussed at length by Elias. I will merely repeat Dr. Stebbins' recommendation: "Every botanist interested in the grasses should read carefully the first part of this work." Nearly half the discussion deals with the taxonomy of living grasses rather than of fossil ones.

Aristida longespica Poir., var. geniculata (Raf.) Fernald. *A. intermedia* Scribn. & Ball, U. S. D. A. Div. Agrost. Bull. **24:** 44. 1901. The description and illustration given by Scribner and Ball are unmistakable; the somewhat shorter lateral awns and length of glumes are those of the robust race of *A. longespica*, and not of the plant of the upper Mississippi Valley to which the name has been extended. The plant is rather common in central and eastern Texas, as far west as Callahan County. Var. *longespica* is much less common, and is restricted to the Pine Belt in the extreme eastern part of the state. The Midwestern plant incorrectly passing as *A. intermedia* (a name based on a type from the Gulf Coast in Mississippi) may be designated as follows.

Aristida **necopina** Shinners, sp. nov. *A. intermedia* of authors, in large part, not Scribner & Ball. Annua stricta; gluma inferior brevior 5.5–8 mm. longa, superior longior; lemmatis aristae aequales divergentes nullae geniculatae. type: sandy ridges near ponds, May Twp., Lee County, Illinois, *Virginius H. Chase 5302*, Sept. 1, 1935 (SMU). The same species is reported from Indiana by Deam (1940), as *Aristida intermedia*. Additional collections have been seen from Wisconsin. lincoln co.: Twp. Bradley, *Frank C. Seymour 12,449*, Sept. 22, 1950. milwaukee co.: Wauwatosa, *Shinners 44–293*, July 30, 1944. portage co.: Stevens Point, *Seymour 12,136*, Aug. 19, 1950.

Leptochloa uninervia (Presl) Hitchcock. This is apparently rather rare in Texas, where it has been collected in the extreme southern and western counties. It must be included in the flora of the northern part of the state because of a collection made just across the Red River in Oklahoma (from which state the species is not reported in Hitchcock's *Manual*). love co.: east of Marietta, Lake Texoma, *W. F. Harris*, July 10, 1949.

Bouteloua uniflora Vasey. Subsequent to his revision of the genus *Bouteloua*, Griffiths distributed specimens collected by himself in Lampasas County, central Texas, as this species (no date, but not cited in the revision). The SMU sheet belongs to a not uncommon form of *B. curtipendula* with few florets in each spikelet. *B. uniflora* itself is apparently restricted to Trans-Pecos Texas. In addition to 1-flowered spikelets, it differs from *B. curtipendula* in the more prominent ligule, with a fringe of hairs longer than the scaly base; in *B. curtipendula* the ligule is very short and largely scaly. I have seen only the following specimen of *B. uniflora.* JEFF DAVIS CO.: about 2 miles south of Kent, *Barton H. Warnock 9258*, Aug. 13, 1950.

BOUTELOUA GRACILIS (Willd. ex H.B.K.) Lag. ex Griffiths, Contrib. U. S. Nat. Herb. **14:** 375. 1912. The authorship of the combination is usually given as Lag. ex Steud., Nom. Bot. (ed. 2) **1:** 219, 1840. But Steudel listed all the names under *Bouteloua* in italics, indicating that they were synonyms; for *B. gracilis* there is a cross-reference to *Chondrosium gracile*, which appears on p. 305 in Roman type with three other names under it as synonyms (*gracilis* is omitted, though *hirsuta* appears under *C. hirtum*). In H.B.K., Nov. Gen. **1:** 176, 1816, the species is published as *Chondrosium gracile*, with *Actinochloa gracilis* "Willd. herb." given as synonym. Article 46 of the International Code states that "a name of a taxon is not validly published when it is merely cited as a synonym." I believe that the second paragraph of examples goes beyond the strict letter of this rule in indicating that when a name published in synonymy is transferred, the name of the originating author is discarded in favor of the publishing author; in other words, the epithet is to be credited to someone who did not coin it. In the case of the present species, only H.B.K. should be cited in parentheses, if the examples in Article 46 are followed. In similar vein, Article 58 decrees that names published by one author and credited to another must be cited as from both authors, as author A "ex" author B, but that if the citation is abbreviated, the originating author is omitted and only the publishing one mentioned. I fear that adherence to this rule will necessitate a good many annoying and needless changes—for example, the numerous species of Nuttall published by Torrey and Gray, which in transfers would no longer be credited to Nuttall. If the tendency shown in these articles is carried only a little further, we should adopt the zoological custom of citing only one author in all cases. If continued to its logical conclusion, we should discard authors' names altogether—perhaps the best solution. If, on the other hand, author citations are retained because it is useful to have some indication about the origins of names, then the two articles (or more precisely, the examples given under Article 46) go too far. Names published in synonymy may have no standing for valid species or varieties or in questions of priority, but they exist in print, they are indexed, are often discussed, and have standing of a sort. Legal decrees do not make them "un-names," like the "un-persons" of Orwell's novel, "*1984*." It seems to me more accurate to write *Bouteloua gracilis* (Willd.) Lag., rather than (H.B.K.) Griffiths; just as it would seem quite out of order to write only "T. & G." after names proposed by Nuttall.

PASPALUM DISTICHUM L., var. **indutum** Shinners, var. nov. Foliorum vaginae hirsutae. TYPE: Turtle Creek at Stonebridge Drive, Dallas, *Shinners 10564*, Oct. 9, 1948 (SMU). "In gray silty clay and chalk gravel. Culms trailing." Known only from the type.

Paspalum **separatum** Shinners, sp. nov. Subrhizomatosa erecta 44 cm. alta; vaginae inferiores pilosae pilis adscendentibus, superiores puberulae vel glabrae margine pilosae; ligula ca. 0.8 mm. longa; laminae glabrae basi longe ciliatae ad 6–7 mm. latae. Racemi 2 terminales approximati racemosi suberecti, inferior 16 cm. longus superiorem excedens; rachis acutangulata glabra exalata; spiculae sine gluma prima, plano-convexae, ellipticae, obtusae, 2.2 mm. longae, 1.5 mm. latae, puberulae, subappressae, pedicellis ca. 0.3 mm. longis solitariae, remotae (rachios internodi 2.5–7 mm. longi). type: 2.3 miles northwest of Golden, Wood County, *Shinners 15566*, July 27, 1953 (SMU). "In thicket, sandy stream bank." Known only from the type, which unfortunately is not fully mature, the base of the inflorescence being still included in the uppermost leaf sheath. The solitary, remote spikelets make it look as if it were not a *Paspalum* at all. In general appearance, it suggests an erect form of *P. ciliatifolium*.

Paspalum ciliatifolium Michx. At first it appeared that Fernald's treatment of the varieties of this species would fit the Texas plants, but intensive collecting during 1953 led to the conviction that it could not be followed. Final blow was the discovery that the SMU sheet of *Plantae Exsiccatae Grayanae 1322*, from New York, distributed as var. *Muhlenbergii*, had sparse but distinct minute pubescence (under strong magnification) as well as long hairs—a feature supposedly restricted to the Mid-western and Southwestern var. *stramineum*. Nor could I recognize *P. Bushii* Nash, retained by Fernald, though treated as a synonym of *P. stramineum* by Chase. Only one race seems distinctive—a dark-pigmented form with stems always erect and with densely long-hairy sheaths and blades (presumably *P. pubescens* Muhl.), found only in the Pine Belt. Otherwise it is impossible to separate the Texas plants even into weak varieties. As here interpreted, *P. ciliatifolium* is our most widespread and abundant native species (the introduced *P. dilatatum* Poir. and *P. Urvillei* Steud. are more plentiful), varying from prostrate to erect and from glabrous to densely pubescent with one or two lengths of hairs, flowering from spring to fall.

Panicum. With 41 species, this is the second largest genus in the local flora, only 3 species smaller than *Carex*, the largest. Subgenus Dichanthelium proved unexpectedly simple, though it contained 22 of the 41 species. One puzzle has been left unsolved: the proper identity of *P. villosissimum* Nash. Plants so named by Hitchcock & Chase and others from as far east as Georgia have an extremely short ligule (0.2–1.2 mm. long), largely obscured by much longer hairs on the base of the blade. According to Nash (Bull. Torr. Bot. Club **23:** 149, 1896), the ligule is "a ring of long hairs"; according to Hitchcock, it is 4 to 5 mm. long. Until further study can be made of the eastern members of the group (the type of *P. villosissimum* was from Macon, Georgia), I am referring to Nash's species a plant in the local flora which largely fits the description except for the very short ligule obscured by long hairs on the blade.

Panicum capillare L. As previously in Wisconsin (1944), I am not able to distinguish var. *occidentale* Rydb. From Dallas westward occur plants which are rather robust, gray-green, with an inflorescence usually only ¼ to ½ their total height, greatly resembling *P. capillare*, var. *hirticaule* (Presl) Gould (*P. hirticaule* Presl). It is often (but not always) possible to find the lunate scar at the base of the fertile lemma, the principal diagnostic feature of *P. Hillmanii* Chase. Commonly they key to *P. philadelphicum* Bernh., though outside the range of that species, and much coarser throughout. The whole *capillare* complex is a very difficult one in the Southwest, and for the present I refer all local material identified as any of the species listed to *P. capillare*.

Panicum pilcomayense Hackel. First collected at Collegeport, Matagorda County, on the Texas coast, in 1929; reported in Hitchcock's *Manual* (ed. 2) only from the one locality. Becoming established farther north and east; it has been collected in Brazos, Chambers, and Navarro counties—the last locality (6 miles south of Richland, *Cory 51549*) in north central Texas. The plant resembles a very diffuse form of the common *P. virgatum*, and may be overlooked on that account.

Echinochloa Crusgalli (L.) Beauv. Represented in Texas by at least four varieties, which fall into two groups. The groups may be designated *E. Crusgalli*, ssp. **muricata** (Michx.) Shinners, comb. nov., based on *Panicum muricatum* Michx., Fl. Bor.-Am. **1:** 47, 1803 (if the hyper-refined and unfortunate homonym rule is strictly adhered to, the basonym must be designated as *Oplismenus muricatus* Kunth, Rev. Gram. **1:** 44, 1829, the first legitimate publication of the epithet. There having been an earlier *Panicum muricatum*, Michaux's species was illegitimately named, even though validly described); and *E. Crusgalli* ssp. **zelayensis** (H.B.K.) Shinners, comb. nov., based on *Oplismenus zelayensis* H.B K., Nov. Gen. **1:** 108, 1815. The varieties in northern Texas may be distinguished as follows. The first pair of leads in the key sets off the two subspecies in the order just named; the varieties are listed thereafter in abbreviated form.[1]

Inflorescence with long ascending to widely spreading or deflexed hairs at summit of internodes or base of branches, their bases conspicuously swollen; spikelets with spiny hairs from swollen bases, at least on margins; panicle branches at maturity ascending to widely spreading

Body of sterile lemma 3.3–4 mm. long; spikelets 1.6–2.3 mm. wide; upper glume usually distinctly awned . . . . var. *muricata*.

[1] Because new varietal combinations are made, it would be better to give formally complete citations, naming the subspecies in every case. I have deliberately taken advantage of the permission granted by Article 34 of the Code, "to reduce more complicated names to ternary combinations," in order to call attention to and illustrate that article, to point out that shifting varieties from one subspecies to another does not involve new author citations so long as they remain within the same species, and to emphasize the utilization of the subspecific category as a comparatively minor and incidental one, for a group of geographic varieties. If full citations were given, var. *zelayensis* would be given without author when under ssp. *zelayensis*, but it is not stated in the Code that this still holds when the subspecies is omitted.

Body of sterile lemma 2.5–3.3 mm. long; spikelets 1.2–1.8 mm. wide; upper glume acuminate or rarely awned . . . . var. *microstachya*.

Inflorescence with very short hairs only, or with long ascending hairs at summit of internodes or base of branches, their bases not swollen; spikelets with fine pubescence, the hairs mostly slender, without swollen bases; panicle branches ascending to erect or loosely appressed

Spikelets 3.6–4.1 mm. long . . . . var. *zelayensis*.

Spikelets 2.6–3.3 mm. long . . . . var. *macera*.

ECHINOCHLOA CRUSGALLI, var. MURICATA (Michx.) Farwell. Doubtless one of the several names in varietal rank published by Pursh (Fl. Am. Sept. **1:** 66, 1814; vars. *aristatum, mite, purpureum*) has priority, but their identity cannot be determined from the brief descriptions. I include *E. muricata* var. *ludoviciana* Wiegand, or *E. pungens* var. *ludoviciana* (Wieg.) Fernald & Griscom. Chiefly eastern, found as far west as Collin and Dallas counties. I have already indicated disapproval of the strange antics one must go through if one adheres strictly to requirements regarding legitimacy of epithets and authorship. Deleting Michaux's name and substituting Kunth's in the author citation of this variety would be of no benefit, and would only contribute confusion and irritation.

ECHINOCHLOA CRUSGALLI, var. **microstachya** (Wiegand) Shinners, comb. nov. *E. muricata* var. *microstachya* Wiegand, RHODORA **23:** 58–59. 1921. *E. pungens* var. *microstachya* (Wieg.) Fernald & Griscom. The commonest and most widespread variety in Texas, known from all sections except the lower Rio Grande Plain.

ECHINOCHLOA CRUSGALLI, var. ZELAYENSIS (H.B.K.) Hitchcock. *E. zelayensis* (H.B.K.) Schultes. Cited by Wiegand from San Elizario (El Paso County) and Big Spring (Howard County). Found in the Red Plains, Panhandle, and Trans-Pecos, considerably west and northwest of the area occupied by var. *macera*. ARMSTRONG CO.: ½ mile west of Washburn, *Eula Whitehouse 17248*, Sept. 27, 1946. HALE CO.: 6.6 miles south of Kress and west 4.1 miles from Highway 87, *Whitehouse 9943*, June 16, 1945. JEFF DAVIS CO.: Scenic Loop, Davis Mts., *Warnock 9309*, Aug. 26, 1950. MITCHELL CO.: N.E. ¼ Sec. 1, T. & P. R.R. Block 27, *R. W. Pohl 4591*, July 29, 1944. TAYLOR CO.: Abilene, *W. L. Tolstead 7735*, Oct. 27, 1943. WICHITA CO.: 11.3 miles south of Electra, *Whitehouse 10886*, Oct. 13, 1945.

ECHINOCHLOA CRUSGALLI, var. **macera** (Wiegand) Shinners, comb. nov. *E. zelayensis* var. *macera* Wiegand, RHODORA **23:** 54. 1921. Type from Matamoros, Tamaulipas, opposite Brownsville, Texas (not examined); cited by Wiegand from "western Texas," *Berlandier* (not Trans-Pecos Texas; old usage of the phrase "West Texas" referred to the region of Austin, San Antonio, and Laredo), and from Waco (McLennan County). Known from a belt running south to north across the middle of the state. DIMMIT CO.: Asherton, *Tharp*, June 24, 1941. ELLIS CO.: 2¼ miles northeast of Bardwell, *Cory 53376*, July 10, 1946. FREESTONE CO.: 12.5 miles northwest of Fairfield, *B. L. Turner 1537*, Oct. 2, 1949. HARRIS CO.: Houston, *G. L. Fisher 49058*, June 5, 1949. ROCKWALL CO.: Royse City, *Cory 53318*, June 28, 1946.

Cenchrus longispinus (Hackel) Fernald. Occasional in the north central counties. grayson co.: 3 miles southeast of Denison, *Shinners 16374*, Sept. 26, 1953. montague co.: 3.5 miles east-southeast of Ringgold, *Shinners 15807*, Aug. 29, 1953. parker co.: 1.4 miles south-southwest of Springtown, *Shinners 16418*, Sept. 28, 1953. van zandt co.: 9.7 miles northwest of Wills Point, *Robert Van Vleet 508*, June 11, 1950.

Cenchrus pauciflorus Benth. The common species from Clay and Edwards counties westward, i. e., in the western half of the state. Not distinguished from the preceding in Hitchcock's *Manual* nor by Gleason. Actually it is more closely allied to *C. incertus.* I distinguish the three as follows:

Spines rather numerous, 15–25 completely visible on one side of bur, slenderly pointed, usually many of the lowest slender nearly to base; body of bur rather long-pubescent, the hairs nearly as long as those on bases of middle and lower spines (usually markedly shorter than those of upper spines); greatest width of mature bur 10–15 mm., including spines. . *C. longispinus.*

Spines fewer, 9–15 completely visible on one side of bur, mostly broad and stout, few or none of the lowest slender; body of bur rather short-pubescent or glabrate, the hairs when present markedly shorter than those on bases of middle and lower spines (much shorter than those of upper spines); greatest width of mature bur 7–12 mm., including spines

- Burs (except lowest) closely crowded, middle internodes of spike 1.5–3 mm. long; annual. . . . . *C. pauciflorus.*
- Burs more loosely spaced, middle internodes of spike 2.5–9 mm. long, mostly more than 3 mm.; perennial, but sometimes flowering the first year. . . . . *C. incertus.*

Cenchrus incertus M. A. Curtis. The commonest species in central and eastern Texas, and in the Rio Grande Plain. In northern Texas it extends as far west as Young County, slightly overlapping the range of *C. pauciflorus.* Apparently a short-lived perennial, sometimes flowering in its first year; tends to form mats, the stems longer, with more nodes and more decumbent than either of the two annual species. *C. Albertsonii* Runyon, Amer. Journ. Bot. 26: 485, 1939, described from Oklahoma, is listed as a synonym of *C. pauciflorus* in Hitchcock's *Manual.* It was distinguished by the describer from *C. pauciflorus* by its perennial habit; the description and figure unmistakably belong to *C. incertus,* not *C. pauciflorus. C. incertus* is not credited to Oklahoma in the *Manual,* but it is widespread there. *C. Albertsonii* was cited in the original description from Harper and Woodward counties, northwestern Oklahoma; specimens have been seen from Muskogee County (4 miles southeast of Biggs, *U. T. Waterfall 10085*) and Payne County (1 mile northwest of Ripley, *B. M. Beard 102*), in the eastern part of the state.

Andropogon scoparius Michx. Two fairly well marked and geographically segregated varieties occur in north central Texas. It is admittedly venturing into dangerous territory to name a new variety of this complex and widespread species. Only a thorough cytotaxonomic study, such as that made by Gould for the *A. barbinodis-A. saccharoides* complex, can provide an adequate account of the races of little bluestem. The completion of such a study necessarily lies well in the future. Meantime I think it a pardonable sin to provide our local plants with names for reference. Some remarks are added relating to extra-limital varieties which have been misinterpreted. The two local ones are separable as follows:

Pedicelled spikelet 1.5–5 mm. long (excluding awn), consisting of a single empty glume; Blackland Prairies westward . . . . var. *frequens*.
Pedicelled spikelet 4.5–7 mm. long (excluding awn), many or most pedicelled spikelets in each inflorescence with two glumes and commonly lemma and stamens; Pine Belt, locally westward on sandy river terraces in oak woods to Dallas County . . . . var. *virilis*.

Andropogon scoparius, var. frequens F. T. Hubbard. Abundant in both clayey and sandy soils; the principal original climax dominant over much of north central and northwestern Texas. Farther west it intergrades with var. *neomexicanus*. Though not definitely known from northeastern Texas, it is found in northwestern Louisiana (3.2 miles east of Greenwood, Caddo Parish, between highway and railroad, *Shinners 15640*, Aug. 16, 1953). A glaucous form is locally very common, especially in the East Cross Timbers (a north-south sandy belt passing between Dallas and Fort Worth, bordered on both sides by calcareous clayey prairie soil). Fernald considers this the same as var. *polycladus* Scribn. & Ball (type from Bradenton, peninsular Florida), and Hubbard cites a collection from Dallas under "var. *polyclados*." If Hubbard is correct in defining var. *polycladus* as a coastal race with compressed sheaths, similar to if not identical with var. *littoralis* (Nash) Hitchcock, the name applies to the race found on the coastal prairies of Texas (specimens seen from Aransas, Harris, Kenedy, Kleberg, and San Patricio counties), but not to the inland plants with sheaths only slightly compressed or keeled. Fernald does not mention this characteristic, and at first (with Griscom) very mistakenly equated var. *polycladus* with var. *divergens* (see below). I follow Hubbard's own broad interpretation of his var. *frequens* (type from Rhode Island), though it is scarcely a homogeneous entity. Its genetic complexity was illustrated some years ago when the Soil Conservation Service attempted to restore little bluestem to an eroding sandy field in Wise County, northwest of Dallas. Seed was obtained from Mandan, North Dakota, and produced a fine row along one edge of the field. But the hope that it would seed in and cover the rest of the field was unfounded. Though supposedly the same as the Texas race, local climatic conditions were apparently unsuitable; the North Dakota immigrants never produced viable seed.

Andropogon scoparius, var. **virilis** Shinners, var. nov. Spicula pedicellata 4.5–7 mm. longa (arista exclusa) saepissime mas cum glumis duobus lemmate staminibusque pedicello brevipiloso (pilis 2 mm. longis) basin versus nudo; foliorum vaginae glabrae vel parce pubescentes. type: 3.3 miles south of New Diana, Upshur County, *Shinners 16009*, Sept. 15, 1953 (SMU; isotype US). "Sandy pine woods. Culms solitary." Southwestern pine-land parallel of var. *septentrionalis* Fernald & Griscom, with shorter and less extensive pubescence on the pedicels; differing from var. *scoparius* in the sparsely pubescent or glabrous sheaths. Possibly identical with *A. praematurus* Fernald, RHODORA **42:** 413, 1940, characterized by early flowering and well-developed pedicelled spikelets; our plants are not early flowering. This entirely replaces var. *frequens* in the Pine Belt of northeastern Texas, extending rarely as far west as Dallas County on sandy river terraces; found also in Arkansas and Oklahoma. The following specimens have been examined.

ARKANSAS. FULTON CO.: Hardy, *Etlar L. Nielsen 4449*, Oct. 4, 1936. OKLAHOMA. PAYNE CO.: northwest of Stillwater, *A. H. Broadhead 94*, Aug. 26, 1948. PONTOTOC CO.: about 2 miles east of Ada, *G. Thomas Robbins 2259*, Sept. 28, 1946. TEXAS. DALLAS CO.: southeast of Seagoville, *C. L. Lundell 12072*, Sept. 22, 1942. FRANKLIN CO.: 12.5 miles south of Mt. Vernon, *Shinners 16300*, Sept. 18, 1953. FREESTONE CO.: 14.5 miles south of Fairfield, *B. L. Turner 1543*, Oct. 2, 1949; same place and date, *Turner 1558*. HUNT CO.: 8 miles east of Greenville, *Turner 1383*, Sept. 11, 1949. SMITH CO.: western edge of Tyler, *Cory 56835*, Aug. 17, 1949. WOOD CO.: 3.8 miles south of Quitman, *Turner 1421*, Sept. 11, 1949.

ANDROPOGON SCOPARIUS, var. DIVERGENS (Anderss.) Hackel. (Basonym published in synonymy by Hackel.) In their account of the varieties of *Andropogon scoparius*, Fernald and Griscom (RHODORA **37:** 143–144, 1935) separate this from their var. *genuinus* by glabrous or pubescent sheaths (vs. pilose sheaths in *genuinus*), give var. *polycladus* Scribn. & Ball as a synonym, and observe "this . . . has had an unfortunate career, being either completely ignored or quite misinterpreted." They were correct in their last statement, and were parties to the crime. (Subsequently Fernald substituted var. *polycladus*, which was not much better; *Gray's Manual*, ed. 8.) The original description of *divergens* (DC. Mon. Phan. **6:** 385, 1889) begins "vaginis (praesertim inferioribus) paginaque laminarum inferiore appresse sericeo-pilosis; spathis propriis appresse pilosis; spiculis sessilibus 7 mm. longis." The type was from Texas, without indication of date or collector, and was in the Berlin Herbarium; presumably now lost. The following specimens from extreme southeastern Texas fit the description, and indicate that var. *divergens* is a restricted endemic of the Texas coastal area. HARRIS CO.: Houston, *Fisher 51051*, Oct. 17, 1951. JEFFERSON CO.: 9 miles west of Beaumont, *Cory 50026*, Oct. 4, 1945. TYLER CO.: 17 miles south of Woodville, *Cory 49969*, Oct. 2, 1945.

ANDROPOGON SCOPARIUS, var. NEOMEXICANUS (Nash) Hitchcock. Panhandle and Trans-Pecos Texas, locally as far east as Fisher and Hardeman counties, west central Texas; intergrading with var. *frequens*. At maturity the pedicelled spikelets are only slightly spreading if at all, unlike the prominently out-curved ones of the more eastern varieties; the whole plant is pale or glaucous.

ANDROPOGON ISCHAEMUM L. King Ranch or KR bluestem, first planted chiefly in the southern part of the state, is becoming established as a weed as well as planted in the northern counties. COLLIN CO.: 3

miles west of Plano, *Shinners 12921*, Oct. 28, 1950. "Weed at edge of field" (of vegetables). DENTON CO.: Texas Substation No. 6, 4¾ miles west-northwest of Denton, *Cory 53708*, May 18, 1947. "Persisting in grass plots of the Experiment Station." GRAYSON CO.: Sherman, *Cory 59126*, Oct. 16, 1951. "Infrequent between sidewalk and curb, south side of square." ROCKWALL CO.: 1.8 miles southwest of Rockwall, *Shinners 16318*, Sept. 25, 1953. "Shallow road-cut on Super-highway 67, evidently planted."

SORGHASTRUM SECUNDUM (Ell.) Nash. Credited to Texas on the basis of specimens collected at Dallas by Reverchon. The plants (SMU, US) are immature and atypical samples of *S. Elliottii* (Mohr) Nash, which is not uncommon in eastern Texas, chiefly in the Pine Belt. *S. secundum* is not known farther west than Mississippi.—SOUTHERN METHODIST UNIVERSITY, DALLAS, TEXAS.

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Previously Unreported Plants from Minnesota with Additional Place Records of Rarities.—Carex pallescens L., var. neogaea Fern. Colonies of this sedge were discovered on Lake Superior terrace at the Duluth water works on the west side of Highway 61. The plants, growing in moist depressions of a meadow-like opening along the shorewoods, were in excellent fruit. On July 17, 1953 No. 16198 was collected. Because of its rarity in the interior, additional material No. 16260 was collected a few days later.

The specimens were referred to Dr. Fernald's New World variety with which they agree in descriptive details excepting the beak of the perigynium. The abruptly rounded apex of the perigynium has a very short beak, but it is sometimes obscured by the sunken apex around the style. In the apparently beakless ones, it seems to have disappeared as seen by the frayed edges of the orifice. The latter condition has been observed in the typical variety of the old world, otherwise distinguished by the long tapering apex of the perigynium with a definite beak.

In studying the plants, the possibility of their European origin was not overlooked, because the area is renowned for adventive flora not encountered elsewhere in the state, e.g., *Filipendula Ulmaria* (L.) Maxim. and *Campanula glomerata* L. The record of the species from Duluth extends its westerly distribution in the interior from Ottawa and Michigan to the head of Lake Superior.

Caltha natans Pall. Ten years ago this species was rediscovered[1] in Minnesota at Deep Lake, Sparta. For some time the colony survived in the eroding creek bed. A recent check of the station indicated its complete disappearance. If so, it is the second locality in the state where this species has disappeared due to human interference, in this instance as a result of mining operations at nearby Gilbert. The lowering of the lake level left the creek bed high and dry and subjected it to erosion. However, a more cheerful outlook holds for *Caltha natans* in its most recently found locality in Superior National Forest. It grows in abundance in shore ponds of Trout River, below the falls, on the portage from Vermilion Lake to Trout Lake. On Sept. 3–6, 1953, the plants were still in flower and in abundant fruit. Collections Nos. 17000 and 17166 were made from ponds along the east bank of Trout River.

[1] Lakela, O. Rediscovery of *Caltha natans* in Minnesota, Rhodora **45**: 53–55, 1943.

Subularia aquatica L. The first record[2] of this species in the state was based on a single specimen from Poplar Lake, Cook Co., as very rare. Its occurrence in Trout Lake north of Lake Vermilion in St. Louis Co. marks the mid-continental position of its range, from N. S. to Calif.

The north bay of Trout Lake has extensive beaches of fine white sand. Wading to a depth of about 20 in., the plants were barely discernible in the bottom growth of aquatics. The least surface disturbance of the clear water obscured from view the tiny plants 2–3 in. high among flocculent masses of algae shifting in currents. In collecting specimens some of the vegetation was scooped up at random. As the plants floated to the surface it became a simple task to separate *Subularia* from *Elatine minima* and *Juncus pelocarpus*, the latter in sterile tufts dominating the scattered aquatic communities. Thus, an ample amount, collection No. 17069, Sept. 5, 1953 was obtained. Careful collecting should turn up the species in many other northern lakes with sandy beaches. A water scope should be an aid in detecting components of matted aquatics especially in deep water.

Primula mistassinica Michx., f. leucantha Fern. Plants with pure white flowers were found growing among the typical form in the crevice vegetation of the North Shore of Lake Superior. On May 16, 1953, No. 15919 was collected at Stony Point beach southeast St. Louis Co.

Prunella vulgaris L., f. albiflora (Bogenh.) Britt. Three plants bearing white flowers were sighted with the typical from covering a clearing along the shorewoods of Lake Superior near the Duluth water works, where No. 16264 was collected on July 22, 1953. The flowers on drying turned drab.

Penstemon pallidus Small. This species was first reported from the state from the Floodwood area, southwest St. Louis Co. Its finding on the coast of Lake Superior is a notable extension of range from the interior. On July 11, 1953, No. 16194 was collected in an opening along the forest border on Highway 61 near Tofte. The plants in full flower whitened the landscape. The species is an addition to the flora of Cook Co.

[2] Butter, Fred K. and Ernst C. Abbe. A Floristic Study of Cook County, Northeastern Minnesota. Rhodora 55: 154, 1953.

[3] Lakela, O. Previously Unreported Plants from Minnesota, Rhodora 53: 159, 1951.

Castilleja coccinea (L.) Spreng., f. lutescens Farw. The yellow flowers of this form brought a pleasing color variation to the undergrowth of the ash-poplar forest glowing with scarlet flowers of the typical form. Collection No. 16109 was made on June 21, 1953 along the road to Seven Beaver Lake, the headwaters of St. Louis River, near Toimi.

Centaurea dubia Suter. This species was discovered along the forest border of Highway 73, about 25 miles north of Chisholm in the northwestern part of St. Louis Co. These elegant plants in full flower, collection No. 16543, Aug. 3, 1953, added a new color tone among early flowering native composites.

Hieracium vulgatum Fries. This adventive, collection No. 16197, came to the attention in the same area where *Carex pallescens* var. *neogaea* was discovered on July 17, 1953. The plant is well established, growing in abundance with masses of yellow flowering heads. The previous western limit of its range in the interior is Michigan.

The author wishes to acknowledge with gratitude the Graduate School of the University of Minnesota for the grant-in-aid of research of the St. Louis County flora used in part to defray the cost of collecting.—Olga Lakela, university of minnesota, duluth branch.

Three Interesting Algae from New Jersey.—**Zygnema novae-caesareae**, sp. nov., *Zygnema* cum filamentis sterilibus 29–33 μ latis; filamenta rupta formant cellulas singulas quae tum copulant; zygospora globosa ad locos connexivos portantur in cellulis binis plus minus genuflexis, simulate sine tubo connexivo; zygospora in diametro 32–36–43 μ, cum membrana laevi.

Zygnema with vegetative filaments 29–33 μ in diameter; filaments disintegrating into single cells which then conjugate by crossing and fusing into each other; zygospores round, membrane smooth, and with a diameter of 32–36–43 μ; zygospores being tightly contained at the point of fusion by the two more or less genuflexing cells.—new jersey: With *Zygnema* sp., etc. in a ditch, meadowland near the Passaic river at South Orange Avenue, Essex County, May 17, 1951, *Herbert Habeeb 3756* (type). Two other numbers were collected from different parts of the same ditch, namely *3757* and *3758*, but these contained only single cells and vegetative filaments. A collection of *Zygogonium ericetorum* Kütz. contained a few of our peculiar cross-celled zygosporangia; ditch, Brookside, Morris County, New Jersey, April 8, 1951, *Herbert Habeeb 3352*.

Zygnema novae-caesareae would seem to be in part the *Zygnema insigne* of Horatio C. Wood in A Contribution to the Fresh-Water Algae of North America especially fig. 8b plate XV. On the other hand fig. 8a plate XV is that of another form of *Zygnema* also found in New Jersey. This is a relative of *Zygnema insigne* (Hass.) Kütz., but differing from the typical plant in that the spores are found partially to completely in the conjugation tube; with about a third of the spores in one filament, a third in the conjugation tube, and a third in the second filament—often arranged in the form of a drawn out "S." This latter *Zygnema*, I propose to name as follows.

Zygnema insigne (Hass.) Kütz., var. **confusospora,** var. nov., a forma typica differt: zygosporis vel partim vel omnino in tubo connexivo.—new jersey: In pasture pond with *Spirogyra* spp., New Brunswick, Middlesex County, April 21, 1951, *Herbert Habeeb 3484* (type). Swale near the Passaic River at South Orange Avenue, Essex County, April 28, 1951, *Herbert Habeeb 3527* (with *Spirogyra* spp. and *Vaucheria* sp.). The writer has also collected from New Jersey several numbers of typical *Zygnema insigne* (Hass.) Kütz.

Vaucheria terrestris (Vauch.) DC., var. **crenulata** (Prescott), stat. nov. *Vaucheria crenulata* Prescott Amer. Midl. Nat. **50:** 468–472. 1953.—new jersey: In a brook, 1½ miles south of Cranberry Lake, Sussex County, April 15, 1951, *Herbert Habeeb 3402*.

The variety differs from the typical form in that its smaller filaments and gonidial branches are uniformly undulate. Dr. Prescott collected his specimens in Alaska.

Specimens of all the numbers cited above are deposited in the Cryptogamic Herbarium of the Chicago Natural History Museum, besides being retained in the collections of the writer.—

Herbert Habeeb. grand falls, new brunswick, and seton hall university.

Calamagrostis insperata in missouri.—In 1935 Swallen described *Calamagrostis insperata* from a single locality, Ofer [or Ophir] Hollow, Liberty Township, Jackson Co., Ohio. Although only one collection is cited there is a second collection by Bartley and Pontius in the United States National Herbarium, labelled "No. 21, Top of cliff, Ophir Hollow." There are no other sheets in the National Herbarium. At about the same time Steyermark made two collections of *Calamagrostis* in Missouri, which were misdetermined and have only now come to light. Comparison with the type of *C. insperata* deposited in the National Herbarium shows that the Missouri plants are conspecific with the plant from Ohio, although differing in the following respects: the spikelets are only (3.75–) 4–5 mm. long instead of 5–5.5 mm. long, the ligules are shorter, only 2–3 mm. long, and, in one of the two collections, the blades are strikingly large, up to 11 mm. wide and 33 cm. long.

The plant with the larger leaves is *Steyermark 23350;* it was growing in "rocky, grassy, open, cherty, limestone slopes at east end of bluffs, along Indian Creek, near Holy Cliff, 3½ miles northeast of Topaz, Douglas Co., July 19, 1937." This plant was apparently taken just before anthesis. The other collection, *Steyermark 20043,* was made on "lower chert slopes in ravine in Blue Springs game refuge, Gardner [Mark Twain] National Forest, Ozark Co., Sept. 12, 1936." This plant is without any complete leaves, having apparently been grazed, and has only what is probably a post-season panicle with undeveloped anthers.

Calamagrostis insperata belongs to the complex of species centered in *C. Porteri* A. Gray, all members of which are known from only a very few localities. The complex apparently represents the remains of a species widely distributed before the Pleistocene and now nearly extinct. The Missouri localities for *C. insperata* harbor those members of the complex which occur farthest to the southwest, and they mark an extension of range of 600 miles. It seems likely that in the intervening area in southern Illinois or southern Indiana there may be one or two spots in which *C. insperata* is growing.—George B. Van Schaack.

The New Index to the First Fifty Volumes of Rhodora[1]—For several years the manuscript of an exhaustive index to volumes one through fifty of Rhodora has been essentially ready for publication. The cost of producing it in a form following the high printing standards of Rhodora seemed prohibitive. However, the Council of the New England Botanical Club, feeling that this index was of considerable importance to botanists generally, have provided a considerable subsidy to insure its publication. The Index, with the high quality printing maintained, is now being offered for sale at a price below the cost of production.

The paper-bound book consists of 405 double column pages divided into two parts. Part I is an index to plant names and is complete in itself. As a guide to pertinent literature concerning each of the plants mentioned in Rhodora, this part of the book should be exceedingly valuable. It not only guides the user to the places where the plant is mentioned in Rhodora, but to a variety of additional outside references given in the Journal at these locations. This feature of the Index should make it valuable as a reference book even if a set of Rhodora is not at hand. There are 273 pages in Part I.

Part II, consisting of pages 274–405, starts the alphabet anew and is an index to authors and titles. This part contains the material usually found in a journal index. However, titles appear both independently and under the author or authors. Each title is indexed by every principal word in the title. Under each author, the titles are given chronologically. Thus, for some who have published regularly in Rhodora, the entries approach a complete bibliography.

Because of the very extensive and varied coverage, many botanists will find this index to be of much greater value to them than most of the indices with which they are familiar. It should be particularly useful in smaller institutions where a set of the journal is not available for it will permit one to obtain particular articles either by microfilm or by the purchase separately of the special issues of Rhodora desired.—R. C. Rollins.

[1] Rhodora, Index to Volumes 1–50. Compiled by Ernest Rouleau. Edited for the New England Botanical Club by Ralph C. Bean, Stuart K. Harris, Albert F. Hill and Reed C. Rollins. 405 pp. $9.75. Copies may be obtained from Dr. A. F. Hill, Botanical Museum, Harvard, Oxford Street, Cambridge 38, Mass.

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THE GENUS TETRACOCCUS (EUPHORBIACEAE)

Robert L. Dressler

Tetracoccus is a small genus of more or less xerophytic shrubs of the southwestern United States and Mexico, whose species appear to be of considerable phytogeographic and phylogenetic interest. In the present paper an attempt is made to give a complete taxonomic treatment of the genus and to make some tentative geographical correlations.

The plants of *Tetracoccus* are decidedly local and usually discontinuous in distribution, but may, in some cases, be quite abundant over limited areas. They are dioecious plants, apparently insect pollinated, whose flowering is largely governed by rainfall. Separate flushes of flowering in response to periods of rainfall have been noted on several occasions and in different species.

Tetracoccus is allied to *Securinega* and may be distinguished by its carunculate seeds and the central disk without a pistillodium in the staminate flower. *Tetracoccus* is probably, as hypothesized by Croizat (1942), one of the more primitive genera of the *Phyllantheae*, being more primitive in floral structure than *Securinega*. [This does not imply acceptance of other aspects of the phylogeny offered by Croizat]. The same author feels that there are close resemblances between *Tetracoccus* and genera of the African and Australian desert areas; this, as well as its distribution pattern, would seem to point to the group as being relictual. The present distribution of the genus is shown by Fig. 1. The genus as a whole is disjunct and, as noted above, the species are usually discontinuous. The probable phylogeny of the species and tentative geological correlations are shown in Fig. 2. The relationships between the species and these attempted correlations are further discussed under each species. Though there is no recognized fossil evidence of *Tetracoccus* itself in western North America, our knowledge of the Tertiary floras of the western United States is sufficient to make some correlations. The geological correlations are based on floristic coincidence with floras and vegetations whose history is partially known, Gentry's "postinsular" hypothesis and morphological divergence. It is felt that the *capensis*-like population from which *T. fasciculatus* was derived, became separated from the plants in the Cape region of Baja California when the latter became an island in the early or middle Tertiary (Miocene?). On the basis of morphological divergence it is hypothesized that "pre-*capensis*" had differentiated from "pre-*dioicus*" and that the latter had separated from the population ancestral to *ilicifolius* before the Miocene. The floristic relationships of *T. dioicus* (a chaparral plant) seem to fit this plan. Too little is known of the Death Valley area for better elucidation of the history of *T. ilicifolius*.

While the separation of the two varieties of *T. fasciculatus* is thought to be relatively recent, the differentiation of the *T. fasciculatus* type may date back at least to the mid-Pliocene time of aridity, at which time Axelrod (1948) feels that the local desert floras had their beginning. Gentry (1949, p. 83), on the other hand, feels that areas of local aridity may have existed in western North America since mid-mesozoic. While the California deserts are largely the result of mountain rain shadow, and most certainly as relatively young as believed by Axelrod, it must be remembered that areas of considerable aridity can result from other factors. The present Vizcaino Desert area of Baja California is a good example.

It is possible that *T. capensis* is not a postinsular endemic, but owes its present distribution to yet poorly known Pleistocene events. Only continued paleobotanical and floristic investigation can clarify the probabilities. In any case, the area in question offers great opportunities for the study and correlation of evolution in land form and biota, as has been so ably stressed by Gentry (1949).

The taxonomic history of *Tetracoccus*, though relatively short, is not without its complications, and, for so straightforward a group, it has accumulated more than its share of synonymy. The first species of this group to be described was *T. fasciculatus*,

Fig. 1. Present distribution of the genus *Tetracoccus*.

which was provisionally placed in *Bernardia* by Watson (1883). The genus was described by Engelmann for *T. dioicus* and published by Parry (1885) after Dr. Engelmann's death. Brandegee, in 1906, described *T. Hallii* from the Colorado Desert of California, but overlooked its close similarity to *Bernardia* (?) *fasciculata*, which he had correctly noted as a member of the *Phyllantheae* (1894). In 1922, Johnston described a collection (Brandegee's) from the Cape region of Baja California as *Securinega capensis* and transferred *T. Hallii* and *Bernardia* (?) *fasciculata* to *Securinega*. The following year he created the genus *Halliophytum* for the above species and gave a key to separate them from each other and from *Tetracoccus*, which

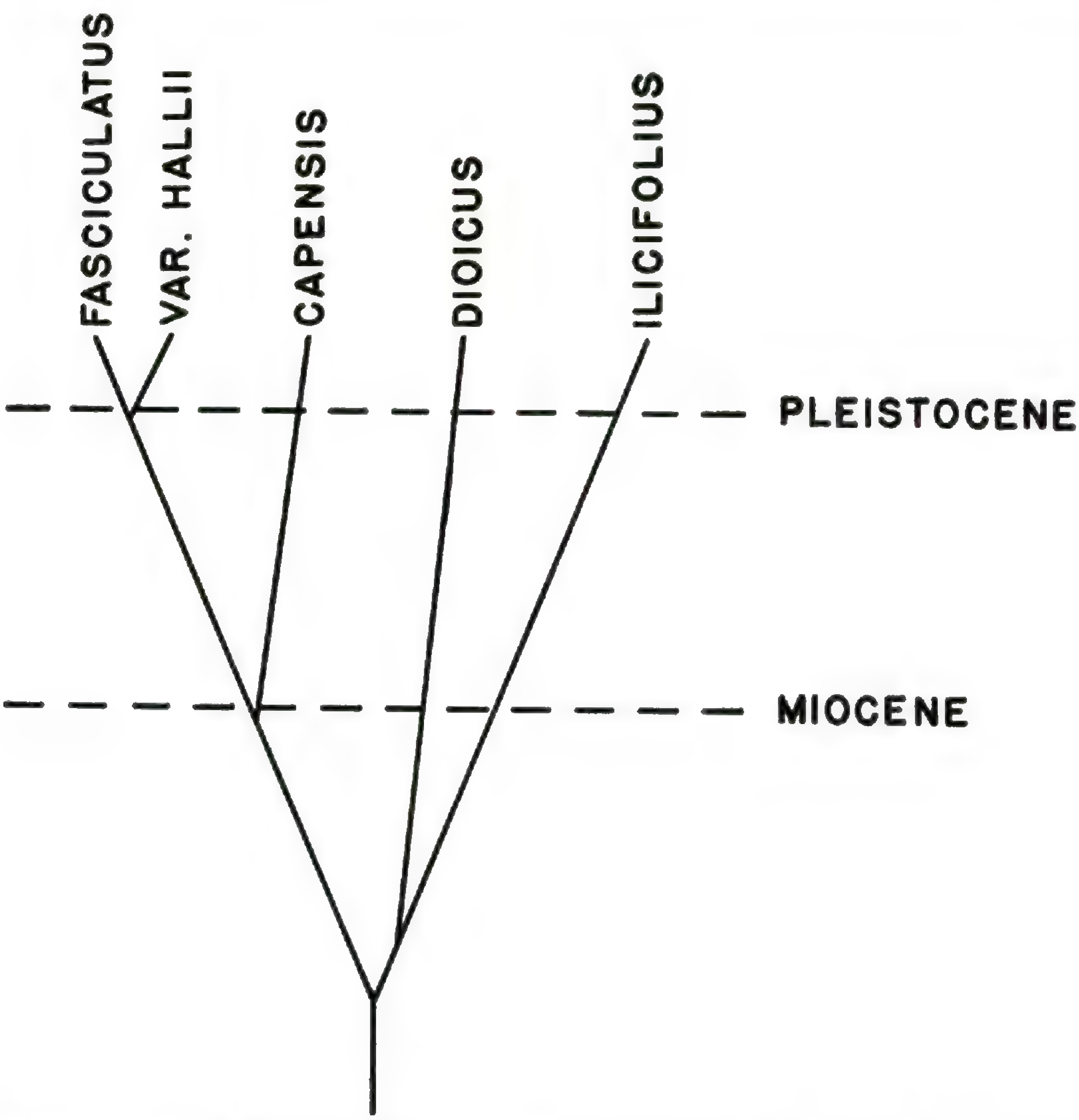

Fig 2. Diagram showing probable relationships between the species and tentative correlations with the geological time scale.

he then considered monotypic. Only in 1936 was *T. ilicifolius* described by Coville and Gilman from Death Valley. This caused Wheeler to review *Tetracoccus* and *Halliophytum* in 1939;

he concluded that they were congeneric and that he was unable to distinguish the three species of "*Halliophytum.*" Croizat then reviewed the problem in 1942, disagreeing with Wheeler as to the validity of the name *Bernardia* (?) *fasciculata* and publishing new combinations under *Tetracoccus* for *Halliophytum fasciculatum* and *H. capense* without comment as to their distinctness.

The author wishes to thank Dr. Louis C. Wheeler for his guidance in the present study, and the curators of various herbaria for the generous loan of specimens. The herbarium abbreviations recommended by Lanjouw and Stafleu (1952) are used in citation. These are listed here for convenience: University of Arizona, Tucson (ARIZ); Dudley Herbarium, Stanford University (DS); Chicago Natural History Museum (F); Gray Herbarium, Harvard University (GH); Iowa State College (ISC); Missouri Botanical Garden (MO); Pomona College, Claremont, Calif. (POM); University of California, Berkeley (UC); United States National Herbarium, Washington, D. C. (US).

Measurements of flower parts have been made from dried material softened and expanded by boiling, while other measurements were taken from dry herbarium specimens (these measurements were supplemented, in the case of *T. fasciculatus* var. *Hallii*, with measurements of fresh material and material from liquid preservative). The tangential dimension of the seed is that dimension tangential to the cross section of the fruit as the seed is oriented in the capsule. The radial dimension is comparable.

TETRACOCCUS Engelm.

Tetracoccus Engelmann ex Parry, West American Scientist **1:** 13. 1885. TYPE: *T. dioicus* Parry—*Tetracoccus* subgenus *Eutetracoccus* Croizat, Bull. Torr. Bot. Club **69:** 456. 1942.

Halliophytum I. M. Johnston, Contr. Gray Herb. **68:** 88. 1923. TYPE: *Bernardia* (?) *fasciculata* S. Wats.: the first species listed by Johnston and designated as type by Croizat.—*Tetracoccus* subgenus *Halliophytum* (Johnst.) Croiz., loc. cit.

Tetracoccus subgenus *Tetracoccaster* Croiz., loc. cit. TYPE: *T. ilicifolius* Coville & Gilman.

Shrubs; leaves alternate, opposite or ternate, often fascicled, simple, petiolate; stipules none; flowers dioecious, apetalous; staminate flowers in axillary panicles or racemes, or in fascicles from spur branches, stamens 4–10 arranged about a central, variously lobed, glandular disk; pistillate flowers solitary and axillary or fascicled on spur branches, glandular ring between sepals and ovary with lobes as many as the carpels and alternating with them, carpels 2–5, usually 3 or 4; styles free, entire; fruit a capsule; seeds 1 or 2 per locule, caruncculate, smooth and shining.

I do not use the subgenera created by Croizat (cited in synonymy) as I feel that the relationships between the species are too close to warrant it. In addition, there is little utility in a series of subgenera all of which are so nearly monotypic.

Key to the Species of Tetracoccus

A. Ovary usually 4-loculed; staminate peduncles mostly exceeding 4 mm. in length; filaments villous toward base; seeds always flattened tangentially.
  B. Leaves oblanceolate or oblong-ligulate to nearly linear, entire or remotely and minutely serrulate; staminate flowers in small racemes 1. *T. dioicus.*
  B. Leaves ovate or broadly elliptic to oblong-lanceolate, manifestly serrate-dentate; staminate flowers in congested panicles. . . . 2. *T. ilicifolius.*
A. Ovary usually 3-loculed; staminate flowers fascicled or peduncles not exceeding 3 mm.; filaments glabrous; seeds usually flattened radially (flattened tangentially only when two develop in the same locule).
  C. Staminate inflorescence racemose, peduncles present though small; pistillate pedicels 5–7 mm. long in fruit. . . . . 3. *T. capensis.*
  C. Staminate flowers fascicled, inflorescence without peduncle; pistillate pedicels rarely exceeding 2 mm. in length.
    D. Caruncle usually well developed (in mature seeds), seed coat little folded ventrally, little proliferated about caruncle (plants of Mexico). . . . . 4. *T. fasciculatus* var. *fasciculatus.*
    D. Caruncle rudimentary, seed coat somewhat proliferated and folded ventrally, especially about caruncle (plants of California and Arizona). . . . . 5. *T. fasciculatus* var. *Hallii.*

1. **Tetracoccus dioicus** Parry, West American Scientist **1:** 13. 1885. Type: Santo Tomás Hills, Lower California, Sept. 24, 1884, *C. R. Orcutt 313* (isc 211889!, isotypes gh!, mo!, uc!, us!).—*T. Engelmannii* S. Wats., Proc. Am. Acad. Arts & Sci. **20:** 373. 1885. Type: same collection as above (gh!, isotypes isc!, mo!, uc!, us!).

Shrub 1.5–2 m. tall; young stems slender, reddish, sparsely crisp-tomentose about axils, becoming grey in age; leaves coriaceous, glabrescent, alternate, opposite or ternate, sometimes fascicled on short spur branches, oblong-ligulate to lanceolate or oblanceolate or nearly linear, sometimes falcate; petiole about 2 mm. long; margins sometimes inrolled, entire or weakly and remotely serrulate, apex obtuse to acute; staminate flowers solitary or in few-flowered (2–10 fls.) racemes to 20 mm. long; pedicels 3–10 mm. long, subtended by acuminate bracts 0.5–2 mm. long, sepals 6–10, ovate to lanceolate, 1.6–2 mm. long; stamens 5–10, filaments 2.5–4 mm. long, basally long villous, anthers about 0.5 mm. long; central glandular disk oblong to circular, ca. 1–1.5 mm. in diameter, 0.5 mm. high, flattened or blunt-carinate, sometimes papillate-lobed, margin irregularly lobed about filament bases; pistillate flowers solitary, axillary;

pedicels 6–15 mm. long, bearing 2 elliptic-oblanceolate bracteoles 1.5–2 mm. long; sepals 7–13, lanceolate or elliptic-lanceolate, acute, 2.75–5 mm. long, 1–2 mm. wide, minutely sericeous-tomentose within, margins often weakly glandular-dentate; glandular ring fleshy, lobes 4, deltoid to quadrate-lingulate, 1.5–1.75 mm. long; ovary softly crisp-tomentose; carpels 4 (rarely 5), styles 3–3.5 mm. long, spreading, flattened; young fruit reddish, sparsely crisp-tomentose; fruiting pedicels thickened; fruit depressed-globose, shallowly lobed, about 6 mm. long, 7–9 mm. wide; seed shiny, brownish red, oblong, tangentially compressed, 4.5–5 mm. long, 1.5–2.2 mm. tangentially, 2.4–2.8 mm. radially, caruncle well developed, 1.2–1.3 mm. in diameter, larger than hilum.

San Diego Co., California and northern Baja California, México. Representative specimens seen: San Diego Co., CALIFORNIA: near Temecula, just south of the Riverside Co. line, east of the road to Pala, April 12, 1900, *C. R. Orcutt* (UC); near Rainbow, March 24, 1914, *S. B. Parish 9130* (US); Lone Palm Spring on road to De Luz, Dec. 17, *Frank F. Gander 2985.2* (GH); Red Mountain near Fallbrook, alt. 1,000 ft., April 27, 1918, common shrub in Chaparral, *I. M. Johnston 1868* (ARIZ, DS, GH, POM, UC); Red Mountain Grade, local, in partly shaded chaparral on dry slope, May 14, 1932, *P. A. Munz & I. M. Johnston 12,613* (pistillate) (F, POM, UC) and *12,614* (staminate) (DS, F, POM, UC); Vista, October 28, 1933, *John S. Webb* (POM); Vista, dry slope in chaparral, April 3, 1933, *Cartwright* (POM); Jamacha, April 7, 1911, *Alice A. Murphy* (UC); along the old narrow road which runs from Lyons Valley to the Lawson Valley Road, May 18, 1929, *Helen L. Dale* (DS). Baja California, MEXICO: 8 miles this side of Table Mountain, Feb. 24, 1883, *D. Cleveland* (UC); near Table Mountain, Feb., 1883, *C. C. Parry* (GH, ISC, MO); Ensenada, *C. C. Parry* (DS); Santo Tomás hills, April 12, 1886, *C. R. Orcutt* (GH, ISC, UC, US); Guadaloupe Creek, April 27, 1873, *T. S. Brandegee* (UC); Santa Cruz road, between Santa Cruz and San Vicente, Feb. 18, 1935. *C. Epling & Wm. Robison* (GH, UC).

Both *Orcutt 313* and the *Parry* 1883 collection were available to Parry when he published the species; the former collection is here designated type since it is more complete, as stated by Parry. Wheeler (1939, p. 33) has adequately discussed the priority of *T. dioicus* Parry over *T. Engelmannii* S. Wats.

The collection by John S. Webb that is cited consists of several twigs which accompanied a letter sent to Dr. Munz. The sender stated that the plant was unusual in having apparently "perfect" flowers. One of the enclosed twigs bore a single fruiting pedicel and columella (the fruit having dehisced); this same twig still retained, at the time of examination, a single somewhat aberrant staminate flower, others apparently having broken off previously. All other twigs bore only staminate flowers. The monoecious condition of this individual may have been correlated with an abnormal rate of growth. Mr. Webb states that the plant had attained a height of six feet and a spread of seven feet in a period of two years since being cut to the ground. The same letter contains a reference to a "delicate odor of the male blossom." This, along with the glandular tissues in flowers of both sorts, would seem to indicate insect pollination for the species. The present species, like the others of the genus, apparently flowers after every adequate rain, at least in the spring and summer. Leaf shape is quite variable, ranging from comparatively broad and flat and relatively thin in northern San Diego County to narrow, thick and inrolled, nearly needle-like leaves in interior, southern San Diego Co. The Mexican material is somewhat intermediate.

The distribution of this species, like that of the other species, is of considerable interest. It is known to occur, apparently somewhat locally, in chaparral from northern San Diego County south to about San Vicente in Baja California. It is not improbable that it is a relictual species dating to the Miocene or Pliocene when the chaparral was more generalized and (in the Pliocene) more widespread (Axelrod 1948). The present restricted distribution may be the result of temperature, rainfall or both. Among the other endemics to this general area is *Cneoridium dumosum* (Rutaceae), which, in foliage, strikingly resembles *Tetracoccus dioicus*. *T. dioicus* probably shows more primitive characters than does any of its congeners. Among these seemingly primitive characters are the larger number of carpels, the larger and indefinite numbers of sepals and stamens, and the more generalized male inflorescence. The leaves of *T. dioicus* are probably of a derived type, though they possess traces of the serrations which are so well developed in *T. ilicifolius*. This species shows resemblances both to *T. ilicifolius* and to *T. capensis* (and through the latter to the other species of the genus).

2. **Tetracoccus ilicifolius** Coville & Gilman, Journ. Wash. Acad. Sci. **26:** 531. 1936. Type: Canyon north of Titus Canyon, Grapevine Mts., Death Valley, California, May 30, 1936, *M. F. Gilman 2180* (us 1,650,292!, fragment uc!).

Open, spreading shrub to 1.5 m. in height; young twigs reddish, sparingly brownish-tomentose, becoming glabrous and grey with age; leaves op-

PLATE 1199. *Tetracoccus fasciculatus* var. *Hallii*.

Fig. 1. Area southwest of Cottonwood Springs, Riverside Co., Calif., April 6, 1952; showing *Tetracoccus* as sub-dominant on decomposed granite, with *Juniperus*, *Larrea* and *Yucca mohavensis*.

Fig. 2. Area just south of Vidal Junction, San Bernardino Co., Calif., April 19, 1952; showing *Tetracoccus* growing in shallow wash bordered by desert pavement.

PLATE 1200. *Tetracoccus fasciculatus* var. *Hallii*.

Fig. 1. Branch of staminate plant. Vidal Junction.

Fig. 2. Young and older branches from same pistillate plant. Vidal Junction.

Fig. 3. Foliage from various plants in one locality to show variation, leaves purplish in some. Southwest of Cottonwood Springs.

posite, ovate to broadly elliptic or occasionally ovate-lanceolate, 15–30 mm. long, 7–20 mm. wide, coriaceous, sparsely tomentose when young, petiole about 2 mm. long, base obtuse, apex broadly acute or obtuse, margin distinctly serrate-dentate with 5–11 teeth on each side; staminate inflorescence an axillary, congested panicle 15–35 mm. in length, peduncles sparingly tomentose, about 10 mm. long; staminate flowers sessile or nearly so, sepals 7–9, lance-linear to lanceolate, with glandular teeth; stamens 7–9; filaments 2–3 mm. long, villous at base; anthers 0.9–1.2 mm. long, minutely papillate; disk 1–1.75 mm. in diameter, irregularly lobed; pistillate flowers solitary, axillary; pedicels 8–15 mm. long, tomentose above, bearing 2 elliptic-lanceolate, acuminate bracteoles to about 5 mm. long and 2 mm. wide (or occasionally larger and similar to the foliage leaves) with few glandular teeth; sepals in 2 series: the outer rhombic-lanceolate, acute to acuminate, 1.5–2.5 mm. wide, 3–4 mm. long, inner series slightly smaller and ovate-lanceolate, both series glandular-dentate along margins, densely tomentose within, less so without; gland lobes more or less opposite inner sepals, ligulate to deltoid and shallowly digitate-lobed, about 1–2 mm. wide and 2 mm. long; ovary 4-carpellate, densely tomentose; styles 4, spreading, about 3 mm. in length, flattened above; fruit with short brownish tomentum, oblong-globose, shallowly lobed, 8–9 mm. long, 6–8 mm. wide; seeds 1 or 2 per locule, shining, brownish red, elliptic-oblong, flattened tangentially; 4.25–5 mm. long, about 2.75 mm. radially, 1.75–2.25 mm. tangentially; caruncle yellowish, well developed, similar to that of *T. dioicus*.

Mountains on both sides of Death Valley, Inyo Co., CALIFORNIA. Representative specimens seen (Mr. Gilman's numbers appear to refer to individual sheets rather than to collections): In large canyon north of Titus canyon [now Falls Canyon], Grapevine Mountains, 2,000 ft. Elev., August 2, 1936, *M. F. Gilman* s. n. (US); May 30, 1935 [sic], *Gilman 2182* (POM); Alt. 4,000 ft., May 30, 1936, *Gilman 2183* (POM). Tetracoccus Peak, Panamint Mountains: alt. 5,000 ft., June 4, 1938, *Gilman 3042* (POM); alt. 5,000 ft., Sept. 7, 1938, *Gilman 3357* (POM); alt. 5,500 ft., June 15, 1941, *Gilman 4376* (POM). Death Valley Canyon, Panamint Mountains: 5,500 ft., June 4, 1938, *Gilman 3036* (POM); 5,000 ft. alt., June 4, 1938, *Gilman 3045* (GH); 5,000 ft., June 4, 1938, *Gilman 3047* (DS); 5,000 ft. alt., Sept. 7, 1938, *Gilman 3350* (GH); 5,000 ft., *Gilman 3370* (DS).

This remarkable plant, a local endemic occurring in the mountains on both sides of Death Valley, is reported as very scarce and perhaps dying out at the type locality, Falls Canyon (Coville & Gilman 1936). Material from that locality shows smaller leaves and branches, which may indicate less favorable conditions there than at the other two known stations. In any case the plant is undoubtedly a relict from the relatively recent times in which Death Valley enjoyed conditions generally more favorable to plant growth than at present. That such conditions did exist is evidenced by traces of Pleistocene lakes in the region (Miller, 1936). *T. ilicifolius* probably retreated to relatively high altitudes in response to increased aridity. This same aridity prevented its occurrence to the south and cold has probably barred its dispersal to the north, leaving the species, as it were, trapped in an unfavorable area, with poor evolutionary prospects. It is unlikely that the present population contains enough variability for rapid selection of a better adapted type.

This species is most closely related to *T. dioicus*, to which it has many similarities. In some respects it is more derived than *T. dioicus:* namely the congested male inflorescence, the double series of pistillate sepals and the more fixed numbers of flower parts. The foliage of this species, on the other hand, may be more like the ancestral type from which they were both derived than is that of *T. dioicus.*

3. **Tetracoccus capensis** (Johnston) Croizat, Bull. Torr. Bot. Club **69:** 457. 1942. Type: West side of Cape Region, Baja California, Oct. 22, 1893, *T. S. Brandegee* (UC 110393!).—*Securinega capensis* Johnston, Univ. Calif. Publ. Bot. **7:** 441. 1922.—*Halliophytum capense* Johnston, Contr. Gray Herb. **68:** 89. 1923.

Shrub; branching more or less divaricately; young stems slender, reddish, very sparsely short-strigose; spur branches short, thick, to 5 mm. in length; leaves alternate, fascicled, glabrescent, thin, oblanceolate or spatulate-oblanceolate, occasionally obovate or linear-oblanceolate, 10–15 mm. long and 2–5 mm. wide, petiole about 1 mm., apex obtuse; staminate flowers solitary or in small racemes of 2 or 3 flowers, peduncle 1.5–3 mm. long, glabrescent; pedicels 5–7 mm. long, glabrous, subtended by ovate-lanceolate bracts about 1 mm. in length; sepals 5, concave, 1–1.1 mm. long, obovate, obtuse, apically denticulate, stamens 5, filaments glabrous, about 2 mm. long, anthers about 0.75 mm. long; disk about 0.7 mm. in diameter and 0.8 mm. high, flattened or crested, somewhat notched or lobed where filaments are attached; pistillate flowers solitary or fascicled 1–3 (or more?) from a spur branch, pedicels about 1.5–2 mm. long, strigose, subtended by small bracts, lengthening in fruit; sepals 5, 1.3–2 mm. long, deltoid, glabrescent; gland lobes lingulate, 1–2 mm. long, obtuse; ovary densely strigose-tomentose, carpels 3 or occasionally 4, styles 1.75 mm. long, spreading, spatulate; young fruit strigose, reddish in color when approaching maturity; fruiting pedicels 3–5 mm. in length, thickened; capsule oblong-globose, moderately lobed, to 8 or 9 mm. in diameter, relatively woody, base not indented; mature seed not seen, apparently resembling that of *T. fasciculatus* var. *Hallii.*

Known only from the Cape Region of Baja California, Mexico. Specimens seen: Coast below Pescadero, Sept. 23, 1893, *T. S. Brandegee* (GH);

West side of Cape Region, Oct. 22, 1893, *T. S. Brandegee* (UC); San José del Cabo, Oct. 7, 1890, *T. S. Brandegee 536* (UC).

This species, endemic to the Cape Region, may well be a "postinsular endemic" (Gentry 1949, p. 86), dating back to the mid-Tertiary, when the Cape Region was insular in nature. It is probably an element of the subtropical scrub flora which occurred in the California region in the earlier Tertiary and later became extinct in this area due to increased aridity and the lack of summer rain (Axelrod 1948). The relictual *T. capensis*, with its primitive resemblances in texture, inflorescence and fruit to *T. dioicus*, would seem to represent the general type from which *T. fasciculatus*, which it more closely resembles, was derived.

4. **Tetracoccus fasciculatus** (S. Watson) Croizat, var. **fasciculatus,** Bull. Torr. Bot. Club **69:** 456. 1942. TYPE: in the mountains 24 miles north-northeast of Monclova, Coahuila, México, September 1–6, 1880, *Edward Palmer 1233* (GH!, isotypes; GH!, US!).—*Bernardia (?) fasciculata* S. Wats., Proc. Amer. Acad. Arts & Sci. **18:** 153. 1883.—*Securinega fasciculata* I. M. Johnst., Univ. Calif. Publ. Bot. **7:** 441. 1922.—*Halliophytum fasciculatum* I. M. Johnst., Contr. Gray Herb. **68:** 88. 1923.

Shrub 1–2 m. tall; branches ascending to strongly divaricate; twigs slender, shortly strigose, spur branches small, to about 2 mm. in length, usually closer together than in var. *Hallii;* leaves numerous, glabrescent, coriaceous, oblanceolate to elliptic-oblong, 1.5–7 mm. long, 0.75–2.25 mm. wide, obtuse or acute, short petiolate; staminate flowers solitary or fascicled, 1–4 (or more?) per spur branch, often subtended by a bract about 0.5 mm. long; pedicels capillary, 2–3 mm. long, sparsely strigose; sepals 5 or 6, ovate-oblong, obtuse, 0.5–1 mm. long, strigose without; stamens 4, 5 or occasionally 6, filaments about 1.5 mm. long, anthers 0.6–0.7 mm. long; disk 0.4–0.5 mm. in height, about 0.7 mm. wide, rounded or somewhat crested, more or less lobed, often 3-lobed, with filaments inserted between lobes and in small indentation at end of each lobe; pistillate flowers solitary (or fascicled?), sessile or short pedicellate, sepals 5 or 6, deltoid or deltoid-ovate, acute to acuminate, 0.7–1 mm. long, appressed strigose-tomentose without; glands deltoid or lingulate, blunt or acute, 0.5–1 mm. long, ovary densely appressed tomentose, carpels 3 or occasionally 4, styles more or less spreading, 0.8–1.75 mm. long, spatulate; capsule depressed globose to oblong-globose, 6–8 mm. long, distinctly lobed, base indented; seeds greyish to dark reddish brown, polished, deltoid-ovoid to pyriform-ovoid, 4.5–6 mm. long, about 4 mm. tangentially (about 2 mm. if 2 develop in 1 locule), 2–2.5 mm. radially, caruncle well developed, about 1 mm. in diameter.

MÉXICO, from the Mesa del Norte of the states of Chihuahua and Durango to the eastern slope of the Sierra Madre Oriental in Coahuila.

Representative specimens seen. CHIHUAHUA: 13 mi. southeast of Saucillo, alt. 4,000 ft., with *Larrea* and *Acacia vernicosa*, July 29, 1937, *F. Shreve 8062* (ARIZ, US); vicinity of Santa Rosalía, alt. about 1,200 m., June 13–15, 1908, *E. Palmer 384* (GH, US); 31 miles southeast of Jiménez, divaricately branched shrub, 2 to 4 ft. high, common on *Larrea-Flourensia* covered slopes, Sept. 16, 1939, *C. H. Muller 3332* (UC); 12 mi. west of Carillo, road to Escalón, elev. 4,000 ft., shrub 1.5 m. high, July 24, 1939, *S. S. White 2040* (DS, GH). DURANGO: 26 miles west of Mapimí, about 5,400 ft. alt., common on rocky slope, loose dichotomous or trichotomous bush with assurgent branches, becoming 6 ft. tall, stem and leaves (*not* red) dark, Sept. 19, 1938, *I. M. Johnston* 7783 (GH, US).

The taxonomic validity of *Bernardia* (?) *fasciculata* S. Wats. has been the subject of some controversy (Wheeler, 1939; Croizat, 1942). The Seventh International Botanical Congress has more carefully delimited the *nomen provisorium* (Lanjouw, 1952, p. 28, Article 43), and *B.* (?) *fasciculata* is clearly to be considered as validly published.

This is one of those cases in which two plant populations may be designated either as species or varieties with little violence to the concepts of natural classification. Now that the nomenclatural validity of *Bernardia* (?) *fasciculata* is clarified, one feels free to use this name in a new combination. The two varieties of this species are closely related, and, while they can usually be easily distinguished and are widely disjunct, their close relationships seem best indicated by varietal status. The most easily definable differences are those in seed characters. The var. *fasciculatus* also differs from var. *Hallii* in smaller, more numerous leaves, smaller, more delicate staminate flowers with fewer parts and in having generally more slender branches. Most of these characters are probably derived from a type more similar to the present day var. *Hallii*, but the presence of a well developed caruncle in var *fasciculatus* is surely primitive.

Perry (1943) gives the chromosome number for "*Halliophytum fasciculatum* Johnst." as 2n = 24. No geographic origin was given for the material nor was there reference to herbarium specimens (cf. Just, 1951). The name used would seem to indicate that the plant was of this variety. In any case, there are not yet enough cytological data at hand concerning either *Tetracoccus* or the other genera of *Phyllantheae* to reach any conclusions.

The type collection, unlike the other collections seen, is from the eastern side of the Sierra Madre Oriental, probably the

Sierra de Hermanas. Dr. I. M. Johnston tells me there is some reason to doubt the data accompanying *Palmer 1233*, and that it may actually be from Chihuahua. This collection does, however, differ somewhat from all other collections in aspect, having larger leaves and more slender, ascending branches, as well as more oblong fruit. These may be due largely to a less xeric environment; there is not adequate material in the type series for full comparison. The region of seeming discontinuity is as yet quite imperfectly known. However the Sierra Madre Oriental in the north is neither relatively high nor altogether continuous. If var. *fasciculatus* is not now a continuous population, it may have been so in relatively recent times and under slightly different climatic conditions. For further discussion of relationships and possible geological history see under var. *Hallii.*

5. **Tetracoccus fasciculatus.** var. **Hallii** (T. S. Brandegee) comb. nov. TYPE: Chuckawalla Bench, Colorado Desert, Riverside Co., California, April 1905, *H. M. Hall 5865* (UC!, ISOTYPES DS! US!).—*Tetracoccus Hallii* T. S. Brandegee, Zoe **5:** 229. 1906.—*Securinega Hallii* Johnston, Univ. Calif. Publ. Bot. **7:** 442. 1922.—*Halliophytum Hallii* Johnston, Contr. Gray Herb. **68:** 88. 1923.—*Securinega fasciculata* var. *Hallii* Jepson, Man. Fl. Pl. Calif.: 595. 1925.—*Halliophytum fasciculata* var. *Hallii* McMinn, Ill. Man. Calif. Shrubs: 249. 1939.

Rigid shrub 1–2 m. in height; stems wandlike from base, branching divaricately above, young stems reddish, shortly gray-strigose; twigs tapering and becoming weakly spinescent by dying back from tips; spur branches 1.5–4 mm. in diameter, rarely reaching nearly 10 mm. in length, sometimes branching and becoming bi- or tri-cephalic; leaves alternate, fascicled, glabrescent, coriaceous, sometimes reddish in color, obovate, oblanceolate or spatulate-oblanceolate, 2–12 mm. long, 1–4 mm. wide, leaves of staminate plants often conspicuously smaller than those of pistillate plants from the same locality, apex obtuse, base cuneate to a very short petiole; staminate flowers fascicled, 1–20 from a spur branch; peduncle scarcely or not developed, pedicels 3–5.5 mm. long, sparsely pubescent, sometimes subtended by bract about 0.5 mm. long; sepals 4–6, 0.7–1.4 mm. long, obovate or orbicular to deltoid-ovate, acute or obtuse to truncate and denticulate, sparsely strigose-tomentose especially without, often more or less concave, often red or red-margined; stamens 4–8, filaments glabrous, 1.5–2.2 mm. long, anther 0.6–0.9 mm. long, central disk 0.5–1 mm. in diameter, about 0.8 mm. in height, rounded or crested, smooth or rugose, lobed as in var. *fasciculatus;* pistillate flowers solitary or fascicled, 1–6 from a spur branch, pedicels 0.5–1 mm. long, rarely reaching 3 mm. in length, sometimes subtended by 1 or 2 bracts about 0.5 mm. long; sepals 5, ovate to deltoid-ovate or lanceolate, obtuse or acute, sometimes denticulate, sparsely tomentose; gland lobes more or less truncate, denticulate, 0.8–1.4 mm. long; ovary densely grey-tomentose, of 2–4 (mostly 3) carpels; styles spreading, 1.5–2 mm. long, spatulate; fruiting pedicel rarely exceeding 2 mm. in length; capsule globose to oblong-globose, shallowly lobed, especially above, 8–12 mm. long, 6–10 mm. wide, base deeply indented; seed smooth, somewhat polished, ovoid or pyriform-ovoid, radially flattened (except when 2 seeds develop in one locule, when the seed is tangentially flattened and the tangential dimension is about half that given for other seeds), 4–7 mm. long, 3–4 mm. tangentially, radially about 2.5 mm.; seed coat somewhat proliferated and wrinkled ventrally, especially about caruncle; caruncle thin, rudimentary, 0.2–0.6 mm. wide, 0.5–1.5 mm. long, sometimes nearly linear.

Local, in the Colorado Desert and the southeastern Mohave Desert in California and in western Arizona. Representative specimens seen: ARIZONA. Mohave Co. Northwest of Alamo, Rawhide Mts., sand and gravel, March 1940, *Lyman Benson 10082* (POM). Yuma Co. banks of small washes along Bill Williams River near Alamo, March 7, 1939, *Forrest Shreve 7841* (ARIZ, DS, F); Weaver Pass, between Quartzsite and Cibola, Dec. 18, 1939, *E. C. Jaeger* (ARIZ. POM); Kofa Mts., about 2 mi. northwest of North Star Mine, March 24, 1933, *I. L. Wiggins 6617* (DS, US); Sheep Tanks, Elev. 1850 ft., on hillsides and abundant in dry washes, March 28, 1935, *T. H. Kearney & R. H. Peebles 11005* (F, POM). CALIFORNIA. San Bernardino Co. about 18 miles west of Needles, igneous, rocky hills with scattered vegetation of *Eriogonum, Larrea* and *Opuntia Bigelovii*, about 1 m. tall, frequent, April 19, 1952, *Dressler 1211* (GH); in a sandy wash near Colorado River between Parker, Arizona and Needles, California, March 22, 1931, *Kearney & Harrison 7530* (US); Carson's Wells, Turtle Mts., alt. 3,000 ft., March 27, 1940, *E. C. Jaeger* (POM); Copper Basin Mine, Copper Basin, Whipple Mts., alt. 1200 ft., coarse volcanic rock and gravel, shrub, height 3 ft., spread 3 ft., trunk diam. ½ in., April 30, 1932, *Carl B. Wolf* (DS, POM); 15 miles west of Earp, Whipple Mts., alt. 800 ft., June 2, 1942, *Robert A. Darrow* (ARIZ, POM); just south of Vidal Junction, local, silty soil of shallow washes bordered by desert pavement, *Encelia, Larrea, Krameria* and *Argythamnia lanceolata*, rounded shrub 1–1.5 m. tall, scattered, April 19, 1952, *Dressler 1205* (GH). Riverside Co. North slope of Eagle Mts., alt. 3,500 ft., quite common, May 18, 1941, *A. M. Alexander & L. Kellogg 2199* (UC); Eagle mts., the most frequently occurring shrub near the crest of the range, March 24, 1926, *E. C. Jaeger* (POM); 5 mi north of Cottonwood Spring, Eagle Mts., plateau, alt. 3,200 ft., associated with *Coleogyne* and *Polygala*, May 9, 1941, *Alexander & Kellogg 2138* (ARIZ, DS, UC); two miles from Cottonwood Springs, dense shrub 3 to 4 ft. high with cruciform branches, abundant, May 15, 1938, *R. S. Ferris & R. P. Rossbach 9540 & 9541* (F, DS, UC); above Cottonwood Spring, Eagle Mts., dry rocky slope of disintegrating granite, alt. 3,600 ft., April 13, 1949, *P. A. Munz 13050* (UC); Mansen Canyon, April 6, 1930, *M. F. Gilman 8* (POM); Lost Palms Canyon, Eagle Mts., elev. 850 ft., sun, desert hillsides and canyons, height 4 ft., spread 6 ft., June 15, 1932, *B. D. Stark* (DS); vicinity of Corn Springs, Chuckwalla Mts., abundant on rocky slopes and in rocky gorges, alt. 2,500 ft., April 9–12, 1922, *P. A. Munz & D. Keck 4882* (POM, UC). Imperial Co. north base of Chocolate Mts., at head of Arroyo Seco, common along gullies, Feb. 15, 1939, *E. C. Jaeger* (POM); Beale's Well, 12 mi. east of Niland, April 1, 1923, *Jaeger* (DS).

According to Parish (1918) the type locality, Chuckawalla Bench, is in the vicinity of Cottonwood Springs; modern maps indicate that it may be further south, in the Chuckawalla Mts. ("midway between Cañon Springs and Chuckawalla Spring," Brandegee, 1906). The number of specimens taken from the vicinity of Cottonwood Springs, in the Eagle Mts., probably surpasses that of all other specimens taken of this species from California. This is no doubt due in part to the convenience of Cottonwood Springs with its camping facilities. However, the species is probably more abundant in this region than in any other. In this locality, the plant occupies varied slopes and soil types and is more variable in form than in most areas. In some other areas it occurs in distinct local habitats, as at Vidal Junction (see Plate 1199) and west of Needles; in these sites the morphological variation is correspondingly reduced, consisting principally of differences in age and between staminate and pistillate plants. Whatever the factor or factors which control the distribution of var. *Hallii*, the edaphic factor alone cannot explain its irregularity. This plant is apparently absent from the Iron, Granite and Coxcomb Mountains, though present in the Eagle, Chuckawalla and Chocolate ranges in the south and in the Whipple and Turtle ranges to the north, each population extending into Arizona. Such discontinuity might well be due to recent climatic changes.

The difference in size of foliage between staminate and pistillate plants is quite evident in *Dressler 1205*, from Vidal Junction, the leaves from staminate plants measuring 3–4 mm. in length while those from the pistillate plants are 6–11 mm. long. The pistillate plants of this collection show numerous flowers, many well developed young fruit and a few fruit of intermediate size, probably representing a response to two separate rains or rainy periods. The young stems from the base are long and wandlike; the upper portion, however, soon takes on by repeated, divaricate branching the irregular form which is so abominably suited to herbarium sheets (see plate 1200, fig. 2). This, like *T. dioicus*, is probably insect pollinated. Both types of flowers have well developed glands, and the staminate flowers, in the laboratory, have been observed to attract houseflies by the nectar, which is especially noticeable about the bases of the filaments. The seed of this species, when solitary in a locule, develops a form strikingly reminiscent of an ordinary grape seed. The foliar aspect of *T. fasciculatus* var. *Hallii* is one which has developed not infrequently among desert shrubs. Those from the same general region which are similar include *Prunus fasciculata, Lycium* and *Crossosoma.*

The split of the ancestral population into those now known as var. *fasciculatus* and var. *Hallii* is perhaps to be correlated with the uplift of the intervening mountain ranges, the southern Rocky Mountains and the Sierra Madre Occidental of Mexico. Chapin and Garfias (1949) state that the Sierra Madre Occidental dates from the orogeny which commenced in the mid-Miocene. This orogeny, however, continued intermittently in western North America until the Pleistocene, and the separation of these desert *Tetracoccus* might have occurred as recently as the Pleistocene.—Gray Herbarium, Harvard University.

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————. 1885. Description of some new species of plants, chiefly from our western territories. Proc. Amer. Acad. Arts. & Sci. **20**: 352–378.

WHEELER, L. C. 1939. A miscellany of New World Euphorbiaceae,—II. Contr. Gray Herb. **127**: 48–78.

SALICORNIA EUROPAEA IN THE JAMES BAY REGION.[1] It would appear that *Salicornia europaea* L. has not been recorded in the literature for the James Bay region. Consequently it was of considerable interest when specimens of this species were found in a collection of plants received for identification from George M. Stirrett of the Canadian Wildlife Service.

The specimen, *G. M. Stirrett 847*, was collected on September 15, 1952, at Cabbage Willows Bay, a small indentation on the west shore of Rupert Bay, at the southern extremity of James Bay (approximately 51° 31′ N, 79° 17′ W). The plants, which were in mature fruiting condition, were recorded as common on tidal flats in shallow pools of open water. An herbarium sheet has been preserved in the Divisional Herbarium and duplicate sheets have been sent to the University of Montreal, Gray Herbarium, and Natural History Museum at Stockholm.

It is interesting to note, however, that this is not the first collection of *S. europaea* from James Bay. Examination of the specimens in the Herbarium of the National Museum at Ottawa has revealed two earlier collections, both of immature plants. These collections may be cited as follows: KEEWATIN DISTRICT,

[1] Contribution No. 1328, from the Botany and Plant Pathology Division, Science Service, Department of Agriculture, Ottawa, Canada.

N.W.T.: Charlton Island, about 52° 00′ N, 79° 30′ W, low alluvial flats subject to flood, *A. E. Porsild 4504*, July 6–14, 1929. ONTARIO: Chickanogahish, 53° 26′ N, 82° 10′ W, west shore of James Bay, fairly common on bare flats, *R. H. Smith 63*, July 11, 1944. *S. europaea* can now be recorded as new to the floras of the three administrative divisions that come together in the area: Ontario; Keewatin District, N.W.T.; and Ungava District, Quebec.

S. europaea is probably much more common in the James Bay region than these three collections would indicate. The plant quite likely occurs in suitable habitats around most of the shores of the Bay, but the muddy tidal flats of the Bay make these habitats not easily accessible to the collector.

Salicornia europaea is apparently not known from the shoreline of Hudson Bay to the north, nor is it known from the Labrador coast. Its disjunct distribution, St. Lawrence Basin—James Bay, is similar to that of a number of halophytic species that have been discussed by Potter[2] La Rocque[3] and Boivin[4] and hence will have to be viewed in the light of the hypotheses presented by these authors.—W. J. Cody.

A Fern Flora of Maryland, Delaware, and the District of Columbia.[5]—This latest of state fern floras ranks among the most complete that have yet appeared. It is based on the examination of material in the author's own extensive herbarium and in the U. S. National Herbarium, Gray Herbarium, the herbarium of the Philadelphia Academy, and a number of other institutions. The introductory matter includes a list of herbaria examined, a map showing counties, a good historical sketch of botanical activities and publications in the area with mention of the number of ferns concerned, a table giving statistics of the ferns and fern allies in different publications on the region and on neighboring states (in which the failure to discriminate be-

[2] Potter, D., Botanical evidence for a post-Pleistocene marine connection between Hudson Bay and the St. Lawrence Basin, Rhodora **34**: 68–89, 101–112. 1932.

[3] La Rocque, A., Post-Pleistocene connection between James Bay and the Gulf of Saint Lawrence, Bull. Geol. Soc. Amer. **60**: 363–379. 1949.

[4] Boivin, B., The distribution of *Arnica wilsonii* Rydberg and its significance, Rhodora **54**: 200–205. 1952.

[5] Reed, Clyde F. The ferns and fern-allies of Maryland and Delaware including District of Columbia. xvii, 286 p. incl. 72 full-page fig. (271 separate fig.), 58 i. e. 59 small maps, front. 23 cm. Reed Herbarium, Baltimore, 1953. ($3.00)

tween species and infraspecific categories makes the figures more misleading than helpful), a discussion of local distribution as influenced by soils and ecology, and an account of the life history of ferns and of their morphology with special attention to venation and spores. The remainder of the book, aside from an alphabetical list of the taxa with their principal synonyms, a glossary, a bibliography, and indices, is occupied by a keyed descriptive treatment of the ferns and fern allies of the region—67 native species (48 ferns, 19 fern allies), 63 varieties and forms, and 8 hybrids, according to my count, which does not entirely agree with the author's; there are also 4 escaped or introduced and slightly or not at all established species and one additional variety, as well as 3 *Asplenium* hybrids known only from adjoining states but apparently included by the author in his enumeration. The statement on p. 14 that the number of species in the District of Columbia is 16 or "perhaps nearer 20" is shown to be incorrect by the maps, which indicate definite records inside the District for 36 species; and there are 7 other cases in which the mark indicating occurrence is so placed that its pertinence is not clear but for which there is supporting material from the District in the U. S. National Herbarium, so that the number of species of ferns and fern allies known from the District is at least 43.

Under each species is given a general description, including statement of habitat, followed by a more detailed description in technical terms and smaller type, then the general and local range. The local distribution by counties of nearly all the species and very many of the varieties and forms, except a few with very restricted range, is shown on outline maps, of which there are 58; in several cases the distribution of more than one variety, or even that of several species, is shown by distinctive symbols on the same map. There are frequent notes on cultivation and sometimes on uses, as on bracken, ostrich fern (said to be "becoming more and more extinct" in the region), and on one of the scouring rushes, under which is the suggestion (borrowed from a writer on biochemistry) that the extinction of the dinosaurs might have been partly due to constipation brought on by the change in diet necessitated by the replacement of the dominant ferns with their purgative oils by the dyscathartic flowering plants.

The utility of the book for identification purposes depends on its keys and descriptions, but neither of these items can be regarded as entirely satisfactory. The keys are sometimes based on distinctions that are vague or hard to observe, while more definite ones that might have been used are omitted, and there is frequently a failure to present both sides of a really contrasting character. The key to the species of *Equisetum*, for instance, is based chiefly on characters of the sheath teeth and the central cavity, not all of which are correctly stated, and there is no mention of such distinctive features as the evergreen stem and apiculate spike of *E. hyemale*, the very dissimilar fruiting and sterile stems of *E. arvense*, or the loose reddish brown sheaths of *E. sylvaticum*.

The offset-printing process by which the book is produced has done full justice to the text but not to the photographs, although the outline maps came out well enough. The 73 full-page illustrations, mostly photographs of herbarium specimens and spores with a few habitat groups, all labeled plates but actually figures since they bear text on the back, are for the most part not completely satisfactory, being either too much reduced or too weakly reproduced to represent their subjects properly; in some cases, for instance fig. 12, 117, and 254, the specimens are poorly pressed or distorted. The few pictures of outdoor groups almost all lack definition, fig. 183 being an exception; the plate in which it appears (pl. 52) is in fact about the only really satisfactorily reproduced one in the whole work, but one could wish that better fronds had been chosen for illustration. The most unique feature of the book is its photomicrographs of spores, which are given for nearly every species; in general they appear to be fairly well reproduced, their usual lack of distinctive features, at least to the non-practiced eye, being probably inherent.

The book contains much good material, but it needs reworking and better reproduction to fulfill its promise.—S. F. Blake, PLANT INDUSTRY STATION, BELTSVILLE, MD.

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PLATE 1201. The earliest illustration of *Polanisia dodecandra* (L.) DC. in J. P. Cornut's *Canadensium Plantarum Historia* (tab. 131). 1635.

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STUDIES IN THE CAPPARIDACEAE I.

Polanisia dodecandra (L.) DC., the Correct Name for Polanisia graveolens Rafinesque

Hugh H. Iltis

Among the large number of poorly known binomials that had to be considered in working out the synonymy of the New World species of *Cleome* (Iltis, 1952) was the Linnaean *Cleome dodecandra* described in the first edition of the *Species Plantarum* (1753). Trying to discover to what plant this binomial applied was both intriguing and difficult. Since modern nomenclature started with the *Species Plantarum* it appeared very likely that I was dealing with a valid name of some member of the *Cleomoideae.* On the other hand, perusal of various floras and reference works did not help much in this matter and only increased the difficulty, since the name had rarely appeared in the literature, and when used, it was applied to plants from as widely separated localities as Madagascar (Durand and Schinz, 1897), North America (often as *C. dodecandra* Michx. not L.), Jamaica, Ceylon, and India, the last three cited by Linnaeus in the original description. Such a distribution is of course open to suspicion. The name does not appear in any contemporary floristic work, such as Fernald's 8th edition of Gray's Manual (1950) or Gleason's New Illustrated Flora (1952).

What, then, is *Cleome dodecandra* L.?

The original description in the *Species Plantarum* of 1753 consists solely of three polynomials from earlier works and reads as follows (p. 672):

dodecandra. 5. CLEOME floribus dodecandris, foliis ternatis. *Fl. zeyl.* 242.*
Sinapistrum triphyllum pumilum glabrum, flosculo purpureo, siliqua membranacea. *Burm. zeyl.* 216. *t.* 100. *f.* I
Sinapistrum indicum triphyllum, flore carneo, non spinosum. *Sloan. jam.* 80. *hist.* I. *p.* 194. *t.* 124. *f.* I.
Habitat in Indiis. ⊙

The first of these polynomials refers to Linnaeus' *Flora Zeylanica* of 1747 and will be discussed presently. The second is difficult to identify with certainty, but Burman's description and illustration might well apply to a young *Cleome rutidosperma* DC. (*C. ciliata* Schum. & Thonn.) or to *C. Burmanii* W. & A., both species of the paleotropics. The last polynomial very clearly represents *Cleome serrata* Jacq., common in the neotropics. Both De Candolle (1824) and Eichler (1865) came to the same conclusion.

The citation in the *Flora Zeylanica* consists of two parts: 1.) two polynomials, one of Boerhave, which is unidentifiable, and that of Burman discussed above; 2.) a description, which is given here in full (p. 109):

Descr. Caulis *herbaceus, longitudine priorum.* Folia ternata, *foliolis lanceolato-ovatis. Florum* corolla *alba,* pistillum *rubrum;* petala *emarginata:* stamina *octo:* glandula *ad basin germinis a latere superiore.* Capsula *crassa, hispida.*

There can be no question that this brief though unmistakable analysis refers to a North American entity which, since the early part of the 19th century, has been commonly called *Polanisia graveolens* Raf., a member of a small genus restricted to the New World and closely related to the Old World species of *Cleome.* This assertion is based on the fact that 1.) emarginate petals occur within the whole of the *Cleomoideae only* in the species of *Polanisia sensu stricto;* 2.) a large, unilateral gland at the adaxial base of the ovary, pointing upward in the open flower, is characteristic of *Polanisia;* and 3.) the number of stamens (i.e. more than 6) is characteristic of relatively few species of *Cleome* but is the usual condition in *Polanisia.* All other characters, such as flower-color, leaflet-shape, etc. agree well with *Polanisia graveolens* Raf.

There is, fortunately, a specimen in the Linnaean Herbarium, 850.12 of Savage's (1945) Catalogue, which fits this analysis, as far as can be ascertained from a rather foggy photograph.[1]

[1] Loaned to me through the courtesy of the Arnold Arboretum.

There are two names connected with this sheet, both written by Linnaeus: one, attached to the stem of the plant and clearly the older of the two, reads "HU 12-andr" (*Horto Upsalensi dodecandra*), while the other, written at the bottom of the sheet, reads "viscosa 5" with a question mark added by J. E. Smith. We can safely assume that this specimen represents one of the plants grown at Upsala[2] by Linnaeus and used by him in his description, and must therefore be considered the type of *Cleome dodecandra* L. The legend at the bottom of this sheet also sheds some light on this matter. Linnaeus, apparently in a lapse of memory, wrote "viscosa" instead of "dodecandra," which is quite incorrect, but placed the right number after it, namely the number 5, which refers to the fifth species of *Cleome* in the *Species Plantarum*, ed. 1., which is *C. dodecandra*! This interpretation of "viscosa 5" differs from that of Savage (1945) who believes the 5 to refer to "Syst. 12 & Sp. 2" (*Systema vegetabilium* ed. 12 and *Species Plantarum* ed. 2 ??). To add to the confusion, Linnaeus labelled another sheet (850.14) "dodecandra" (with a ? added by J. E. Smith), even though it is clearly one of the four sheets of *Cleome viscosa* L. (though not the type) in the Linnaean Herbarium.

It is significant that all the old collections of this species in the Bernhardi Herbarium of the Missouri Botanical Garden, and the Vahl and Rottböll Herbaria of the Botanical Museum of Copenhagen are labelled "C. dodecandra." It is also of interest that this species occurs commonly in the Northeastern United States and adjoining Canada, a region which was fairly well-known botanically during Linnaeus' day, and from where he must have indirectly received the seeds, even though he thought the plant a native of "India"!

In tracing the fate of *Cleome dodecandra*, we find that the astute Michaux, in his *Flora Boreali-Americana* (1803), recognized its true identity and equated it with the plants he found growing in America. Many other authors (Pursh, Nuttall, Barton, Bigelow) followed Michaux's interpretation in the twenty years that followed.

[2] Svenson (1945) points out that the *Flora Zeylanica* was based on herbarium specimens. Here we have apparently one exception, for this plant was reputedly cultivated at Upsala, where Linnaeus must have seen it alive. It is certain that this specimen did not come from Asia, though Linnaeus did not state where the plants or seeds were obtained.

Not so Rafinesque! When this great, ingenious eccentric came to America and found this plant to be common "on the gravelly banks of rivers and lakes," he correctly recognized 1) that there were many major morphological differences between the North American plant and the genus *Cleome*, and 2) that Linnaeus' *C. dodecandra* of the *Species Plantarum* was a mixture of species. In 1819 he therefore established a new genus, *Polanisia*, for this plant, renaming the epithet *graveolens*. Rafinesque wrote (1819 p. 378–9):

> The type of the genus is the *Cleome dodecandra* of Linnaeus under which denomination many species were blended, which have no similitude with the real genus *Cleome*, differing in the calyx, corolla, nectarium, stamina, and fruit. I shall describe here that of North America, where 2 or 3 species exist, besides those of the West Indies, Africa, and Asia, which are totally different. . . . *Polanisia graveolens* . . . is the *Cleome dodecandra* of Michaux and Pursh.

It is curious that Rafinesque saw fit to use *C. dodecandra* as the basis for his new genus without retaining the Linnaean specific epithet. Apparently he was not sure of the identity of the taxa included by Linnaeus under that name, and it is doubtful whether he ever checked the reference in the *Flora Zeylanica*, which would have cleared up the confusion.

After 1819 *Cleome dodecandra* L. all but disappeared from the literature and Rafinesque's name was used commonly. In 1824, De Candolle enlarged *Polanisia* to nine species, including in it an unnatural assemblage of *Cleomoideae* with more than six stamens. In doing this he transferred *Cleome dodecandra* L. to *Polanisia*, at the same time recognizing *P. graveolens* as an equally valid species.

Polanisia dodecandra (L.) DC., like the Linnaean species on which it was based, has since that time been completely ignored in America and has been incorrectly applied only once or twice for some African taxa. Many authors, as for example Britton and Brown (1913), repeated Rafinesque's misconception by citing in synonymy under *Polanisia graveolens* Raf. "*Cleome dodecandra* Michx. 1803, not L. 1753.," not realizing that all three of these names referred to one and the same entity.

My studies indicate *Polanisia* to be a valid genus (Iltis 1950), though in a narrower sense than that of De Candolle.[3] It in-

[3] A thorough taxonomic and morphological discussion of *Polanisia* is in preparation, and will appear soon elsewhere.

cludes six North American taxa with emarginate to lobed petals, 8 to 20 stamens and unilateral disks with concave apices. Therefore *Cleome dodecandra* properly belongs in *Polanisia.*

Thus the synonymy of the species is as follows:

POLANISIA DODECANDRA (L.) DC. Prodr. **1:** 242. 1824.
Cleome dodecandra L. Sp. Pl. ed. 1.**2:** 672. 1753; Michx. Fl. Bor.-Am. 2:32. 1803.
Polanisia graveolens Raf. in Am. Journ. Sci. **1:** 379. 1819; Journ. Phys. Chim. Hist. Nat. 89: 98. 1819.
Cleome dodecandra L. var. *canadensis* L. ex DC. *loc. cit.* **1:** 242. 1824, *nom. nud. in synon.*
Cleome graveolens (Raf.) Schult. f. Syst. **7**[1]**:** 45. 1829.

A very complete enumeration of Rafinesque's own references to this species would be beyond the scope of this paper and would cover nearly a printed page (He must have been very proud of this genus and species !). A complete listing may be found in Merrill's *Index Rafinesquianus* (1949).

It may be of interest to note that there exists a very early, accurate illustration of this species in *tab. 131* of Cornut's *Canadensium Plantarum Historia* of (1635) reproduced as plate 1201. Though Linnaeus used this work in the preparation of the *Species Plantarum* (Svenson 1945), he must not have recognized the subject of this drawing. De Candolle (1824), however, did, and cited it under *Polanisia graveolens* Raf.—DEPARTMENT OF BOTANY AND BACTERIOLOGY, UNIVERSITY OF ARKANSAS, FAYETTEVILLE, ARKANSAS.

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NOTES ON SOME ROSES IN THE GRAY'S MANUAL RANGE

Julian A. Steyermark

In an attempt to arrive at a satisfactory evaluation and disposition of the various taxa of *Rosa* occurring in Missouri, it became obvious that in both the latest Gray's Manual and in Gleason's Flora several taxa were not treated. Fernald states (p. 868) that "Only the clearer-cut species and varieties are here included. Many scores of recently proposed 'species' are omitted until their relative stability is better demonstrated." The following names: *R. conjuncta* Rydb., *R. petiolata* Rydb., *R. Bushii* Rydb., *R. Aucuparia* Rydb., *R. subserrulata* Rydb., *R. rudiuscula* Greene, and *R. Palmeri* Rydb. were based originally upon Missouri specimens. Two others, *R. polyanthema* Lunell and *R. relicta* Erlanson, were either based in part on or have been identified with Missouri material, and their status is of present interest.

Of this assemblage Fernald recognized *R. conjuncta* as a valid taxon. He relegated *R. Bushii* to synonymy under *R. arkansana* var. *suffulta,* a course of procedure with which the present author is in full agreement. The other names, however, have not been taken up in either of the above manuals, and it becomes necessary to dispose of them in relation to existing taxa.

In an effort to untangle these poorly defined and not clearly cut taxa, the various Missouri species described by Rydberg were studied from material borrowed from the New York Botanical Garden. I am deeply grateful to Mr. Frank Mac Keever, Custodian of the Herbarium, and to Dr. David D. Keck, Head Curator, for their courtesy in making this material available for my study.

As a result of these studies, it appears that none of the taxa listed above can be maintained, and that Fernald's treatment in the New Manual is, for the most part (with the exception of *R. conjuncta*), wholly adequate for them, while Gleason's treatment is much more superficial and fails to account for a number of names entitled to recognition. In the following summary, my own opinions of the taxa are given.

Rosa Bushii Rydb., *R. conjuncta* Rydb., *R. polyanthema* Lunell. = R. ARKANSANA var. SUFFULTA (Greene) Cockerell.

Rosa Aucuparia Rydb., *R. petiolata* Rydb. = R. VIRGINIANA Mill.

Rosa relicta Erlanson = R. ARKANSANA, var. SUFFULTA (Greene) Cockerell.

Rosa palmeri Rydb. = R. CAROLINA var. VILLOSA (Best) Rehder.

Rosa subserrulata Rydb. = R. CAROLINA, f. GLANDULOSA (Crépin) Fern.

Rosa rudiuscula Green, in my opinion, may best be abandoned as a name of confusion.

ROSA AUCUPARIA Rydb.

The type of this species (*Bush 5866* from Dumas, Missouri), deposited in the herbarium of the New York Botanical Garden, has the stout, elongated, rather broad-based prickles characteristic of *R. virginiana.* With respect to the corymbose inflorescence, broad adnate portion of the upwardly dilated stipules, height of stems, number, shape, size, and glabrosity of leaflets, the type specimen can be matched by numerous collections of *R. virginiana*, with which it may be judged as conspecific. Besides this collection, Bush made others from Clark County, Missouri (no. *9145a* from Medill) which can also be assigned to *R. virginiana.*

ROSA BUSHII Rydb.

I am in agreement with Fernald in reducing this name to synonymy under *R. arkansana* var. *suffulta* (Greene) Cockerell. In the original description, it was characterized by Rydberg (N. Am. Fl. **22,** pt. 6: 485. 1918) as having a "decidedly pear-shaped hypanthium" as contrasted with a "globose or slightly pear-shaped" hypanthium. This character, however, cannot differentiate it from various specimens annotated as *R. suffulta* [*R. arkansana* var. *suffulta*] by Mrs. Erlanson. One specimen, *Bush 3970a*, collected in flower from Courtney, Missouri, labeled by Rydberg as *R. Bushii*, shows an hypanthium which can be matched by various specimens annotated as *R. suffulta* by Mrs. Erlanson (i.e. *Gates 3070* from 3 km. north of Janesville, Wisconsin), and by a fragment of the type specimen of *R. suffulta* (*Vasey* from Las Vegas, New Mexico) in the herbarium of the New York Botanical Garden. The pear-shaped hypanthium acute at base in fruit can be matched by such fruiting specimens of *R. arkansana* var. *suffulta* as *Moodie 998* from the Vicinity of Rosedale, Alberta, and *Arsène 17732* from the vicinity of Las Vegas, New Mexico. In the specimens annotated *R. Bushii* by Rydberg there is variation in size of leaflets from a small size (in the type specimen) to a larger size (in various flowering specimens).

Rosa conjuncta Rydb.

The type specimen (*Bush 101* from Atchison Co., Missouri) was collected in an area where subsequent and additional material, labeled *R. suffulta*, has been taken. In his original description of *R. conjuncta* Rydberg states (N. Am. Fl. **22,** pt. 6: 505. 1918) that the sepals in fruit are "persistent but reflexed," using this character, together with the glaucous nature of the plant, to separate *R. conjuncta* from *R. suffulta*, in which the sepals are stated (ibid.) to be "erect in fruit" and "plant not glaucous." Under *R. suffulta* Rydberg makes the statement (loc. cit. p. 505) that the sepals are "after anthesis ascending and *usually* persistent or *tardily deciduous*" (italics are those of the present author), a statement not conforming to his "sepals after flowering erect, connivent, long persistent on the fruit", used as key characters on p. 483 for separating the section Cinnamomeae, in which he places *R. suffulta*. Fernald in the new Gray's Manual keys out *R. conjuncta* (p. 870) under "sepals widely divergent or reflexed in maturity", whereas *R. arkansana* [var. *suffulta*] is keyed under "sepals porrect in fruit, forming a loose beak at summit of the receptacle", but both are placed under a larger heading (p. 809) of "sepals erect to divergent after flowering, persistent in fruit"!

After a study of a large series of specimens of *R. arkansana* var. *suffulta* and *R. conjuncta* in the herbaria of the New York Botanical Garden, Missouri Botanical Garden, and Chicago Natural History Museum, I have reached the inescapable conclusion that these two taxa must be treated conspecifically, and placed with *R. arkansana* as *R. arkansana* var. *suffulta*. Examination of this material, as well as studies made in the field, leads me to conclude that it is impossible to employ the character of the sepals after anthesis, or any other character, moreover, as criteria for distinguishing *R. conjuncta* from *R. arkansana* var. *suffulta*. In this connection herbarium material is misleading, as pressure on the fruiting hypanthium may distort the original position of the sepals so that it is not possible to ascertain whether they were actually spreading, reflexed, ascending, or erect. The attempt to separate *R. conjuncta* from *R. arkansana* var. *suffulta* on the basis of the position of the sepal in fruit has led to considerable confusion.

Rydberg described *R. conjuncta* on the basis of a fruiting specimen in which the sepals are shown (*in the pressed state*) as mostly reflexed. But in various specimens of *R. arkansana* var. *suffulta* annotated by Rydberg and Erlanson as *R. suffulta*, the sepals are erect, ascending, spreading, and, under certain conditions of pressing, even reflexed. In a collection of *R. suffulta* by Mackenzie from Little Blue Tank, Jackson Co., Missouri on July 29, 1900, the sepals on some of the fruits are spreading to ascending, but on other fruits they are deciduous. In *Moyer 570* from Big Stone, South Dakota, identified by Erlanson as *R. suffulta*, an even later fruiting stage is shown in which most of the sepals have fallen, while the other remaining sepals are reflexed, spreading, or ascending, and in the case of those sepals remaining attached by their lower portion to the hypanthium, it is impossible to decide whether the sepal is erect or spreading. In another specimen, *Bush 12353* from Mound City, Missouri, identified as *R. conjuncta*, the very mature fruit has completely lost its sepals. It would be difficult, indeed, to reconcile this type of specimen with Rydberg's description of the sepals in *R. conjuncta* as "persistent" or with the new Gray's Manual "sepals erect to divergent after flowering, persistent in fruit."

In this connection, it should be pointed out that the key character "sepals widely spreading or reflexed in maturity" on p. 870 to include *R. conjuncta* is indented under the heading on p. 869 "sepals erect to divergent after flowering." In several specimens, such as *Bush 9371* from Courtney, Missouri, identified by Rydberg as *R. suffulta*, and *Mackenzie 5* from Waldo Park, Missouri, identified by Mackenzie as *R. suffulta*, the sepals are *not erect* after anthesis, but, if one judges by the pressed specimen, are definitely *reflexed.*

Since sepal position after anthesis is influenced in an herbarium specimen by the pressure applied from a given direction, often unequally exerted on one side, and, as the sepals become more and more deciduous with age, it seems surprising that such importance to the position of the sepals on the fruit should have been held by both Rydberg and Fernald to be reliable criteria as applied to *R. conjuncta* versus *R. arkansana* var. *suffulta.* Furthermore, the character of the glaucous upper surface of the leaflets in *R. conjuncta* breaks down, as the foliage of *R. arkansana* var. *suffulta* also exhibits this, although not invariably.

In short, *R. conjuncta* Rydb. can in no way be separated from *R. arkansana* var. *suffulta.*

Rosa Palmeri Rydb.

In his key Rydberg (loc. cit. p. 485) characterizes this putative taxon as having "leaflets firm, dark-green above, paler and pubescent beneath, at least on the veins; leaf-rachis glandular-hispid." However, neither these characters nor the number of leaflets "leaflets on the young shoots mostly 9 and the floral branches mostly 5" [p. 502] serve to distinguish *R. Palmeri* from *R. carolina* and var. *villosa.* The type of *R. Palmeri* (*E. J. Palmer 3428* from Carthage, Jasper Co., Missouri), deposited in the Gray Herbarium, and other material segregated by Rydberg as *R. Palmeri* in the herbarium of the New York Botanical Garden, possess leaflets that are pale and more or less pubescent beneath as in *R. carolina* var. *villosa*, but *Palmer 18322* from Webb City, Jasper Co., Missouri, has the lower surface of the leaflets only sparsely pilose and tends towards *R. carolina* f. *glandulosa* (Crépin) Fern.

Rosa petiolata Rydb.

As he erred in believing that a "decidedly pear-shaped hypanthium" set *R. Bushii* apart from species having a "globose or slightly pear-shaped" hypanthium (loc. cit. p. 485), Rydberg was misled trying to distinguish *R. petiolata*, based entirely on a fruiting specimen, with "hypanthium decidedly pyriform, or ellipsoid, long tapering at the base" (loc. cit. p. 485) from species having the hypanthium "globose or short-ellipsoid, rounded or barely acute at the base" (loc. cit. p. 484).

An attempt to analyze this species and to resolve its taxonomic status leads me, after careful comparison of the type specimen (*Bush*, Aug. 27, 1892, from Clark Co., Missouri in the herbarium of the Missouri Botanical Garden) with the herbarium material of the Chicago Natural History Museum, New York Botanical Garden, and Missouri Botanical Garden, to conclude that it is conspecific with *R. virginiana.* The height of 1–2 meters given by Rydberg for *R. petiolata* (loc. cit. p. 501), as well as the character of "small straight prickles," can be duplicated in *R. virginiana.* Ordinarily, the prickles in *R. virginiana* are conspicuous, but the species is variable with respect to the degree of prickliness, specimens occasionally occurring that are quite prickleless or with few reduced prickles.

So far as the pyriform or ellipsoid hypanthium is concerned, this appears to be the result either of varying degrees of maturity of the fruiting receptacle or of the manner of pressure exerted within the press, rather than to be indicative of any natural condition. For example, in a collection by *John K. Small* (3 mi. north of Harrisburg, Pennsylvania, July 30, 1888), deposited in the herbarium of the Chicago Natural History Museum and identified by Dr. Erlanson as *R. carolina,* two of the fruiting receptacles are pressed in such a way as to appear acutish and subturbinate, while others have a characteristic depressed-globose shape. A collection by *Bush* (no. 10122) from Dumas, Clark Co., Missouri, which may be referred to *R. virginiana,* and in a somewhat earlier stage of fructification than the type specimen of *R. petiolata,* has fruiting receptacles varying from subglobose and rounded at the base to subpyriform and narrowed at the base. I have also referred to *R. virginiana* the specimen of *Steyermark 26417* from Chariton Co., Missouri, which has pyriform fruits narrowed at the base.

However, the subpyriform-shaped receptacles appear to owe their form to the pressure on that particular part of the press. It is probable that the type of *R. petiolata* from Clark Co. originated from Dumas, as that locality was the principal one visited by Bush in Clark Co. in the early days of his collecting. It is significant that other collections made by Bush from Dumas have proven to belong to *R. virginiana,* such as his *5866* (type of *R. Aucuparia*) and *10117*, *10122*, and *10173* (all of which he himself identified as *R. virginiana*). Rydberg identified a *Deam* collection (no. 39512) from Porter Co., Indiana, as *R. petiolata* because of the pyriform fruit, whereas Deam identified this collection as *R. carolina*. Although Rydberg describes the hypanthium of *R. conjuncta* (loc. cit. p. 505) as "subglobose, acute at the base," the type specimen (*Bush* 101 in the herbarium of the New York Botanical Garden) shows most of the hypanthia as subpyriform! As any rose-gardener or student of roses knows, a number of species possess pyriform and elongated fruiting receptacles, but in the case of the species under discussion, i. e. *R. petiolata* and other species segregated by Rydberg on the basis of pyriform fruits (*R. Bushii*), the pyriform shape appears to be due to either degrees of maturity of the receptacle or pressure exerted on the specimen in press.

Rosa polyanthema Lunell.

Lunell (Am. Midl. Nat. **3:** 138. 1913) describes the leaflets of the type specimen (collected on the banks of the Missouri, not far from Bismarck, Burleigh County, South Dakota) as "glaucous and more or less tomentulose and even glandular beneath, especially on the main nerve." Rydberg, however, in his specific description (loc. cit. p. 505) states the leaflets to be "short-pubescent beneath", but in his key (loc. cit. p. 485) modifies the statement, placing *R. polyanthema* under the part of the key with "leaves densely pubescent, especially beneath."

An examination of isotype material of *R. polyanthema* in the herbaria of the New York Botanical Garden and Chicago Natural History Museum reveals that the leaflets are mainly pubescent on the midrib beneath and glabrate to very sparsely pubescent on the main surface, and can not be considered as "densely pubescent beneath." This type of pubescence can be matched in other material from Missouri, Kansas, and South Dakota referred to *R. polyanthema*, as well as *R. arkansana* var. *suffulta* specimens showing variation in pubescence on the lower leaf surface from a more or less moderately pubescent surface to one only sparsely pubescent. Dr. Erlanson identified the specimens of *Milligan* from Lancaster Co., Nebraska, *Aiton* from near Minneapolis, Minnesota, and *Sandberg*, Hennepin Co., Minnesota, as *R. suffulta* [= *R. arkansana* var. *suffulta*], but each of them matches well the isotype material of *R. polyanthema*. In both these taxa the leaflets vary from 9–11, and are glaucous beneath. In my opinion *R. polyanthema* can be considered a vigorous type of *R. arkansana* var. *suffulta* with large, broad leaflets.

Rosa relicta Erlanson.

Deam treats this taxon (Fl. Indiana, p. 577) as a variety of *R. suffulta*, while Jones (Fl. Illinois, 2nd ed., p. 164) makes it a synonym of *R. suffulta*. In her original description (Rhodora **30:** 116–117. 1928) Erlanson states that "*Rosa relicta* begins to flower earlier than *R. suffulta*," but several specimens from Missouri which I would identify as *R. arkansana* var. *suffulta* (*Steyermark 5708*, *5711*) were collected in flower on June 2, and had already been in anthesis for several days previously. This is as early, then, as the May 29th date of *Bush 11336* and *11337*, the Wellington, Missouri collections cited as *R. relicta* by Erlanson in her original description.

Other collections from Wellington by Bush (*11327* and *11334*) made on the same day (May 29) and probably from the same locality ("dry banks, Wellington") as the specimens cited by Erlanson, match material of *R. arkansana* var. *suffulta*, as do additional collections Bush made at Wellington (his numbers *11754*, *11771*, and *11768*). In both taxa the infrastipular prickles are not differentiated from prickles of the internodes, the leaflets are more or less appressed-pubescent beneath with varying degrees of pubescence, and the hypanthia are glabrous. The aerial branches of the stems of *R. relicta* are described by Erlanson as being "5–30 cm. high," but Bush's Wellington specimens, which I would refer to *R. arkansana* var. *suffulta*, collected on May 29 (number *11327* and *11334*) on the same day as his other Wellington collections (numbers *11336* and *11337*), cited by Erlanson under *R. relicta*, have stems which are 50 cm. or more high and are certainly not "weak" or "semi-herbaceous" as stated (loc. cit. p. 117) by Erlanson.

So far as the stipules in *R. relicta* being narrower than those of *R. suffulta*, there is no justification for stating that such a difference exists. So far as *R. relicta* having a "small fruit with reflexed and semi-deciduous sepals" is concerned, it would not seem possible, after studying material examined by Erlanson, to judge the validity of this character from herbarium material. Indeed, in anthesis, it is impossible to state whether the sepals are erect and persistent or reflexed and semi-deciduous.

In short, the characters by which Erlanson distinguishes *R. relicta* cannot be used reliably to separate this putative taxon from *R. arkansana* var. *suffulta*, and the study of available herbarium material points to the two being conspecific.

Rosa subserrulata Rydb. I have examined the type (*Bush 42*, from Swan, Missouri) deposited in the herbarium of the New York Botanical Garden. The stipitate-glandular rachis of the leaf and more or less glandular-toothed leaflets, which are mostly glabrous beneath, differ in no fundamental respects from other collections satisfactorily identified and placed with *R. carolina* f. *glandulosa* (Crépin) Fern.

Rosa rudiuscula Greene. This species was based upon a Bush collection (no. *208*) from Little Blue, Jackson Co., Missouri. As Deam states in his Flora of Indiana (p. 578), "This rose is intermediate between *R. carolina* and *R. suffulta*, and has been produced experimentally by Dr. Erlanson by crossing these species. Because of its hybrid nature it is difficult to identify unless one is familiar with our wild roses. In former accounts of the genus the tendency of *Rosa rudiuscula* to have thick, leathery leaves has been stressed. This character is also found in *Rosa carolina* and is not invariably present in the hybrid."

I am in agreement with Deam's remarks that the character of thick, leathery leaves is not invariably present in *R. rudiuscula*. In fact, there are many transitions from a submembranaceous to subcoriaceous texture in both *R. carolina* and *R. suffulta* [= *R. arkansana* var. *suffulta*] as well as in what is passing as *R. rudiuscula*. Since some of the specimens identified as *R. rudiuscula* show both glabrous as well as bristly receptacles, it is possible to place them either with *R. carolina* and var. *villosa* or with *R. arkansana* var. *suffulta*. Greene describes the calyx (Leaflets **2:** 134. 1911) as "more or less obviously beset with short stout strongly gland-tipped bristles, but otherwise glabrous." The fruit is described as "depressed-globose, the sepals persistent and closely reflexed over it." The persistent character is that of *R. suffulta* [= *R. arkansana* var. *suffulta*], while the reflexed nature of the sepals is more characteristic of *R. carolina*. However, many fruiting specimens of *R. carolina* exhibit various stages of sepal persistence, and a tardily deciduous sepal is difficult to distinguish from a persistent one.

Even granting that *R. rudiuscula* is intermediate between *R. carolina* and *R. arkansana* var. *suffulta* and has been produced experimentally to indicate its hybrid origin, the fact that plants identified as *R. rudiuscula* run the gamut of variation from submembranaceous to firmly subcoriaceous leaflets and from a glandular-hispid to glabrous receptacle leads me to conclude that such a taxon cannot be recognized as a clear-cut one, and, therefore, becomes a permanent source of confusion. According to Art. 75 of the latest edition (1952) of the International Code of Botanical Nomenclature, "A name of a taxon must be rejected if it is used with different meanings, and so becomes a long-persistent source of error." Even by creating a new nomenclatorial status for it in the category of a hybrid indicated by a × would not clarify the confusion. I believe taxonomy is best served if when specimens are recognized as intermediate between *R. carolina* and *R. arkansana* var. *suffulta* it is so stated or indicated on an herbarium label. Such statements as "tending towards *R. carolina*" or "tending towards *R. arkansana* var. *suffulta*" are appropriate. In this manner, it can be recorded that there are various intermediate stages exhibited by a number of specimens, ranging from firmly coriaceous to membranaceous leaflets and from hispid-glandular to glabrous receptacles, without committing oneself to a given name, especially when that name cannot be applied to any one of the intermediates.

In various recognizable oak hybrids and in various named hybrids belonging to other genera, the differences between the hybrid and its parent species are sufficiently marked and perceptible to be distinguished in field and herbarium. In the case of *R. rudiuscula*, however, there are no definite characters which hold true to distinguish specimens as either *R. carolina* on the one side or *R. arkansana* var. *suffulta* on the other or definitely as a hybrid between them. I, therefore, propose that in the interests of clear taxonomy the name *R. rudiuscula* be abandoned and rejected as one leading to confusion and error.—CHICAGO NATURAL HISTORY MUSEUM.

Iris brevicaulis in Canada.—The discovery of a large colony of *Iris brevicaulis* Raf. near Point Pelee on the north shore of Lake Erie in June, 1953, has extended the known range of this species to Ontario and appears to furnish a new record for the Canadian flora.

This Iris was found growing near the marshy edge of Sturgeon Creek, which empties into Lake Erie about three miles southeast of Leamington at the base of Point Pelee. Along the same stream, growing with *Typha angustifolia* L. at its mucky margin, were seen numerous scattered individuals of *Iris virginica* L. var. *Shrevei* Anderson. The colony of *I. brevicaulis* was at some distance back from the margin of the creek near a woods, growing in a low marshy area which appeared to be periodically flooded. The shorter flexuous stems of *I. brevicaulis* contrasted sharply with the longer and straight-stemmed plants of *I. virginica* var. *Shervei.*

Specimens from the following collection of *Iris brevicaulis* Raf. have been placed in the Herbarium of the Department of Botany at the University of Toronto and of the Missouri Botanical Garden:—near the marshy edge of Sturgeon Creek, three miles southeast of Leamington, Ontario, June 20, 1953, *J. K. & M. E. Shields 1348.*

Field work in Essex County was carried out under the direction of Dr. J. H. Soper of the University of Toronto and was supported by the Research Council of Ontario. Dr. Edgar Anderson has kindly verified the identification of *Iris brevicaulis.*

J. K. Shields, department of botany, university of toronto.

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SOME FLORISTIC RELATIONSHIPS BETWEEN MEXICO AND THE UNITED STATES

Robert L. Dressler

Mexico has long been recognized as a biological cross-roads between the Americas and as a biotic peninsula in relation to the rest of the continent. It is becoming apparent that the biogeography of North America cannot be properly studied without giving a great deal of attention to its southern extensions and relationships. The floristic similarities between Mexico and the United States, particularly in their eastern regions, were noted by Watson (1891), and this relationship has, in recent years, received notice somewhat proportionate to its biogeographic interest, particularly through Sharp and his collaborators.

Various and somewhat conflicting interpretations have been offered for these floristic relationships. The present, imperfect state of knowledge concerning the eastern Mexican-eastern United States pattern of distribution has been adequately dealt with by Sharp and others (Miranda and Sharp, 1950, Sharp, 1946, 1951). In the present paper, an attempt will be made to review the floristic evidence and to consider in some detail its possible interpretations.

Floristic Relationships

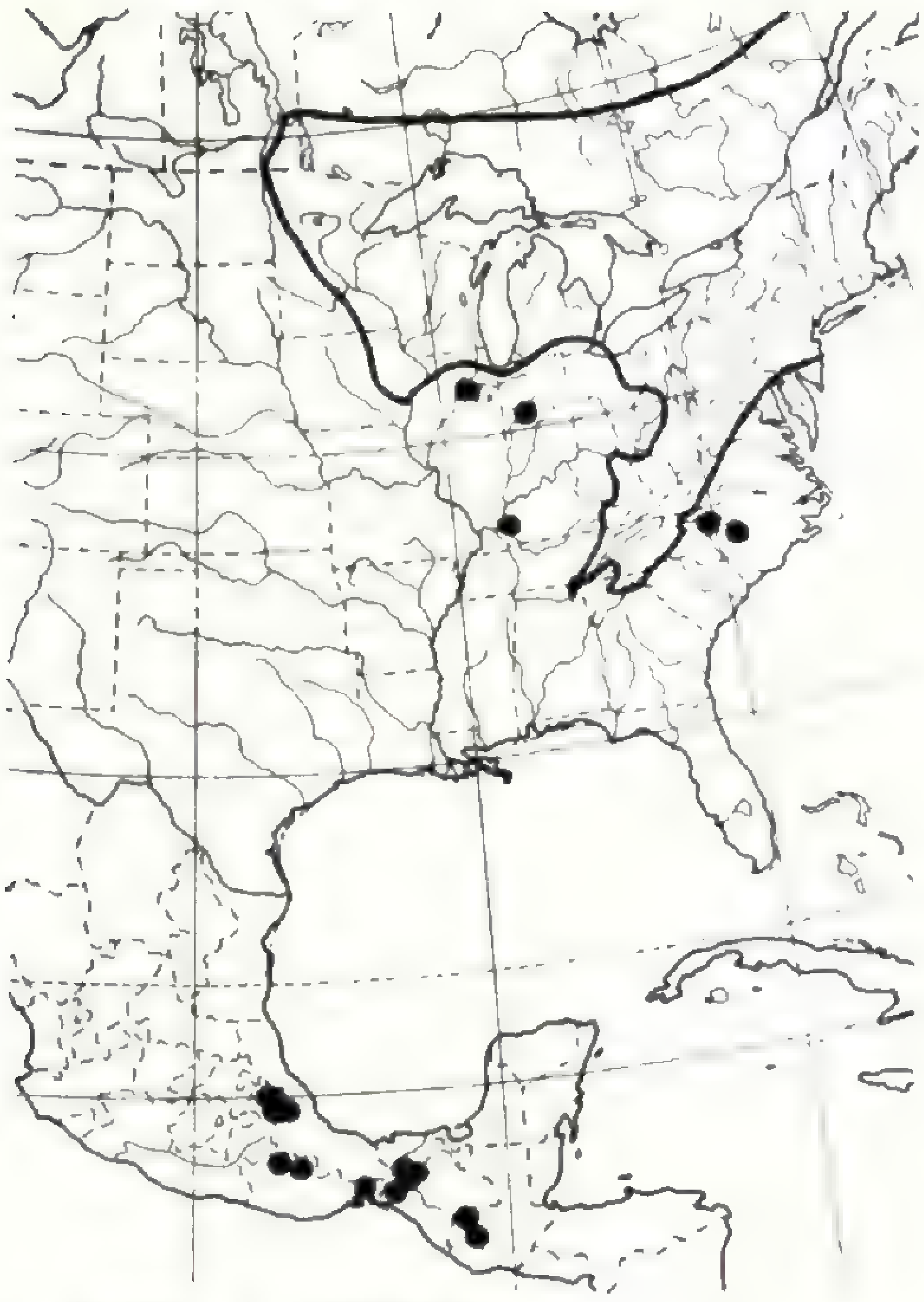
This discussion will largely be limited to the spermatophytes, as these are best known geographically and paleobotanically. Miranda and Sharp (1950) list a number of ferns which occur in eastern Mexico and the eastern United States, as well as some mosses and fungi (see also Sharp, 1948) which show a similar pattern. The characteristic distribution pattern with which this paper is especially concerned is that shown in maps 1 to 6. A number of species that are relatively widespread in the eastern United States occur also on the escarpments of the mountains of eastern and southern Mexico and of Guatemala. Many, if not most, of these plants have disjunct ranges, being absent from southern Texas and northern Mexico and frequently discontinuous in Mexico. Since lists of the species with ranges of this type have been published elsewhere, the present discussion will be limited to species of special interest and a few which have not been listed in the papers cited (Hernández, et al. 1951; Miranda, 1945; Miranda & Sharp, 1950; Sharp, 1946–1952; Steyermark, 1950).

Taxus globosa Schlecht.: This species is known from the Mexican states of Veracruz, Hidalgo, Mexico and Oaxaca. Its relationships among the more northern species are uncertain, but it seems to resemble most closely *T. floridana* Nutt., of west Florida.

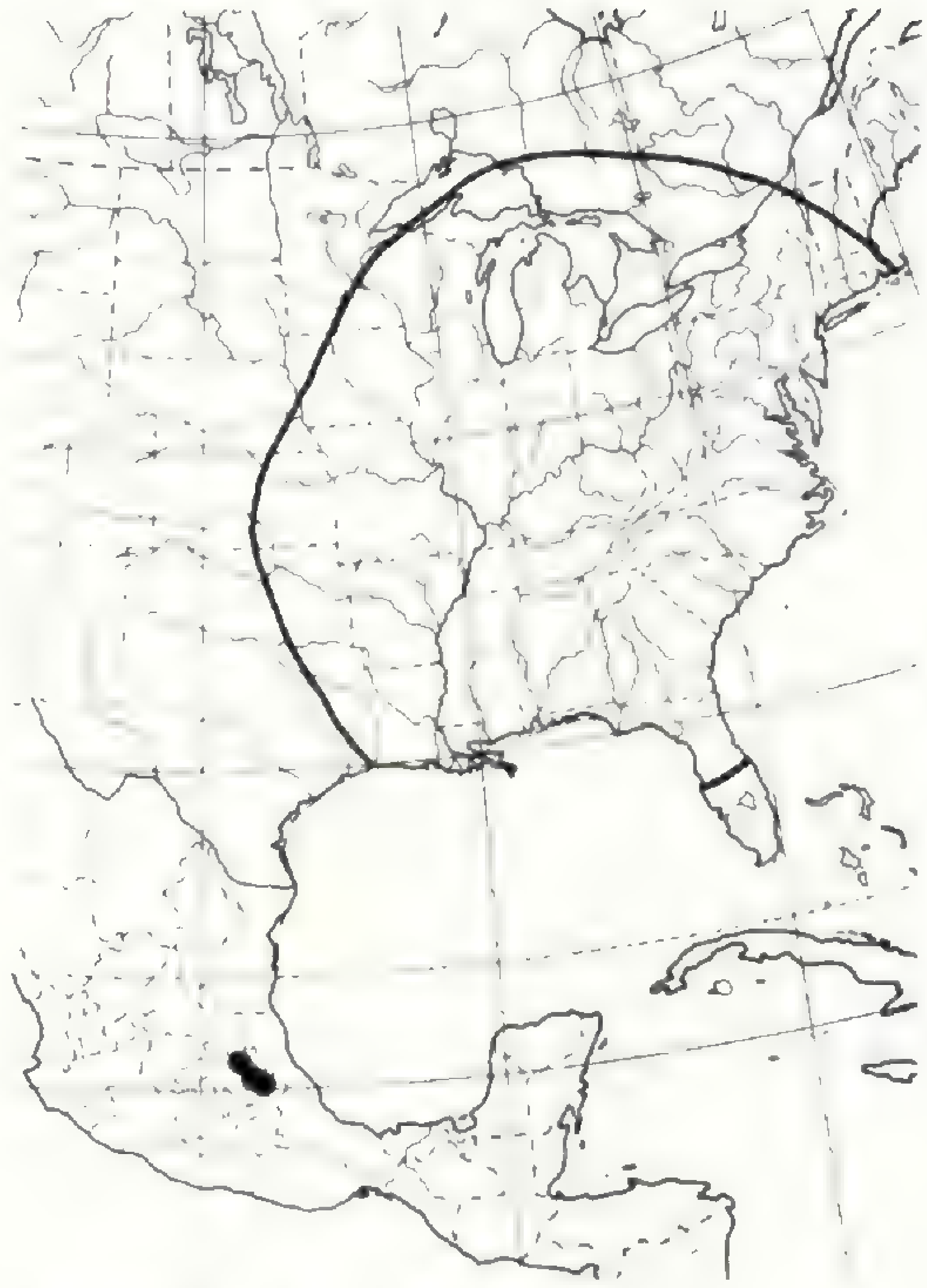
Pinus Strobus L. & var. chiapensis Martínez: (Map 1). This species provides one of the most striking distributions of this type. *Pinus Strobus*, which is so generally considered a northern type, has, in recent years, been found to be fairly abundant in the Mexican states of Chiapas, Oaxaca and Puebla and in Guatemala (Martínez, 1945; Sharp, 1946).

Panicum villosissimum Nash: This grass is widespread in the eastern United States and occurs in Nuevo León, Mexico, but is apparently absent between that station and Guatemala, where other collections of this species have been made (Steyermark, 1950).

Epidendrum conopseum R. Br. & var. mexicanum L. O. Wms.: The orchids, with their tiny, wind-blown seeds, are perhaps poor material for phytogeographic study; this species, however, is exceptional among the epiphytic species in its distribution. Other epiphytes of the United States are limited to Florida and are either West Indian or very widespread species. *E. conopseum* is absent from southern Florida and occurs in Alabama and Louisiana and north to southern North Carolina. Its Mexican occurrence, in Morelos, is somewhat west of the usual area for such disjunctions, but the pattern is otherwise

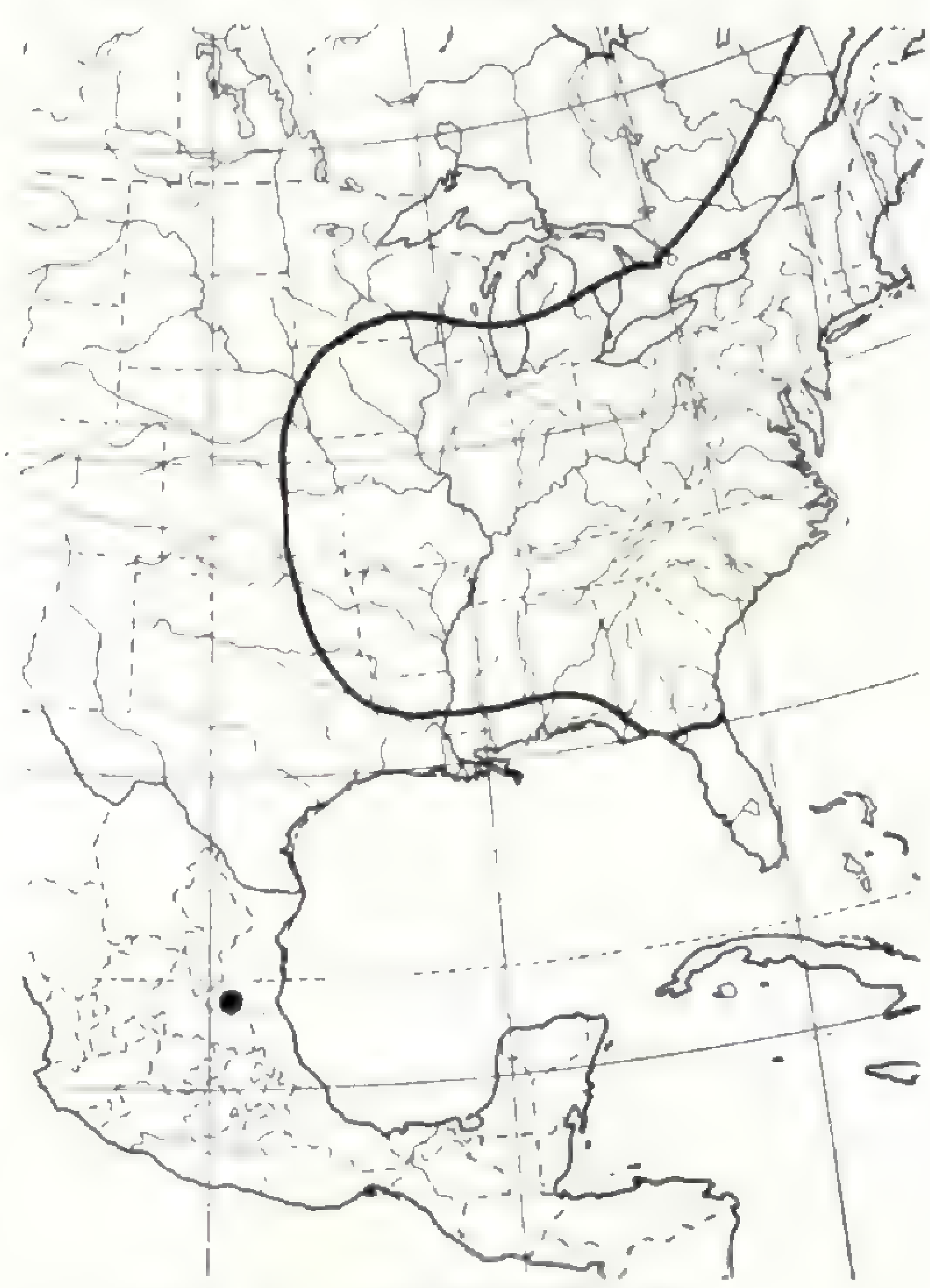


MAP I. PINUS



MAP 2. TOVARA

MAP 3. ILLICIUM



MAP 4. HAMAMELIS

Map 1. *Pinus Strobus.* Data from Martínez (1945), Munns (1938) and Sharp (1946). Map 2. *Tovara virginiana.* Data from Li (1952) and Sharp (1952). Map 3. *Illicium floridanum* (including *I. mexicanum*). Data from Hernández, et al (1951) and Smith (1947). Map 4. *Hamamelis virginiana.* Data from Hernández, et al (1951) and Munns (1938).

typical. Its associates in the United States, *Magnolia, Liquidambar, Fagus, Carpinus, Acer, Taxodium* and *Nyssa* (Correll, 1950), are all trees of typical Mexico-United States disjunct pattern.

Tovara virginiana (L.) Raf. (Map 2).

Illicium floridanum Ellis: (Map 3) The southernmost Mexican collection, from Veracruz, was named *I. mexicanum* by Smith (1947).

Liquidambar styraciflua L.: This tree is abundant in parts of Mexico and occurs as far south as Nicaragua. Miranda and Sharp (1950) consider its distribution to represent that of the vegetation types in which most of these disjuncts occur.

Hamamelis virginiana L. (Map 4).

Prunus serotina Ehrh.: This species has recently been studied and mapped by McVaugh (1951, 1952). Three taxa, subspecies *serotina, hirsuta* and *eximia,* are of special interest to the present paper. The subspecies *hirsuta* (Ell.) McVaugh is a primitive, conservative population of the southeastern United States, which is now hybridizing with the subspecies *serotina.* Though McVaugh thinks that the original isolation of subsp. *hirsuta* probably dates back to the Cretaceous, it is possible that it dates only to the early Pleistocene. The subsp. *serotina* is a wide-ranging and more aggressive type occurring in much of the eastern United States, Mexico and Guatemala. McVaugh feels that it may have spread northward into the United States in the Pleistocene. It shows evidences of introgression from subsp. *hirsuta* in much of its range. Subsp. *eximia,* of central Texas, appears to be a recent offshoot of subsp. *serotina* which was separated from that population without being affected by introgression from subsp. *hirsuta.* It may be that the migrations of the Pleistocene brought about hybridization which was important in the formation of the modern subspecies *serotina.*

Nyssa sylvatica Marsh (Map 5).

Cornus florida L. & var. Urbiniana (Rose) Wang (Map 6).

Similar Faunistic Relationships

It might be expected that some animal species or genera would show similar patterns, but relatively few examples are available. Epling (Dobzhansky & Epling, 1944) has attempted to correlate the occurrence of a chromosome inversion phylad of *Drosophila pseudoobscura* in Mexico and Guatemala with the distribution of the Arcto-Tertiary forest species which occur in this region. However, this species of *Drosophila* is not present in the eastern United States, and its range in the western United States is scarcely to be correlated with the Arcto-Tertiary forest type.

Schmidt (1946) has noted the relationships between Central America and eastern North America in their herpetological faunas. In a general way this relationship parallels the floristic pattern, but it is largely on the generic rather than the species level, and it may well be an older pattern.

The Pattern of Distribution

Our knowledge of the east Mexican flora seems too inadequate to warrant an attempt at mathematical treatment of the types of distribution and plants involved. It is clear, however, that many plants are distributed in the way indicated and that many of the ranges are disjunct. It is interesting to compare these disjunctions with those involving southeastern United States and eastern Asia, since a number of the same genera are involved in both relationships (Gray, 1859; Li, 1952). The most striking difference is that the Mexican plants, unlike the Asiatic ones, are frequently the same species as those in the United States. In some cases varieties have been recognized and sometimes questionable species, but many are clearly the same species in both areas. While many of the Mexican disjuncts are trees, a number are herbaceous plants, including at least one grass. The herbaceous flora is probably less strictly bound by vegetational limits and therefore less likely to be disjunct. In addition, the herbs are less well known, because nothing comparable to Standley's *Trees and Shrubs of Mexico* is available to aid in their study. It appears, however, that the peculiar herbaceous endemics of the southeastern United States and of that area and Asia (such as the several Berberidaceous herbs listed by Li, 1952) are absent from Mexico. This may be due to the generally tropical nature of the undergrowth, even where the dominants are temperate species (Miranda & Sharp, 1950; Leopold, 1950). This feature would also reduce the probability of faunistic parallels.

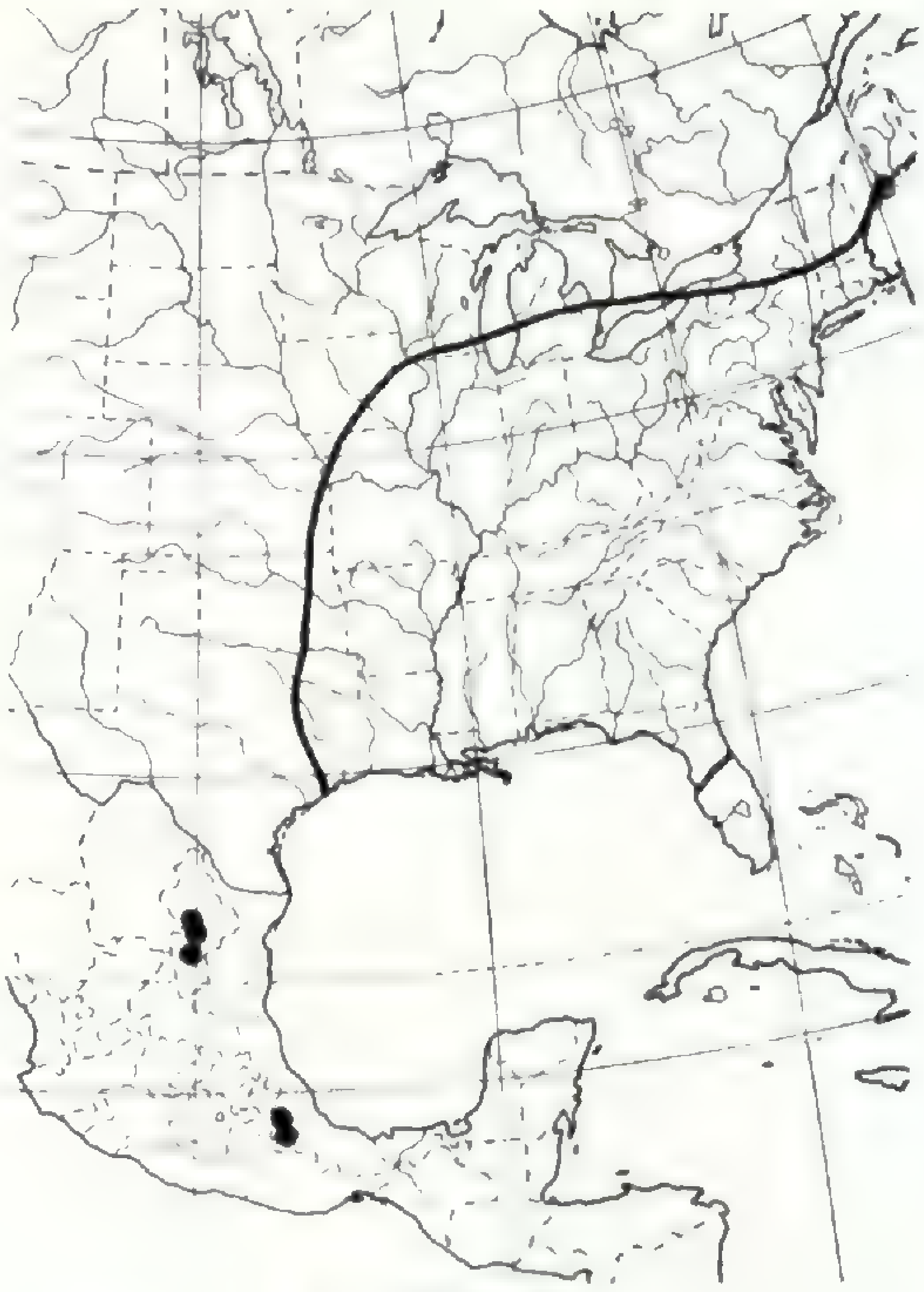
The areas south of the United States where the greatest number of these plants occur are between Zacualtipán, Hidalgo and Jalapa, Veracruz, about the Mesa de San Cristóbal, Chiapas and in the mountains of Guatemala. In all these areas the plants occur most frequently on mountain escarpments, where locally temperate climate with adequate rainfall may be found. That rainfall is probably the most critical factor in accounting for the present disjunction of these species is seen by referring to the vegetation and rainfall maps for this area (Maps 7 & 8). These plants are largely coincident with the more mesic forest types. These forests, in the region of discontinuity, correspond roughly with the areas receiving over forty inches of rainfall annually. Farther south a higher rainfall figure, 50 or 60 inches, corresponds more closely to the vegetational pattern.

An interesting parallel to this distribution pattern is to be found in southeastern Asia, where Li (1952, p. 402) notes of these temperate genera: "Some genera also extend into the tropical regions of Asia, to Malaysia, . . . But in these warmer regions they represent only rare relic elements, inhabiting mostly the mountain regions." The faunistic relationships are also generally parallel in the two areas (Schmidt, 1946).

Other Extra-tropical Relationships of the Mexican Flora

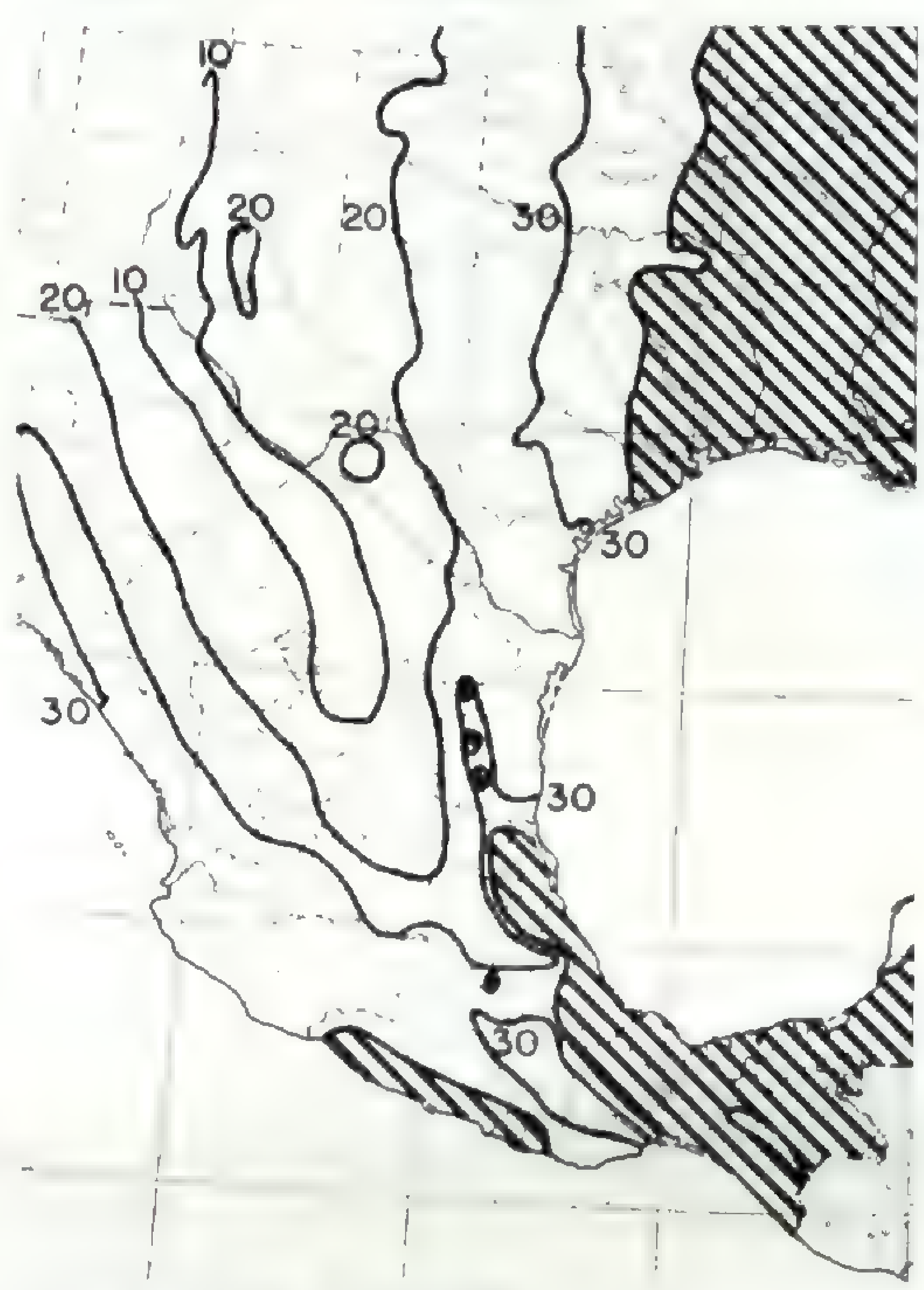
Miranda and Sharp (1950) point out several plants of the eastern escarpment which seem to be conspecific with, or closely related to, West Indian species; these may represent a dissected circum-Caribbean pattern of distribution. The other floristic element of the east Mexican flora which must be considered here is that which it shares with the western United States and northwestern Mexico. Miranda and Sharp (1950) observe that the floristic dissimilarity between eastern and western United States seems to extend into Mexico but with diminished intensity. However, as they note, a west-American element is conspicuous in eastern Mexico. Muller (1947) draws attention to the close relationships between the chaparral vegetation of northeastern Mexico and that of California. The two-fold relationship between the Mexican and the United States floras extends south into Guatemala, where Steyermark (1950) notes,

MAP 5. NYSSA



MAP 6. CORNUS

MAP 7. FORESTS



MAP 8. RAINFALL

Map 5. *Nyssa sylvatica.* Data from Miranda (1945) and Munns (1938). Map 6. *Cornus florida.* Data from Munns (1938) and Rickett (1950). Map 7. Forest distribution in Texas and eastern Mexico. Diagonal lines represent mesophytic forest types, while the stippled area represents xerophytic forest types. Adapted from Braun (1950), Leopold (1950) and Tharp (1939). Map 8. Annual rainfall distribution in Texas and eastern Mexico. Diagonal lines represent areas receiving 40 inches or more of rainfall annually. Adapted from Brooks, et al (1936), Shreve (1944) and U.S.D.A. Yearbook, 1941.

in addition to the eastern types, a strong element with its affinities in the Rocky Mountain area, including such genera as *Calochortus*, *Zygadenus*, *Montia*, *Gaura* and *Penstemon*. The elements involved in this relationship are Madro-Tertiary or Cordilleran (Axelrod, 1939) rather than Arcto-Tertiary as are the eastern disjuncts. The noteworthy feature of the western relationships is that the Mexican and Guatemalan plants are rather consistently different species than those of the western United States, a fact which may be of some value in interpreting these relationships.

Historical Interpretation

Before attempting to present a coherent explanation of these relationships, it seems most convenient to review and discuss briefly the various explanations which have been offered.

Epling (Dobzhansky & Epling, 1944), in his discussion of *Drosophila*, attempts to correlate the distribution of a *Drosophila* phylad with that of the Arcto-Tertiary forest, and thus with many of the plant disjuncts considered here. His interpretation of past forest distributions is perhaps the earliest to give much attention to the Mexican-Guatemalan outliers of northern types, and is in keeping with previous vague suggestions implying an early Tertiary age for this floristic relationship. He concludes that the present distribution of *Drosophila* must have arisen either in the pluvial periods of the Pleistocene or in the early Tertiary and strongly favors the latter on paleobotanical and paleoclimatic grounds. His conclusions concerning *Drosophila* have proven controversial and have been discussed at length elsewhere (Mayr, et al. 1945). In any case, the disjunction in *Drosophila* does not parallel that in the forest species with which it is associated in southern Mexico and Guatemala.

Steyermark (1950) notes the two-fold floristic relationship between Guatemala and the United States and considers the relationship with eastern North America to be the more ancient. Following concepts developed by Fernald (1931) and Braun (1947, 1950), he notes that the area occupied by these types in Guatemala includes the oldest land surfaces in the country and that these same plants occupy the Ozarkian and Appalachian plateaus, also old land surfaces. Steyermark concludes that these northern plants occupied both the Appalachian region and the Guatemalan highlands in the early Tertiary when these areas were reduced to low-lying peneplains. He observes that many of these plants occur in the North American Coastal Plain flora, but does not explain the failure of these species to migrate to younger land surfaces in Central America. It would appear that the occurrence of these plants in the latitude of Guatemala is dependent upon the effects of altitude; if this be the case, they could not have existed there when the area was peneplained. The relationships between Guatemala and western North America seem, on the basis of geological and floristic evidence, to be older than the eastern relationships. Steyermark's explanation of the floristic differences between eastern and western North America as being due to the Cretaceous seas seems equally doubtful in view of the evidence from paleobotany that these differences have largely been of more recent origin.

McVaugh (1952) thinks it probable that many of these temperate types may have persisted in Mexico and Central America since the early Tertiary or even the Cretaceous, and stresses the occurrence of temperate and tropical types in the same area at different altitudes. It is the dependence of these temperate types on higher altitudes which weakens the argument. It seems improbable that these temperate types could have persisted in Mexico in the early Tertiary when the climatic-vegetational zones were much farther north than now and mountain ranges were poorly developed. While I do not doubt the ultimately tropical origins of many groups, those populations which are conspecific in Central America and temperate North America would seem to have had, as suggested by Miranda and Sharp (1950), "a northern evolution and relationship", at least during the Tertiary. McVaugh's plea for a consideration of the whole of North America in botanical studies is laudable, and the phylogenetic pattern which he offers is probably quite applicable to many plants, especially the more modern herbs, such as *Lobelia* and *Salvia*.

Gentry (1946, p. 461), in describing a similar but less striking mixture of tropical and temperate types in western Mexico, states: "Most of such distributions appear to be relics representing Pleistocene adventives established during glacial epochs, when the cold front was farther south." This is an explanation which must be given due consideration, and, as will be shown, there is considerable evidence in its favor.

Deevey (1949), though not directly concerned with the present problem, stresses the importance of the Pleistocene in shaping modern ranges and suggests that temperate species were "pushed south of the Rio Grande" during parts of the Pleistocene. While it seems, as Deevey admits, that "southeastern North America taken as a whole may have served as a refuge," great distributional changes must have taken place during the Pleistocene, and these changes are probably directly related to the present problem. Deevey stresses the necessity of studying Mexico and other non-glaciated areas to a proper understanding of the Pleistocene.

Sharp (1951) draws attention to the close generic parallels between the Eocene Wilcox flora and the modern flora of the Mexican eastern escarpments. More genera (68%) of the Wilcox flora are represented in eastern Mexico than in any other area. It is noted that there are a few more temperate types represented in the Wilcox strata than Berry (1937) had thought. Sharp feels that, barring extensive parallel changes in ecological requirements, such a mixture of "temperate" and "tropical" types demands either transport from the uplands or greater ecological amplitude for many genera in the early Tertiary, and favors the latter explanation. Brown (1946), however, implies that long distance transport may have been involved in the case of some of these temperate types. There remains the possibility that a lessening of the climatic extremes might allow such a seemingly incongruous mixture of floristic types (Axelrod, 1948). Many of the east Mexican disjuncts probably occurred in Eocene time further north than the Wilcox area, and perhaps at higher altitudes.

In a more recent paper, (1953), Sharp reviews the floristic relationships between Mexico and other parts of the world and points out the fact that the physiographic history of Mexico seems to indicate a relatively recent invasion from the north for temperate types.

Geological and Paleobotanical Evidence

If, as appears to be the case, the presence of most "temperate" species in tropical latitudes is dependent upon high altitude habitats, then the physiographic history of southern North America is a critical part of the evidence. The material for the following summary was largely obtained from Garfias and Chapin (1949). While some mountain building occurred at about the close of the Cretaceous, the effects of this orogeny were largely nullified by early Tertiary peneplanation, this apparently culminating in the low relief of the Oligocene. Thus, for our purposes, the history of the present Mexican mountains may begin in the Miocene. The Sierra Madre Occidental arose at this time and the Sierra Madre del Sur also underwent some uplift, so that a mountain chain traversing western North America was available from the Miocene onward. The physiographic ties binding Mexico and Central America to the western United States seem to have been stronger than those connecting to the eastern United States, at least in the Cretaceous and earlier Tertiary. The western mountains, however, are not involved in the distribution of the majority of the temperate, Arcto-Tertiary disjuncts. The Sierra Madre Oriental, the critical link in these distributions, was not uplifted until the Pliocene. Since its uplift, the northern part of this mountain range has undergone considerable erosion, reaching a mature stage, with the mountains now somewhat discontinuous in the north. This would point to the late Pliocene or earlier Pleistocene as the time most favorable, physiographically, for the development of the ranges with which we are here concerned. The Sierra Madre del Sur was further uplifted in the Pliocene and the Sierra de Chiapas and related mountains of Guatemala were greatly uplifted in the late Pliocene.

The paleobotanical evidence is almost non-existent for critical areas, but gives climatic and floristic evidence for other areas, which can be correlated with the physiographic evidence to give a tentative interpretation. As previously stated, it seems improbable that a significant number of temperate plants could have persisted in Mexico during the Eocene or Oligocene. The first montane connections with temperate North America, in the Miocene, were with the western United States. The relative absence of Arcto-Tertiary types from western Mexico argues that the area of the xeric Madro-Tertiary flora in northwestern Mexico was an effective barrier to the Arcto-Tertiary types or that climatic conditions were not then such as to push them that far south. The prairie vegetation was already developing in the central United States (Chaney & Elias, 1936; Elias, 1942) at this time, and North America was being effectively divided into eastern and western floristic areas. The movement of Cordilleran and Madro-Tertiary elements southward toward Guatemala was probably underway at this time.

During the Pliocene physiographic connections between the eastern United States and Mexico developed, but the middle Pliocene, at least, appears to have been a period of aridity (Axelrod, 1948), scarcely the proper setting for the southward extension of mesophytic plants. This was probably the time of the maximum extension of Madro-Tertiary plants, including the western types in northeastern Mexico (Miranda & Sharp, 1950, Muller, 1947), in Guatemala (Steyermark, 1950) and in the southeastern United States (McVaugh, 1943). Again, paleobotanical data for the critical areas are few, but the Clarendon florule from northern Texas exhibits Madro-Tertiary species of an aspect more xeric than that of the floras farther north (Axelrod, 1948; Chaney & Elias, 1936).

It is in the Pleistocene that the proper climatic and physiographic conditions for a floristic exchange between eastern Mexico and the eastern United States seem to be met. It is difficult to localize these contacts in the Pleistocene. The physiographic evidence points to but does not require an earlier Pleistocene time. The latest that this vegetation could have been continuous would be before the xerothermic period (if it was felt, as such, in that region), though the disjunction may have arisen at an earlier time. Evidence from pollen analysis indicates that east Texas had a cooler and more mesic climate in the past (Potzger & Tharp, 1947) and shows a long period of climatic fluctuation for Mexico (Sears & Clisby, 1952). If the Pleistocene was felt by marked pluvial periods in the southwest, the relative absence of mesic disjuncts in western Mexico is probably to be explained by the Pliocene modernization of the western United States (Axelrod, 1948). Few mesic plants were available in the western United States by Pleistocene time.

The floristic data support the interpretation here given in that many of the most striking eastern disjuncts have not developed into separate species, while the Mexican and Guatemalan plants with relatives in the western United States are usually distinct species. Evidence of this nature cannot be precise, but its general utility has been pointed out by Fernald (1931) and Li (1952). Particularly interesting are *Carya, Magnolia, Hamamelis, Liquidambar, Cercis, Parthenocissus, Nyssa* and *Mitchella.* All of these genera have distinct species in eastern Asia and the southeastern United States, but the Mexican and Guatemalan plants are, in each case, conspecific with those of the United States. Schmidt's zoogeographic paper (1946) deserves mention, and the chart on page 151, though not directly applicable to this problem, deserves the attention of phytogeographers. The faunistic evidence generally parallels that available from plant geography.

The main vegetational continuity in the east probably occurred not through the most direct route now available but through the Big Bend region, being determined by physiography. The present xeric forest types are nearly continuous along this route (see Map 7). This area is also of interest in that it has been suggested as the path along which an aboriginal culture pattern including agriculture with maize, beans and perhaps squash entered the United States (Thone, 1935). More data from pollen analysis is greatly to be desired from this region.

Summary

The importance of Mexico to North American biogeography is noted and the two-fold relationship between Mexico and the eastern and western United States is discussed. Some species involved in the Guatemala and eastern Mexico-southeastern United States pattern of distribution are discussed and a few are mapped. The physiographic and paleobotanical evidence is reviewed and it is concluded that temperate types may have migrated southward in western North America as early as the Miocene. The western temperate groups in Guatemala may well have arrived there, as Steyermark suggests, in the Pliocene.

The eastern North American plants, on the other hand, probably did not migrate southward into Mexico and Guatemala until the early Pleistocene. These eastern species have since become disjunct because of decreased rainfall in Texas and northeastern Mexico.

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A HISTORY OF TILLAEA AQUATICA (CRASSULACEAE) IN CANADA AND ALASKA[1]

W. J. Cody

Tillaea aquatica L. (*T. simplex* Nutt.; *T. Vaillantii* sensu Gray's Manual, ed. 7, 1908, not Willd.; *Tillaeastrum aquaticum* (L.) Britt.) has been but little collected in Canada, both because of its small stature and its apparently restricted habitat. A collection from Yellowknife in Mackenzie District, N.W.T., suggested the following study.

Tillaea aquatica in Canada was apparently unknown to John Macoun as late as 1886, for there is no mention of it in his Catalogue of Canadian Plants, Part 1, 1883, or in the Additions and Corrections published in 1886.

There is a specimen in the Herbarium of the National Museum of Canada collected by Professor Macoun on August 4, 1887 from a salt marsh, Alberni Canal, Vancouver Island, British Columbia, which is apparently the first collection for Canada, but it was at first misnamed *Elatine americana.* It was not on the basis of this specimen that it was reported as new to the flora of Canada, for in the Canadian Record of Science, January 1895, the following record by J. M. Macoun appears: "*Tillaea simplex* Nutt. In mud in mill pond at Mount Stewart, Prince Edward Island 1888 (John Macoun). New to Canada." (August 17, 1888 [John] Macoun (CAN)). Other records from Prince Edward Island are those of J. R. Churchill the fifth collection of the species in Canada—(Tracadie Beach, *J. R. Churchill* August 1, 1901 (CAN)), and Fernald and St. John (wet brackish sand, Tracadie, *Fernald & St. John 11071*, August 22, 1914 (MT)).

[1] Contribution No. 1340 from the Botany and Plant Pathology Division, Science Service, Department of Agriculture, Ottawa, Canada.

Churchill,[2] has the following discussion of the species: "The second native and notable plant was a *Tillaea*, which I found in the wet sandy margin of Campbell's Pond, which is separated from the ocean by the same broad beach at Tracadie. Though the station was far north of its known range, it was of course assumed to be *Tillaea simplex*, and it was only after careful examination since my return, that Mr. Fernald identified it with *T. Vaillantii*, Willd., of Africa and Central Europe. The little plant, less than an inch high, grows in moss-like tufts like its congener *T. aquatica*, L. (*T. simplex*, Nutt.) from which it differs principally in the elongated pedicels of some of the flowers. This species has not been reported from North America; but the '*Tillaea simplex*' mentioned in Mr. J. M. Macoun's Contributions to Canadian Botany as "new to Canada," and collected also on Prince Edward Island, may be '*T. Vaillantii*'."

In Contributions to Canadian Botany XVI by J.M. Macoun,[3] John Macoun's collection from Mount Stewart was referred to *T. vaillantii*, but later[4] that author published the following note:

"*Tillaeastrum aquaticum* (L.) Britton.
Centunculus minimus Cat. Can. Plants vol. II p. 340 in part.
Tillaea simplex Contr. Can. Bot. Pt. V.
T. vaillantii Contr. Can. Bot. Pt. XVI in part.

"Our specimens are from Mount Stewart, Prince Edward Island, No. 8,705; Beauport, near Quebec, Que., No. 68,640; Kamloops, B.C., No. 8,706. (John Macoun). The only specimens of *T. Vaillantii* in our herbarium are those collected on Prince Edward Island by Mr. Churchill. Prof. Macoun's specimens referred to that species in Pt. XVI of these papers proves to be *T. aquaticum.*"

Fernald has since included the North American material named *T. vaillantii* with *T. aquatica*.[5] The author is in agreement with this at least in so far as the Prince Edward Island collection is concerned. These plants, which appear to differ from typical material only in that some of the pedicels are elongated, might possibly be given the rank of form, but certainly not the rank of species. The Fernald and St. John material collected at Tracadie has short pedicels similar to all the other material observed.

[2] CHURCHILL, J. R. Some Plants from Prince Edward Island. RHODORA **4**: 35. 1902.

[3] Ott. Nat. **16**: 216. 1903.

[4] Ott. Nat. **21**: 159. 1907.

[5] FERNALD, M. L., Gray's Manual of Botany, ed. 8. 1950.

The third collection of this species was made by John Macoun in 1889, again in British Columbia (damp places, Kamloops, June 26, 1889 (CAN)) and was originally recorded as *Centunculus minimus* (see above). *T. aquatica* was recorded, presumably for the first time for British Columbia, by J. M. Macoun,[4] on the basis of this collection. The only other records from British Columbia are from Alberni Canal, Vancouver Island (see above), New Westminster[6] and Crawford Bay, Kootenay Lake.[7]

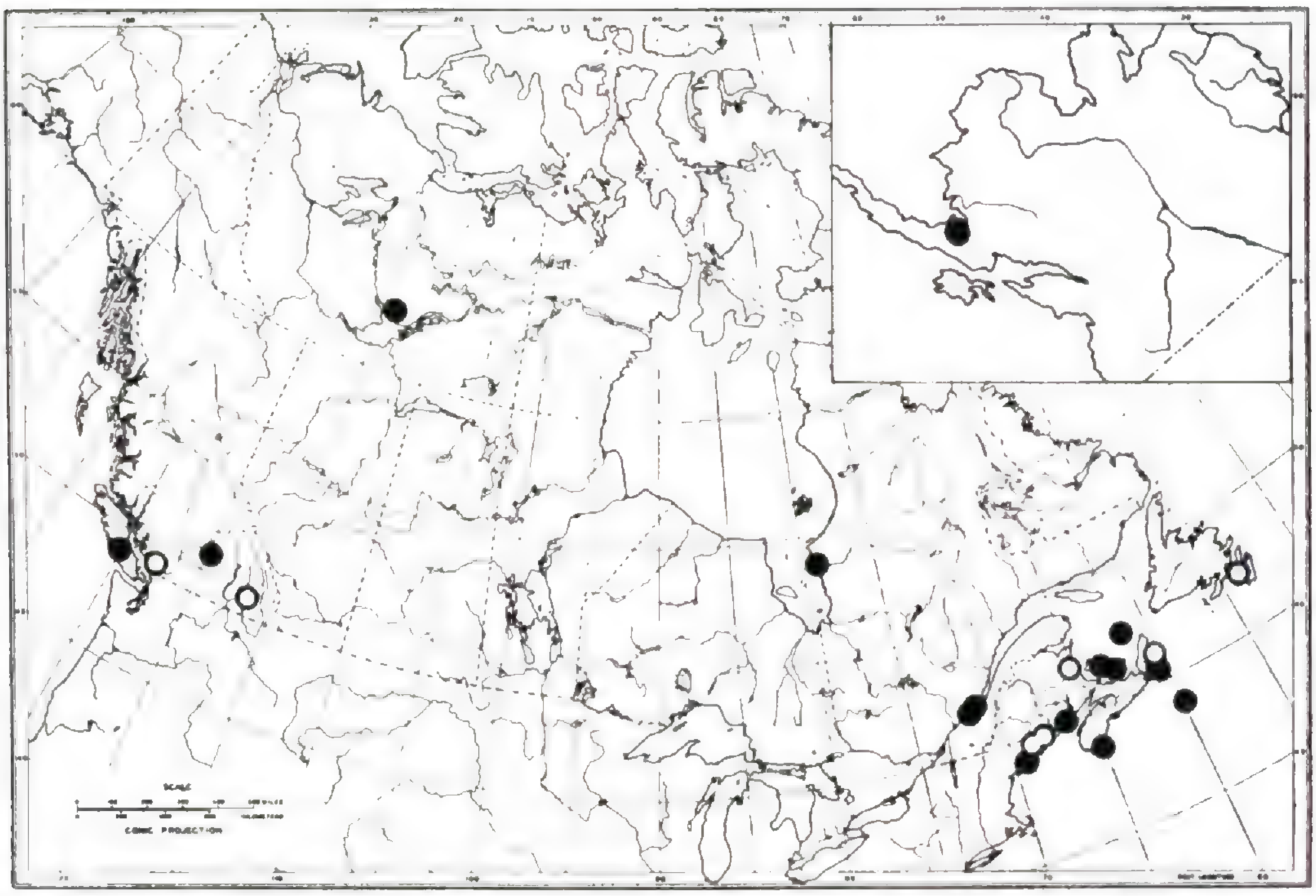

Fig. 1. The northern distribution of *Tillaea aquatica* in North America; dots: herbarium specimens; circles: literature records. (Goode's Series of Base Maps No. 111. Copyright 1939 by the University of Chicago).

In 1899 Macoun collected the plant on Sable Island, Nova Scotia—the fourth collection for Canada—(Sable Island, quite common in wet sand, [John] Macoun July 22, 1899 (CAN)), but somehow misnamed it *Montia fontana.* It was not recorded from that area until 1921 when Harold St. John published his paper, Sable Island, with a Catalogue of its Vascular Plants,[8] based on his own collections of 1913 (CAN) as well as the earlier collection of John Macoun. *T. aquatica* was not known from the

[6] Henry, J. K., Flora of Southern British Columbia. 1915.

[7] Eastham, J. W., Supplement to 'Flora of Southern British Columbia.' 1947.

[8] Proc. Boston Soc. Nat. Hist. **36** (1): 76. 1921. Contr. Gray Herb. Harvard Univ., N.S. No. 62.

mainland of Nova Scotia until 1920 when it was collected by Fernald *et al.* (damp sand-flats back of beach, Villagedale, Shelburne Co., *Fernald et al. 21360* (CAN)),[9] or from Cape Breton Island until recorded by Erskine,[10] on the basis of a collection by Smith *et al.* No. *2853* from muddy pond behind beach, Catalogue, Cape Breton Co. A still more recent collection from Cape Breton Island is that of Smith *et al.* from Richmond County (abundant, flat area near pond), Point Michaud, *5135*, August 15, 1951 (DAO).

The first collection for Quebec—and the sixth for Canada—was made in 1905 (Marshes, Beauport near Quebec, John Macoun, August 30, 1905 (CAN)). This was recorded by J. M. Macoun[4] (see above), presumably the first published record of its occurrence in that province. Since then it has been collected numerous times along the St. Lawrence River in the fresh water intertidal zone between Lake St. Peter and Island of Orleans. Elsewhere in Quebec, it is known from the Magdalen Islands in the Gulf of St. Lawrence (wet brackish sand at the margin of a pond northwest of Etang du Nord village, Grindstone Island, *Fernald et al. 7541*, July 24, 1912 (CAN, MT) and wet brackish sand near Hospital Point, *Fernald et al. 7540*, July 18, 1912 (MT)) and Fort George on James Bay (rivage vaseux de la rivière, Fort George, *E. Lepage 12,986*, 5 Sept. 1950 (DAO)). This latter collection is apparently a new record for the James Bay region and Ungava District, Quebec, and is an extension of range of some 550 miles northwest from the St. Lawrence River sites.

Apparently the first record for New Brunswick is that of Blake, based on a collection made in 1913 in brackish tidal mud, French Fort Cove, Miramichi River, Newcastle.[11] This is on the Gulf of St. Lawrence shore of New Brunswick. A second record from New Brunswick is that of C. A. and Una F. Weatherby (forming loose mats in mud over sand, margin of barrier-beach pond, Cheney Island, Grand Manan, No. *7305*, August 3, 1944 (DAO, CAN)). This was reported by Weatherby

[9] FERNALD, M. L., The Gray Herbarium expedition to Nova Scotia, 1920. RHODORA **23**: 150. 265. 1921.

[10] ERSKINE, D., Species newly or rarely reported from Nova Scotia and Cape Breton Island. RHODORA **53**: 268. 1951.

[11] BLAKE, S. F., Notes on the flora of New Brunswick. RHODORA **20**: 105. 1918.

and Adams,[12] from which the following note is quoted: "Not otherwise known from southwestern New Brunswick nor from Maine east of Penobscot; in Nova Scotia known from a single station in Shelburne County." Fassett[13] records specimens from the estuaries of the Kouchibouguac and Kouchibouguacis Rivers but these specimens have not been seen.

The only record from Newfoundland is the collection by Fernald, Long & Dunbar from the sandy and peaty margin of pond back of barrier beach, Argentia, in 1924.[14] Dr. Ernest Rouleau, who is currently working on a Flora of Newfoundland has kindly reported that he has seen this collection, No. *26737*, in the Gray Herbarium.

On August 27, 1948 Lepage collected *T. aquatica* in Alaska (muddy shore of Naknek River, Naknek, Alaska Peninsula, *E. Lepage 24,105* (DAO)). It was again collected in this area by Schofield in 1952 (damp sandy margins of pool, *W. B. Schofield 2770* and damp sandy margin of pond among hills, *2566*, Naknek (DAO)). These collections are an extension of range of some 1400 miles from the nearest known sites in southern British Columbia and the collection from Mackenzie District mentioned below. Its occurrence in Alaska may possibly be more closely related to the Japanese and eastern Siberian distribution reported by Fassett[13] than to the British Columbia or Mackenzie District sites. It is new to the flora of Alaska.

In 1949 the author collected *T. aquatica* at Yellowknife in Mackenzie District and in 1953 revisited the collection site (in 4 inches of water, in thick mat of moss, Yellowknife, *W. J. Cody 3511*, August 16, 1949 (DAO) and in muck sometimes in water up to ½ inch depth of flats of bay by old townsite, Yellowknife, *W. J. Cody & R. L. Gutteridge 7318*, July 14, 1953 (DAO)). Both these collections were from exactly the same locality, but a slight lowering in the level of the water of Yellowknife Bay had considerably altered the habitat. This site is some 1400 miles from the nearest known site to the southeast (Fort George,

[12] Weatherby, C. A. and J. Adams. A list of the vascular plants of Grand Manan, Charlotte County, New Brunswick. Contr. Gray Herb. Harvard Univ. N.S., No. 158. 1945.

[13] Fassett, N. C., The vegetation of the estuaries of northeastern North America. Proc. Boston Soc. Nat. Hist. **39** (3): 73–130. 1928.

[14] Fernald, M. L., Two summers of botanizing in Newfoundland. Rhodora **28**: 86. 210. 1926.

THE HARVARD UNIVERSITY HERBARIUM, built to house the Gray Herbarium; a major portion of the Herbarium and Library, and the Wood Collection of the Arnold Arboretum; the Paleobotanical Collection of the Botanical Museum and the Orchid Herbarium of Oakes Ames, also of the Botanical Museum.

James Bay) and some 900 miles from the sites in southern British Columbia and is the most northerly in North America. It is new to the flora of Mackenzie District and the Northwest Territories.

There is an unsubstantiated record for the French Islands of St. Pierre et Miquelon, off the south coast of Newfoundland. Brother Louis-Arsène in Contribution to the flora of the islands of St. Pierre et Miquelon[15] states "I think I found *Tillaea aquatica* in 1902 near the Grand Barachois, but it was late in the season, the flowers were gone and I did not take specimens, hoping to make a future collection."

Fernald[5] gives the the following North American distribution for *T. aquatica:* Newfoundland to lower St. Lawrence River, Quebec, s. along or near coast to Md.; La. to Tex. and Mex., inland n. to pools and depressions of Minn., Wyo., Utah and Wash. To this should now be added an extension of range into southern British Columbia and the seemingly isolated stands of James Bay, Great Slave Lake and Western Alaska. A map of the northern distribution of *T. aquatica* in North America, is given in figure 1.

Fassett,[13] gives the following extra-North American distribution: Northern Europe, Iceland, Spitzbergen, eastern Siberia, Japan. His map (Pl. 13, fig. 2) shows the worldwide distribution of *T. aquatica* as known to him; the Siberian record, however, seems to have been omitted.

Specimens have been examined in the following herbaria in the preparation of this paper: Botany & Plant Pathology Division, Department of Agriculture, Ottawa (DAO); National Museum of Canada, Ottawa (CAN); Botanical Institute, University of Montreal (MT); and Montreal Botanical Garden.

THE CLUB HERBARIUM GETS A NEW HOME.—As workmen put the finishing touches on a new Harvard University building (Plate 1202) at the head of Divinity Avenue in Cambridge, the herbarium of the New England Botanical Club was moved into it. Now (April 27) metal workers are busy fastening the steel cases back into position and by the middle of July the

[15] RHODORA **29**: 128. 1927.

specimens should again be available for consultation by the members. Located on the fourth floor, the Club herbarium occupies a rectangular area along the north wall of the building. Large, single-pane windows provide excellent natural light and the aisles between the cases have artificial projection light that reaches to the lowermost compartment of each case. The wall space is occupied by stool-high benches, tables and book-cases. When properly arranged, the Club books will all be shelved for easy access. Formerly, many of them were in storage or in a cabinet where they could not be easily consulted.

The new building has been carefully designed to provide the maximum in the safety and care of herbarium specimens and books. Fire-proofing has been carried out to the fullest. The building is air-conditioned and has humidity control. The violent fluctuations in humidity, especially, have previously been a source of worry in connection with the proper preservation of books and specimens. A most important feature of the building is its air-cleaning system. All air coming into the building and all air circulated within it is passed over cleaning devices that take out dirt and soot particles. This should permit an order of cleanliness for books and specimens here-to-fore unobtainable.

The preparation, mounting, sorting, fumigation and temporary storage of specimens will be carried out on the ground floor where special facilities for these activities are provided. This floor, though slightly below ground level, has full-sized windows and is admirably suited to its purposes.

The Club herbarium has been closely associated with the Gray Herbarium for many years and this relationship will continue. The new building was erected to house the Gray Herbarium, a major portion of the Herbarium and Library, and the Wood Collection of the Arnold Arboretum, the Paleobotanical Collection of the Botanical Museum and the Orchid Herbarium of Oakes Ames. Instruction in Dendrology, Paleobotany and Taxonomy will also be carried out in the building, which is located at 22 Divinity Avenue.—R. C. Rollins.

SOME NEW NAMES IN SOUTH AMERICAN GENTIANA.—During the course of his careful work on the South American species of *Gentiana*, the late Dr. Ernst Gilg inadvertently gave names to three species which are later homonyms. Accordingly, it becomes necessary to rename these species.

Gentiana alticola R. C. Foster, nom. nov. *G. lancifolia* Gilg in Engler, Bot. Jahrb. **22:** 326 (1896), not *G. lancifolia* Rafn, Danm. og Holst. Fl. **2:** 217 (1800).

G. neomandonii R. C. Foster, nom. nov. *G. Mandonii* Gilg in Engler, Bot. Jahrb. **54,** Beibl. **118:** 37 (1916), not *G. Mandoni* Rusby in Mem. Torr. Bot. Cl. **6:** 80 (1896).

G. sancti-matthaei R. C. Foster, nom. nov. *G. praticola* Gilg in Engler, Bot. Jahrb. **54:** Beibl. **118:** 46 (1916), not *G. praticola* Franch. in Bull. Soc. Bot. France, **43:** 493 (1896).—ROBERT C. FOSTER. GRAY HERBARIUM, HARVARD UNIVERSITY.

RECENTLY INTRODUCED PLANTS IN SOUTHERN ONTARIO.—Two new arrivals have been brought to my attention recently in plant collections by S. L. Thompson of Toronto, and M. Landon of Simcoe, Ontario.

NARDUS STRICTA L.—This grass, introduced from Europe, was collected by S. L. Thompson in a sandy meadow near Huntsville in the Muskoka District on July 1, 1953. This species has been found locally in Nova Scotia, Quebec and Michigan.

XANTHISMA TEXANUM DC.—An introduction from Texas, found by M. Landon growing along a sandy roadside in Norfolk County. It was collected in August of 1937, on lot 6, Conc. XII, in Townsend Township.

Specimens have been placed in the Herbarium of the Department of Botany at the University of Toronto.

J. K. SHIELDS, DEPARTMENT OF BOTANY, UNIVERSITY OF TORONTO.

A POPULAR FLORA OF CENTRAL COLORADO[1]—The identification of the flowering plants of the Rocky Mountain region has always been difficult for amateurs and none too easy for professional botanists. Of the two

[1] Weber, William A. Handbook of plants of the Colorado Front Range. Keys for the identification of the ferns, conifers, and flowering plants of the central Rocky Mountains from Pikes Peak to Rocky Mountain National Park and from the Plains to the Continental Divide. vi, 232 p. 78 fig. (mostly in glossary, and incl.map). 22 cm. University of Colorado Press, Boulder, 1953. ($5.00)

standard manuals of the last half century, that of Coulter and Nelson (1909) is out of print and long out of date, and that of Rydberg (1917 [1918], 2d ed. 1922 [1923]), in addition to being out of print and only very rarely obtainable at a high price (now about $30), has disadvantages of its own; and neither work is adapted for use by amateurs without considerable acquaintance with botanical terminology. None of the more popular works on the flowers of the region is a complete guide to identification, and most attempt to cover too great an area to be used very satisfactorily in any single part of it. Among those of more restricted range are popular floras of Rocky Mountain Park in Colorado, Yellowstone Park in Wyoming, and Glacier Park in Montana, all put out by the National Park Service, each illustrating a hundred or more plants but none attempting to key all the species found in its region.

The most comprehensive of these popular works is M. W. Pesman's *Meet the Natives*, now in its fifth edition (1952), which relates primarily to Colorado and includes very brief descriptions of over 700 species grouped by life zone and color, about 200 of which are figured. A more complete work for its area is C. L. Porter's *A Spring Flora of the Laramie Area* (rev. ed., 1949), written primarily for college students and consisting of keys employing a minimum of technical terms. A. O. Garrett's *Spring Flora of the Wasatch Region* (5th ed. 1936; out of print) is intended for use by amateur botanists; it includes descriptions as well as keys.

Prof. Weber's work covers completely an area about 135 miles long from north to south and 50 to 75 miles wide, from Ft. Collins south to the latitude of Pikes Peak, with Denver about in the center of its eastern margin, and can be used to advantage in much of mountainous Colorado west and south of this. It includes about 1300 species, almost half the total flora of the state, and embraces an altitudinal range from 5000 to over 14000 feet, from the western edge of the Great Plains to the Continental Divide. The prefatory matter deals briefly with such subjects as plant zones, use of keys, parts of the flower, collecting equipment, and reference books. The bulk of the book consists of dichotomous, non-indented keys to families, genera, and species. In many cases, when the species are not too numerous, generic keys as such are omitted and all the species of a family are included in a single key. The key characters appear in general to be well chosen for constancy and ease of observation, and the technical terms that must necessarily be used in a work that aims to be complete are defined in simple terms in the glossary, where many of them are illustrated. The habitats of all species are given in the keys and constitute an additional aid in identification. Altogether the work seems well adapted to serve the needs of amateur and professional alike in the identification of the vascular plants of this much visited region. —S. F. Blake, Agricultural Research Service, Beltsville, Md.

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STUDIES IN FRUTESCENT LECIDEACEAE (LICHENIZED DISCOMYCETES)[1]

I. MACKENZIE LAMB[2]

GENERAL REMARKS

ACCORDING to Reinke (17) and Zukal (27), frutescent development in the lichenized Ascomycetes has occurred in response to the need for greater development of surface area for purposes of photosynthesis by the algal symbiont. Sättler (22), on the contrary, considers the requirements for effective spore distribution to have played the more important determining role. As this must have been the sole operative selective factor in the non-lichenized Discomycetes (Geoglossaceae), there is no reason to discount its possible effectiveness in the lichenized forms also, especially since in certain of them (*Baeomyces*) the elongation of the apothecial stipe may take place independently of any investment with assimilative thalline tissue.

In the present author's preliminary paper on the genus *Stereocaulon* (Lamb, 14), an attempt was made to indicate the probable lines of its phylogenetic development from more primitive forms, and it was concluded, in agreement with views expressed by Kajanus (10, 11), that the ancestral prototypes of *Stereocaulon* must have been similar to certain species of *Toninia*. It was pointed out (Lamb, *op. cit.*, p. 576) that certain existing species of *Toninia* possess stipes of medullary origin upon which the assimilative squamules are elevated. Duvigneaud (4) considers *Stereocaulon* to be derived from the closely related genus or

[1] *Contribution from the Farlow Herbarium, Harvard University, Cambridge, Mass.*
[2] *Curator, Farlow Herbarium, Harvard University, Cambridge, Mass.*

subgenus *Psora* in the Lecideaceae. The object of the present paper is to focus closer attention on such primitive frutescent forms among the Lecideaceae, in the hope that the question of the phylogenetic origin of the Stereocaulaceae may thereby be made somewhat clearer.

It has long been known that the podetium (*sens. lat.*) of the lichen fungi may arise in two different ways, either as an outgrowth of the carpogenous or apothecial tissues (true podetia) or as an upward growth of the thallus tissues supporting the apothecia (pseudopodetia); the stipes of *Stereocaulon* are pseudopodetia, those of *Baeomyces* are true podetia. Smith (23) has suggested that in some species of *Baeomyces* the podetial structures are pseudopodetia of thalline origin, but this does not appear to be the case; on the contrary, *Baeomyces* seems to offer a particularly clear instance of the development of a true carpogenic podetium. As Galløe (8, pp. 77–79) has shown, the stipe in *B. placophyllus* originates as a solid medulla inside the apothecial primordia; it is derived from the tissues of excipulum + hypothecium (= calyx), and becomes secondarily clothed from below by corticate thallus tissue containing algae. Dughi (2) is of the opinion that such stipes are formed by the ascogenous hyphae as they rise upwards before giving rise to the hymenial tissues. Choisy (1), on the contrary, believes that in podetia of apothecial origin the ascogonia are always formed at their summits. In actual fact, either of these two conditions may be realized, as has been shown by Galløe (*op. cit.*), who demonstrated that in *Baeomyces roseus* and *B. rufus* the ascogenous cells arise in the head of the developing podetium, whereas in *B. placophyllus* formation of ascogenous cells takes place in the still sessile apothecial primordium before stipe-formation; cfr. his figures on Pl. 117, figs. 780, 781; Pl. 119, fig. 796; Pl. 122, fig. 812. It seems therefore that the podetium may arise by elongation of the apothecial tissues either before or after the formation of ascogonia.

In the genus *Cladoniopsis* Zahlbr., which is closely related to *Baeomyces*, differing chiefly in the branched podetia, the thalline tissue invades not only the apothecial stipe, but also the sterile apothecia themselves, converting them into shield-shaped assimilative bodies (Lamb, 15).

Pilophoron is included by Duvigneaud (4) in the family Stereocaulaceae, largely on the evidence of the presence of cephalodia and chemical similarities; it appears nevertheless to have true podetia of carpogenic origin (Lamb, 14, p. 524, footnote), as was already suggested by Vainio (24, pp. 20–21).

In *Cladonia*, vegetative transformation of the podetia has proceeded so far that in most species their carpogenic origin is not at all obvious, but studies of certain species having very short or rudimentary podetia confirms the correctness of Vainio's statements (24) that they are derived from the apothecial tissues as in *Baeomyces.* In the North American endemic species *C. linearis* Evans, in which the apothecia are borne on short pedicellate podetia not over 2 mm. in length, the central core of the podetium merges gradually above into the hypothecium, and the reflexed excipulum of radiating palisade-hyphae also shows a gradual transition into the podetial cortex. As a rule the podetia lack algal cells altogether, but occasionally small groups of algae are present (Evans, 5, p. 46). The primitive podetia of this species differ from those of most *Cladoniae* in being solid internally, lacking a central canal and an inner cartilaginous layer; these characteristics in *Cladonia* are apparently secondary and derived. Additional evidence for the carpogenic origin of the podetia is provided by the findings of Weise (26), who proved by alga-free cultures of the fungal component of *Cladoniae* that the colonization of the podetium by the assimilative thalline mantle is a secondary phenomenon.

Other frutescent genera placed in the Cladoniaceae (*Glossodium, Gomphillus, Heteromyces, Thysanothecium*) will not be considered here, because their ontogeny is mostly too little known to allow their phylogenetic relationships to be determined. *Thysanothecium,* and also the subgenus *Clathrina* of *Cladonia,* according to Duvigneaud (4), possess pseudopodetia of thalline origin, and for that reason have been removed from Cladoniaceae to autonomous monotypic families, Thysanotheciaceae and Clathrinaceae (*op. cit.*, p. 155). It is very doubtful whether *Gomphillus* belongs to Cladoniaceae. *Gymnoderma* has been found by Evans (5, p. 50) to be inseparable from *Cladonia. Pseudobaeomyces* Satô (19, 20, 21) is of doubtful taxonomic position. Its author first placed it in the Cladoniaceae, then subsequently in the Stereocaulaceae. It differs from *Baeomyces* in the possession of cephalodia, its longer and more septate spores, and its lecanorine apothecia. The type-species is *P. insignis* (Zahlbr.) Satô (Syn. *Baeomyces insignis* Zahlbr., *Baeomyces soboensis* Yasuda ex Räs., *Pseudobaeomyces pachycarpus* var. *stipitatus* Satô). The fact that the apothecia rise from a well developed, crustaceous, rimose-areolate thallus seems to indicate that the stipes are probably true podetia of carpogenic origin, secondarily clothed, up to the apothecial margin, with assimilative thalline tissue. The genus may possibly be better placed in Lecanoraceae than in Cladoniaceae.

Baeomyces, in particular, shows clear relationships to some of the non-lichenized Discomycetes. Le Gal (Bull. Soc. Mycol. France, LXII, 1946, p. 50) has emphasized its affinity to *Leotia*, showing that "*Leotia Batailleana*," described as a new species by Bresadola, is a typical *Baeomyces roseus.* Duvigneaud (4) points out the close analogy between *Baeomyces* and two other genera of inoperculate Helotiaceous Discomycetes, *Cudonia* and *Cudoniella.* Rizzini (Arquivos Jard. Bot. Rio de Janeiro, XII, 1952, p. 139) has described a Brazilian species of *Cudoniella* which he calls a "hemilichen"; it appears to be parasitic on pleurococcoid algae, these occurring also on the stipes and apothecial discs.

Reinke (17) included *Baeomyces* in the Lecideaceae as "der aufsteigende Stamm der Tribus." Kajanus (10) placed it, together with *Cladonia* and *Pilophoron*, in a subdivision *Baeomycei* of the order Lecideales, and kept the genera *Catillaria, Toninia, Stereocaulon,* and *Argopsis* apart in a separate order *Catillariales.* The view that *Baeomyces* represents an intermediate condition between the Lecideaceae and the Cladoniaceae (excl. *Stereocaulon* and *Argopsis*) seems to be correct, but Kajanus' segregation of the Catillariales as a separate order can hardly be maintained, as it attaches too much importance to the character of spore-septation. The genus *Toninia*, for instance, shows considerable variation in this respect; it is usually divided into the sections *Thalloidima* (spores 1 or rarely 2-septate) and *Eutoninia* (spores 3 to multiseptate), but the limits between the two sections are not at all well defined. (It should be noted that the placing of species under sections in

Zahlbruckner's Catalogus Lichenum Universalis is unreliable and in some instances quite erroneous.) The artificiality of the two sporological sections *Thalloidima* and *Eutoninia* is also well seen in the separation of *Toninia subcandida* B. de Lesd. from the habitally indistinguishable *T. candida* (Web.) Th. Fr. Furthermore, the species in which the spores are entirely or predominantly simple transgress into the genus *Lecidea* (sect. *Psora*), and have been placed in various systematic positions. Some, like *T. bossoniana* and *T. conglomerata*, are retained in *Toninia* sect. *Thalloidima;* some were placed in *Lecidea* (*L. thalloedaemiformis* Szat., *L. fujikawae* Satô, the latter as the type of a new section, *Tonniopsis* Satô).

In the family Lecideaceae as defined in Zahlbruckner's classification, frutescent development is found in several genera, and the production of stipes may be either from the apothecial tissues (true podetia) or from thalline tissues (pseudopodetia).

Among the Lecideaceae examined by the author, true podetia have been observed only in the genus *Bacidia* (incl. *Bilimbia*). Here the formation of stipes, derived from the tissues of the excipulum (calyx) and the hypothecium, is rather common, although often they are buried in the thallus and for that reason not externally visible. A similar downward prolongation of the hypothecial and excipular tissues is occasionally found also in some non-lichenized Ascomycetes with a mycelial subiculum (rudimentary thallus), *e.g. Eriopezia* in the Helotiales; see Korf (13), fig. 15, p. 147. Galløe (7) describes and figures stipes of parallel hyphae, formed from the base of the excipulum, in *Bacidia beckhausii* (Körb.) Arn. (*op. cit.*, p. 65, Pl. 113, fig. 364). In the Philippine species *B. robinsonii* (Vain.) M. Lamb (see revision on p. 119), the apothecia, although delimited on the under side by the entire excipulum, are subtended by a strand of dark tissue, obviously of carpogenic origin, running down into the underlying thallus to a depth of up to 400 μ. Galløe (*op. cit.*, Pl. 119, fig. 386) figures a section through an apothecium of *Bacidia acerina* (Pers.) Arn., showing a very short but distinct pedicellate stipe, which appears to be derived from the lower hypothecium, referred to by Galløe as the "inner calyx." On Pl. 61, fig. 207 of the same volume is shown a section through the thallus and apothecia of *Bilimbia sphaeroides* (Dicks.) Körb.

with distinctly raised-stipitate apothecia; an interesting feature here is the presence of a group of algal cells inside one of the stipes, indicating the beginnings of a tendency towards investment of the podetium with assimilative thalline tissue. Galløe (*op. cit.*, p. 47) points out the resemblance of the excipular stipes of *Bilimbia*-species to the stratum chondroideum in the podetia of *Cladonia*, and does not hesitate to regard the two structures as homologous. Other species of *Bacidia* in which the apothecia are raised on distinct pedicellate stipes are *B. gomphillacea* (Nyl.) Zahlbr., *B. kuopioensis* (Vain.) Vain., *B. obscurata f. substipitata* (Nyl.) Zahlbr., *B. ophiospora* (Hellb.) Th. Fr., and the exotic species *B. buchanani* (Stirt.) Hellb. and *B. exaltata* Zahlbr. Of these, only two, *B. gomphillacea* and *B. buchanani*, have been examined by the author, and the origin of the pedicellate outgrowth was found to be different in each.

In *Bacidia gomphillacea* (see revision on p. 124) the apothecial pedicels are undoubtedly of carpogenic origin, but, as suggested by Vainio (25), they seem to be derived from the tissues of older apothecia upon which new apothecia have grown by proliferation. In *B. buchanani*, on the contrary, the rudimentary pedicel, when present, is of purely thalline origin, and is not in any way derived from the apothecial tissues (see revision on p. 121).

Bacidia marginalis (Vain.) R. Sant. (18, p. 447) has pseudostipitate apothecia, the whole stalk-like base being formed from the lower part of the hymenium with the surrounding excipulum, as is also the case in the genus *Gomphillus*.

In other genera of Lecideaceae studied, the stipes are of thalline origin (pseudopodetia). As pointed out by the author in connection with *Stereocaulon* (Lamb, 14), a pseudopodetium may be formed either by the elongation of all parts of the thallus (medulla, algal stratum, and cortical layer when present) or by the vertical growth of the medullary or hypothalline tissue only, which then raises the assimilative part of the thallus upwards on its summit. These two types may be termed *holostelidious* and *enteropodious* pseudopodetia respectively, corresponding to the two subgenera of *Stereocaulon* distinguished by the author (14, pp. 564, 566) on that basis.

The beginnings of orthotropic elongation of the thallus to form pseudopodetia may be observed in *Catillaria columnatula*

(Nyl.) Zahlbr., in which the areolate thallus is formed of a number of minute, erect, connate columns (see revision on p. 114).

Well developed holostelidious pseudopodetia are found in the monotypic genus *Sphaerophoropsis* Vain. *S. stereocauloides* Vain. has been anatomically investigated by Reinke (17, pp. 98–99), and the thallus shown to consist of homoeomerous stipes of thick-walled hyphae intricated in various directions, without differentiation of medulla or cortical layer, the symbiotic algae being disposed quite at random through the tissue. The author's revision of the type material (p. 148) fully confirms Reinke's observations. The algae occur in all parts of the stipes, in which they are buried, and do not form granulose excrescences on the surface. Sections of the apothecia show that the excipular and hypothecial tissues are abruptly differentiated from those of the stipes, which are obviously purely thalline formations.

In the genus *Toninia* the development of pseudopodetial stipes is rather a common phenomenon, and they are of the enteropodious type, being derived from the lower medullary tissue of the squamules, and usually of purely mycelial composition, without symbiotic algae. They are not constantly present in the species in which they occur, and do not constitute a taxonomic character of great importance in this genus. *Toninia ruginosa* (Tuck.) Herre, in its typical form, shows little or no development of stipes, but in the newly described variety *andicola* M. Lamb they are very conspicuous, and partially corticate in their upper parts (pp. 144–148). In other species of *Toninia* examined they are ecorticate, formed of vertically parallel, often more or less fibrous-dissolute hyphae. The thalline squamules are raised up on the summits of these mycelial stipes, which spring from their under side and are continuous with their medulla. The apothecia may be formed either directly on the thalline squamules or on stipes of their own. Usually the stipes are more or less buried in the earthy substratum, and may form at their base a mass of fibrous root-like strands, as in some states of *T. coeruleonigricans* (Lightf.) Th. Fr.; in a specimen of this species collected by the author in Canada, boundary between Alberta and British Columbia (M. Lamb no. 6481), the radicate stipes are up to 14 mm. long and at their base fibrous-floccose or dissolute into sheets of pale mycelium. Such forms have been described in the literature: "*Lichen radicatus*" Villars, Hist. Plant. Dauphin. III (1789), p. 948, Pl. 55 ("La partie inférieure de tout le lichen se prolonge en un faisceau de racines fibreuses d'environ un pouce"). Possibly *T. coeruleonigricans* f. *caulescens* Lettau represents the same modification.

Descriptions are here given of three representative caulescent species of *Toninia* with simple, 1-septate, and multiseptate spores respectively: *T. conglomerata* (Ach.) Boist. (p. 137), *T. bumamma* (Nyl.) Zahlbr. (p. 139), and *T. squalida* f. *caulescens* (Anzi) M. Lamb (p. 142). As the stipes are in close contact with the substratum, they naturally tend to be commonly conspurcated with accidentally adherent soil particles and groups of Cyanophyceous algae, but in a specimen of *T. squalida* f. *caulescens* colonies of blue-green algae were observed enclosed by hyphae in the upper stipes and lower sides of the thalline squamules (fig. 10, p. 143), a fact which suggests the formation of primitive cephalodia, and this is interesting in view of the probable close relationship between *Toninia* and the cephalodia-bearing genus *Stereocaulon*.

Toninia bornmülleri (Stein) Zahlbr. is stated to have *hollow, branching* stipes up to 2 cm. high, terminated apically by inflated-verrucose heads of squamules; "erinnert an eine *Dufourea* und weicht habituell von allen europäischen *Thalloedema*-Arten weit ab." Unfortunately no material of this interesting species has been available for examination, and nothing can be said regarding its systematic position and morphological features.

A few species of *Lecidea*, such as *L. alboradicata* B. de Lesd. and *L. glomerans* Nyl., are stipate-radicate, probably with the same type of enteropodious pseudopodetia as in *Toninia*, but they have not been examined by the author. In some *Lecideae* of the section *Psora*, e.g. *L. rubiformis* Wbg., the tendency towards formation of this kind of stipe is often very obvious.

Enteropodious pseudopodetia are now described in one species of *Catillaria* and two species of *Bacidia*, genera in which this type of thalline development was not previously known. The resulting difference in habitus and structure is so marked that it has been felt necessary to create new sections of the genera for these species: *Catillaria* n. sect. *Hypocaulon* and *Bacidia* n. sect. *Thamnopsis* (pp. 116, 125). In both of them the stipate pseudopodetia consist of purely fungal tissue of intertexted

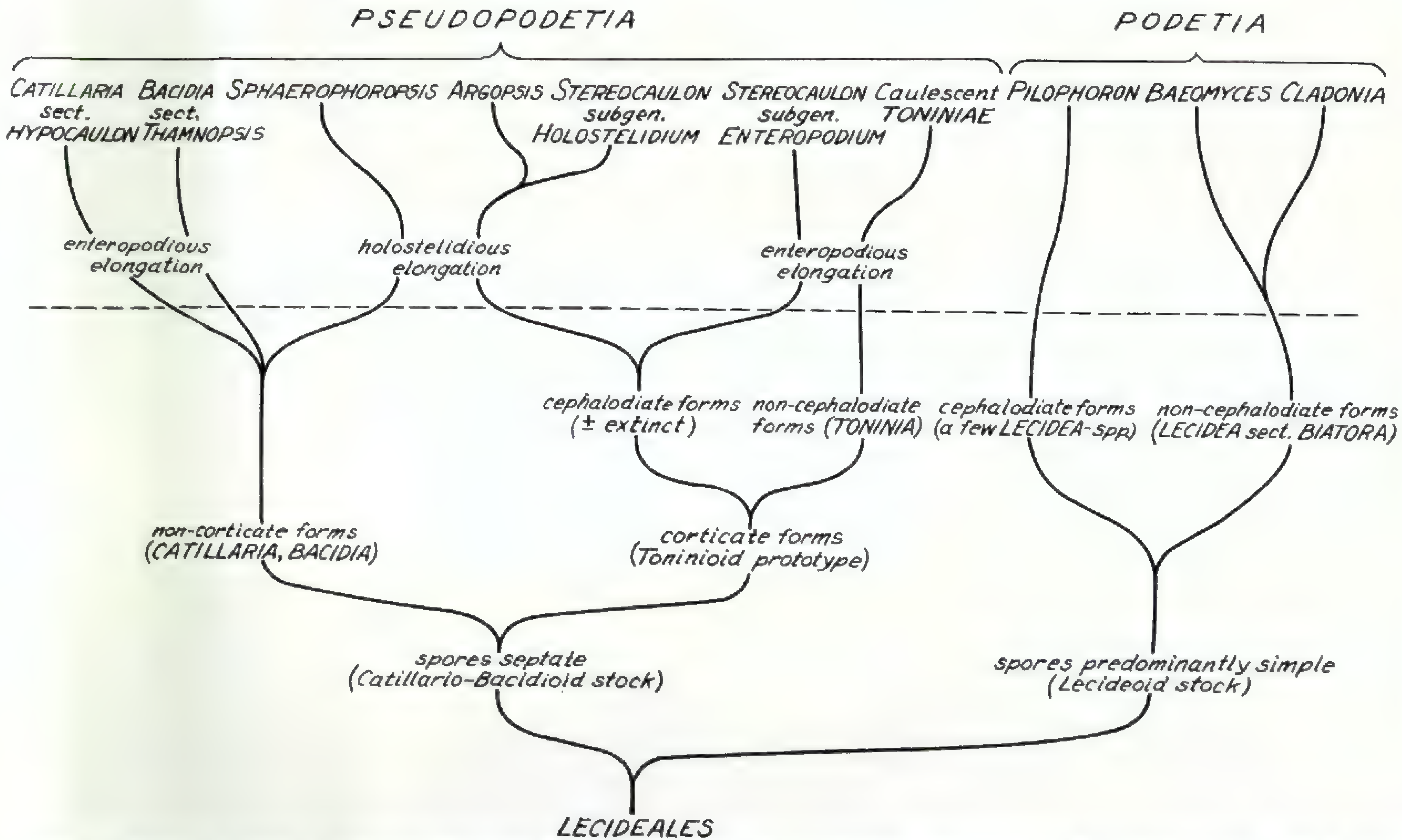

Fig. 1. Scheme of probable phylogenetic derivation of fruticulose forms in Lecideaceae, Stereocaulaceae and Cladoniaceae. The dotted line represents the level at which frutescent development took place.

hyphae, without cortex and with few or no algae, and formed from the lower medulla or perhaps the hypothallus. The assimilative granules containing the symbiotic algae are raised up at the apices of the pseudopodetia. The apothecia and spores are normal for *Catillaria* and *Bacidia*. Strangely enough, both these new sections are represented by endemic Antarctic species. Antarctica is known to be the home of fruticulose representatives of elsewhere purely crustaceous genera (*Caloplaca* sect. *Thamnoma, Lecania* sect. *Thamnolecania*). *Bacidia* sect. *Thamnopsis* shows considerable similarity to *Stereocaulon* subgen. *Enteropodium*, and indeed one of the species was first described as a *Stereocaulon;* however, it differs in the absence of cephalodia and of a differentiated central chondroid pseudopodetial strand, and in the aeruginose epithecial pigmentation which is unknown in *Stereocaulon.*

The accompanying diagram (Fig. 1) is intended to show the presumed phylogenetic origin of the frutescent genera derived from the order Lecideales.

DESCRIPTIONS OF THE SPECIES INVESTIGATED

Catillaria Mass. emend. Th. Fr.

Sect. *Biatorina* (Mass.) Th. Fr.

Catillaria columnatula (Nyl.) Zahlbr. Cat. Lich. Univ. IV (1926) p. 34. Syn. *Lecidea columnatula* Nyl. in Flora, LX (1877) p. 228.

material examined: the type-specimen from Ireland, Kylemore, coll. *Larbalestier*, 1875, in herb. Nylander, Helsinki (no. 19140).

On a chip of gneissic-schistose rock 2.4 × 0.7 cm. Thallus seen from above granulose-areolate, dirty gray with a faint brownish tinge, matt, of irregular, sinuate-angulose areolae 0.3 0.7 (–0.9) mm. diam. separated by narrow or ± gaping, very deep cracks. Areolae plane, with obsoletely granulose surface, as if composite. Seen from the side, the thallus, about 0.5 mm. thick, consists of closely packed, vertical, simple, whitish columns about 0.1 mm. diam., firmly attached to the rock. No dark hypothallus. Thallus externally and internally KHO + sordid yellowish, $CaCl_2O_2$ – , PD – ; sections under microscope I – , not giving any noticeable yellow mist with KHO. Apothecia abundant, scattered or ± contiguous, sessile on the thallus and rising above its general surface, round, minute, 0.25–0.40 mm. diam., entirely black, matt or subnitid, not pruinose, mostly moderately convex and immarginate from the first, a few with indistinct, hardly prominent, moderate, concolorous proper margin.

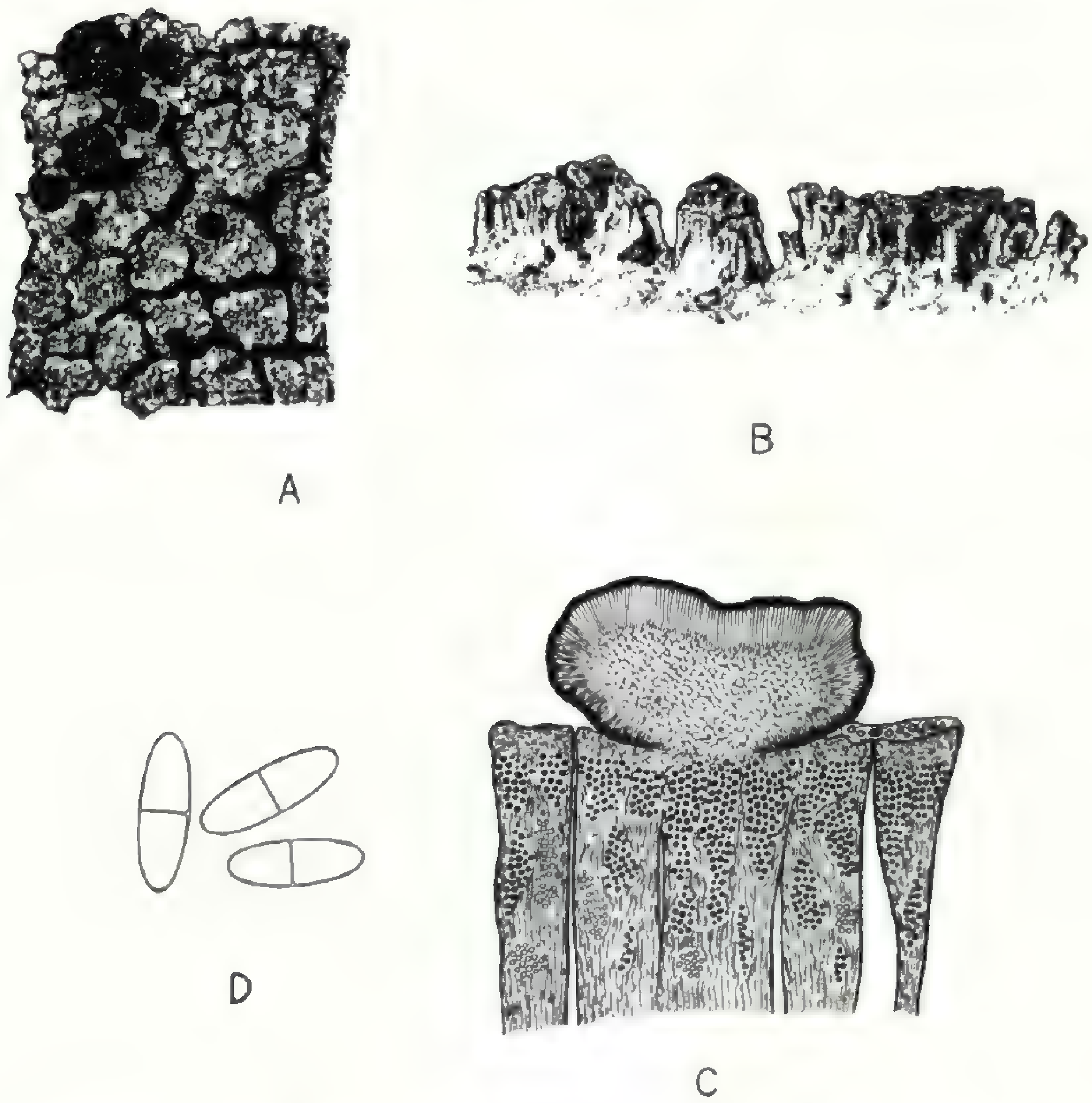

Fig. 2. *Catillaria* (*Biatorina*) *columnatula* (Nyl.) Zahlbr. The type-specimen. A, part of thallus and apothecia seen from above ($\times$ 10). B, part of thallus seen from the side (x 10). C, vertical section of thallus and apothecium. D, Spores.

Thallus without distinct cortex, the upper surface of the areolae with an ill-defined outer layer up to 30 μ deep of indistinct, shortly septate or cellular, thin-walled, grayish-nubilated hyphae entangled and fused in various directions, 3–4 μ diam. Interior of columnar areolae with numerous unevenly distributed symbiotic algae, not forming a distinct stratum, but more abundant in upper parts. Algae pleurococcoid, pale green, round, 4–7 μ diam., cohering in clumps by the thin but $\pm$ gelatinous walls (Micareoid type), multiplying by transverse fission. Numerous blue-green algae also present in the thallus, of various types; also present in places over the surface of the areolae, with hyaline or reddish sheaths. Internal medullary tissue sordid yellowish-gray-nubilated (becoming clear in KHO), of indistinct, gelatinized, compacted, $\pm$ vertically parallel, thin-walled hyphae 2–3 μ thick. Sides of columnar areolae formed by the exposed medulla, in places covered by a hyaline, amorphous, necrotic layer up to 12 μ thick.

Apothecia lecideine (biatorine), without symbiotic algae. Excipulum 45–75 μ thick, in outermost 6–12 μ brown-blackish or partly sordid aeruginose, internally gradually pale reddish-brown or $\pm$ colorless; composed of parallel-radiating, indistinct, thick-walled, gelatinized hyphae 3–4 μ thick; in its upper part with gradual transition into the hymenium. Hypothecium $\pm$ colorless and hyaline, obconical, up to 200 μ deep, composed of gelatinized, thick-walled, colorless hyphae 3–5 μ thick compactly intricated in various directions; at its sides merging gradually into the excipulum. Hymenium about 50 μ high, unevenly sordid aeruginose-blackish in upper 6–11 μ, otherwise colorless or very faintly brownish. Dark epithecium and parts of outer exciple HNO_3 + dark crimson-red (not HNO_3 −, as stated by Nylander). Paraphyses ± discrete in water, about 1 μ thick, simple or branched, not anastomosing, not or only slightly thickened at the tips, where they bud off round moniliform cells. Asci clavate, 32–48 × 9–11 μ, with gelatinous wall 1–2 μ thick at sides, at apex often spuriously gelatinously thickened up to 8 μ; persistently blue with Iodine (blue then vinose-fulvescent according to Nylander). Spores 6–8 in ascus, biseriate, colorless, ellipsoid-fusiform, with distinct thin transverse median septum, minute, 9–10 × 3–4 μ (Nylander describes them as up to 16 μ long).

Some of the apothecia show signs of proliferation, the original excipulum persisting as a fold below the secondary upper one.

Sect. *Hypocaulon* M. Lamb (n. sect.)

Thallus frutescens, stipitibus e parte infima thalli evolutis et (summitatibus ipsis exceptis) algis destitutis, homoeomeris, ecorticatis, e hyphis compositis compactis et irregulariter contextis. Pars gonidiifera thalli apicibus stipitum enata, e verruculis vel granulis sorediiformibus formata. Apothecia terminalia aut subterminalia, biatorina aut lecideina, margine thallino destituta; sporae solitae generis. Typus sectionis: *C. corymbosa* (Hue) M. Lamb.

Catillaria corymbosa (Hue) M. Lamb (n. comb.). Syn. *Alectoria corymbosa* Hue in Expéd. Antarct. Franç. 1903–5, Lichens (1908) p. 12.

MATERIAL EXAMINED: the type-specimen from Antarctica, Palmer Peninsula, Booth (Wandel) Island, in herb. Hue, Paris (ster.); South Orkneys, Laurie Island, Whitton Bay, coll. "Discovery" Exped. 1931–33, no. 1095a (fert.); Palmer Archipelago, Port Lockroy, Goudier Islet, coll. 1944, *I. M. Lamb, 2124* (ster.).

Thallus directly adnate to the rock, caespitose, forming small pulvinate or irregular clumps 0.7–1.8 cm. diam., composed of crowded, intricated, flattened or irregularly angular, often longitudinally striate and cariose, irregularly branching stipes 4–10 mm. high, 0.2–0.8 mm. thick, often splitting into several strands, dull sordid yellowish, matt*, firmly attached to the rock by a thin effuse holdfast of concolorous, felted or in places almost root-like, fungal tissue (hypothallus). At their summits, and on their sides near the summits, the stipes are covered with masses of sorediiform granules up to 0.1 mm. diam., concolorous with or slightly paler than the stipes, and aggregated in cauliflower-like formation. No distinct reactions with KHO, $CaCl_2O_2$, or PD. Apothecia rare, terminal or perhaps partly lateral (attachment not well seen in the formalinized and ± crushed material), on the upper parts of the stipes among the assimilative granules; scattered, 0.7–1.5 mm. diam., pale dull reddish or reddish-brown and semipellucid (probably dull yellowish and matt in natural unformalinized material), naked, at first flat and scutelliform with

* In formalinized material, such as the type specimen, the thallus appears pellucid and reddish.

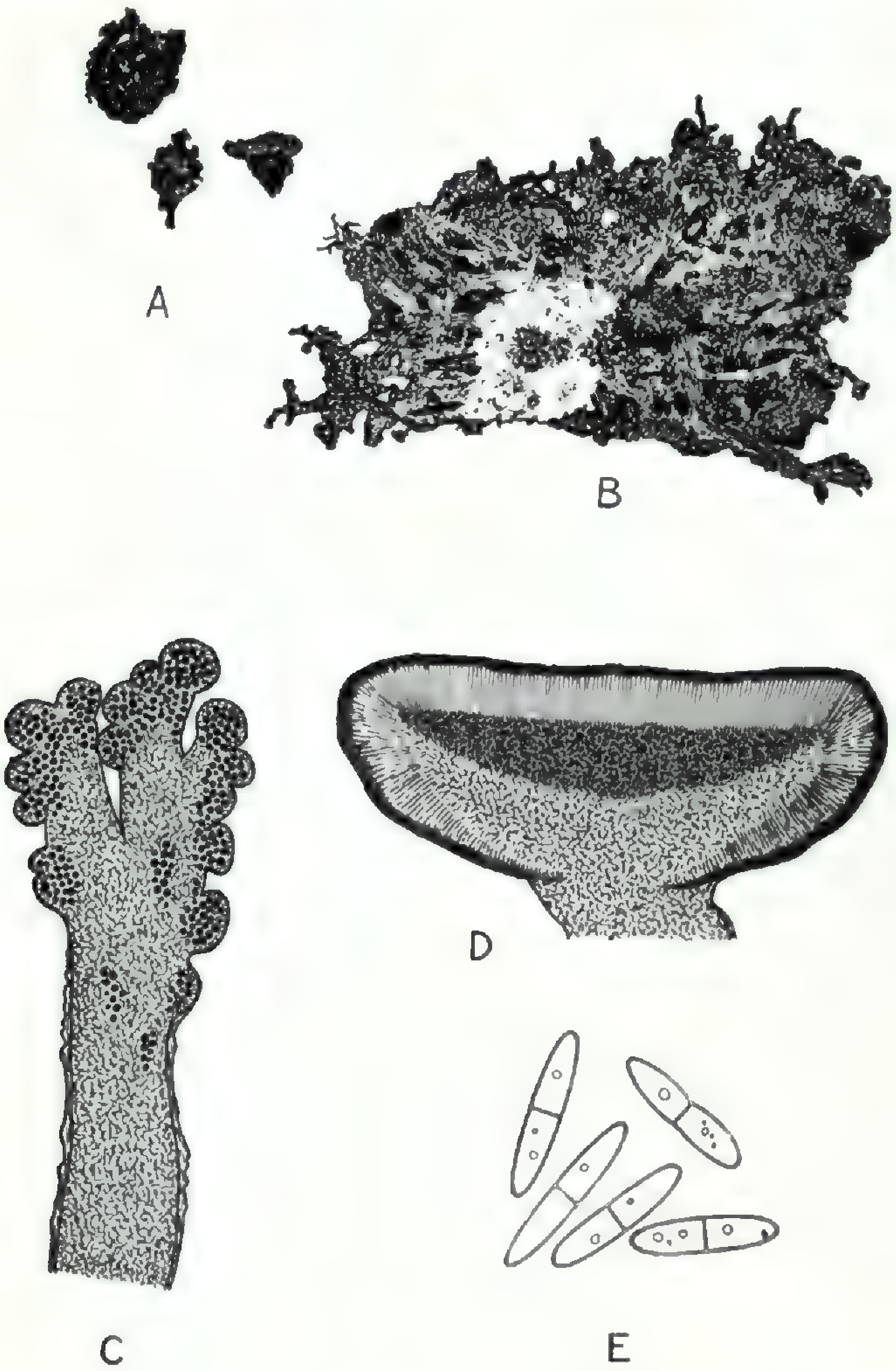

Fig. 3. *Catillaria* (*Hypocaulon*) *corymbosa* (Hue) M. Lamb. A, part of the sterile type-material in herb. Hue, Paris (× 1). B, fertile specimen from South Orkneys, showing attachment to rock (× 2). C, longitudinal section of a thallus-branch. D, vertical section of apothecium. E, spores.

a slightly raised, moderate, entire, concolorous proper margin, then becoming plane-immarginate or finally slightly convex.

Stipes ecorticate, of homogeneous structure, formed of ± colorless, clear, branching hyphae 2–5 μ thick running in various directions and closely compacted; their walls thick, gelatinized and conglutinated, with tubular lumina 1–2 μ wide. Outer surface of stipes covered with a ± colorless, amorphous or indistinctly granulose, necrotic stratum 2–6 μ thick. No central axis is developed. No algae present in the stipes except near the apices, where a few scattered clumps may be imbedded. Assimilative granules borne on the irregularly and minutely multifid apices o' the stipes, and on their sides near the summits; each consisting of a central mass of algae surrounded by a ± colorless hyphal envelope 3–6 μ thick of rather indistinct, irregularly angulose, ± isodiametric, thin-walled cells 2–5 μ diam. Algae cystococcoid, pale or bright green, globose, 10–20 (–27) μ diam., with gelatinous walls up to 4 μ thick. Stipes and granules KHO − in section.

Proper margin (excipulum) well developed at sides, 60–80 μ thick, colorless or faint yellowish in section, slightly nubilated in outermost 12–15 μ; inner part without algae, composed of flabellate-radiating, conglutinated hyphae 1.5–2.0 μ thick with walls about 1 μ thick. Underneath the apothecium the exciple gradually decreases in thickness and terminates, not being produced downwards into the stipe. Lower part of apothecium filled with a compact, colorless, hyaline, medullary tissue consisting of thick-walled, gelatinized and $\pm$ conglutinated hyphae 3–4 μ thick, intricately interwoven in various directions, only the fistulose lumina (1.5–2.0 μ diam.) distinctly visible. This medullary tissue continues downward into the stipe, and seems to be a "central cone" intruded from the thallus, as in *Stereocaulon*. Although the apothecia are clearly biatorine, occasionally one or two isolated clumps of symbiotic algae from the upper part of the stipe penetrate into this medullary tissue. Hypothecium 70–130 μ deep, not well delimited from the medullary tissue, sordid yellowish-nubilated and opaque except in very thin sections, also containing scattered or $\pm$ crowded, dull yellowish, granular inclusions; composed of closely compacted and interwoven hyphae 1.5–3.0 μ thick running in various directions, or in places $\pm$ cellular with cells 2–3 μ diam. Hymenium 55–65 μ high, not well delimited from the hypothecium, sordid yellow-brownish in uppermost 10–12 μ, otherwise $\pm$ colorless. Paraphyses discrete in water, about 1.5 μ thick, simple or branched, not anastomosing, at tips slightly capitate-thickened (up to 3 μ), but not noticeably pigmented. Asci clavate, 50–60 $\times$ 9–13 μ, with wall 1.0–1.3 μ thick at sides, at apex thickened up to 9 μ. Spores 6–8 in ascus, irregularly biseriate, colorless, fusiform, rounded or obtusely pointed at ends, thinly 1-septate, often with small vacuoles or oil-droplets in the protoplasm, 12–15 (–17) $\times$ (4.0–) 4.5 μ. With Iodine, hymenium blue then dark wine-reddish; hypothecium blue then aeruginose. With KHO added to sections under microscope, excipulum gives distinct yellow mist.

No pycnidia were found in the material seen.

Hue described the sterile material under *Alectoria*, considering that it might be placed near *A. virens* Tayl., but adding "auquel cependant il ne ressemble nullement." Even from his description it was obvious that the plant could be no *Alectoria;* Du Rietz (3, pp. 28–29) was not able to form any opinion as to its systematic position, and Köfaragó-Gyelnik (12, p. 252) hazarded the guess that it might be a *Ramalina*. The author succeeded in finding the type specimen of this species in Herb. Hue, Muséum d'Histoire Naturelle, Paris, in 1936. It is no. 272 pr. p. of Charcot's first expedition; Hue mentions also two further numbers from the same locality, 277 and 299, but these could not be found. It was hard to say to what genus the sterile material might be referred; it could be compared only to a fruticulose *Lepraria*. For some years the problem remained unsolved, but finally some material collected by one of the British "Discovery" expeditions in the South Orkney Islands supplied the answer. It was identical with Hue's type material of "*Alectoria corymbosa*", but somewhat better developed, and bore several apothecia in several stages of development. These on sectioning were found to be biatorine, with colorless 1-septate spores. From consideration of all the characters now afforded, it became apparent that the lichen was best to be included in the genus *Catillaria*, as the type of a new section analogous to the sect. *Thamnolecania* of the genus *Lecania*, characterized by the frutescent habitus. The stipes are derived from the lower medulla or possibly the hypothallus, and are enteropodious pseudopodetia, devoid of symbiotic algae except at the tips, where they bear the mass of assimilative granules. *Catillaria* sect. *Hypocaulon* differs from *Sphaerophoropsis* Vain. in the enteropodious formation of the pseudopodetia; in the latter genus these are clearly holostelidious.

At a later date the author saw *Catillaria corymbosa* in the living state on an islet in the Palmer Archipelago off the Palmer Peninsula of Antarctica, and was able to study its development. The lichen commences as minute scattered groups of granules, similar to those on the apices of the tufts, but sessile on the rock. At a later stage the stipes are formed, and the mass of assimilative granules is carried up on them. Around fully developed clumps there are few or no granules left sessile on the rock. The color in the living state is dull sordid yellowish, sometimes with a faint pinkish tinge. The specimen seen was sterile, and occurred in small quantity near sea level, on a granodiorite stone protected by an overhanging rock, a somewhat bird-frequented and possibly nitrogenous position.

BACIDIA De Not. emend. Zahlbr.

Sect. *Eubacidia* Zahlbr.

Bacidia robinsonii (Vain.) M. Lamb (n. comb.). Syn. *Toninia Robinsonii* Vain. in Ann. Acad. Sci. Fennic., ser. A, XV, no. 6 (1921) p. 62.

MATERIAL EXAMINED: the type-specimen from Philippines, Luzon, Laguna, Mt. Banajao, coll. 1909, *C. B. Robinson, 6545*, no. 20356 in herb. Vainio, Turku (Åbo).

On bark. Thallus up to 0.8 (–1.0) mm. thick, pale sordid olivaceous buff-colored, matt, not pruinose, granulose to indistinctly subsquamulose with crowded granules or indistinct minute soft squamules not over 0.25 mm. diam.

which are ± concrescent and irregularly imbricated to form an uneven, spongy crust; not changing color when moistened. Periphery of thallus not seen. The thallus is not distinctly frutescent, but the squamulose granules are somewhat elevated on a ± undifferentiated, paler (whitish to pale sordid brownish), ± fibrous basal hypothalline layer or subiculum. Apothecia scattered, sessile on the crust, round, moderately to well constricted at base, 0.6–1.0 mm. diam., versicolorous, at first dark reddish, then becoming black, persistently plane or scutelliform with matt, naked disc and moderate to thickish, entire, slightly prominent, concolorous proper margin.

The thalline granules are not corticate, but are surrounded by a lax weft of colorless, partly intertexted, partly loosely protruding hyphae 2–4 μ thick, enclosing masses of pale green pleurococcoid algae 3–7 μ diam. in coherent clumps (Micareoid type, *Coccomyxa* ?).

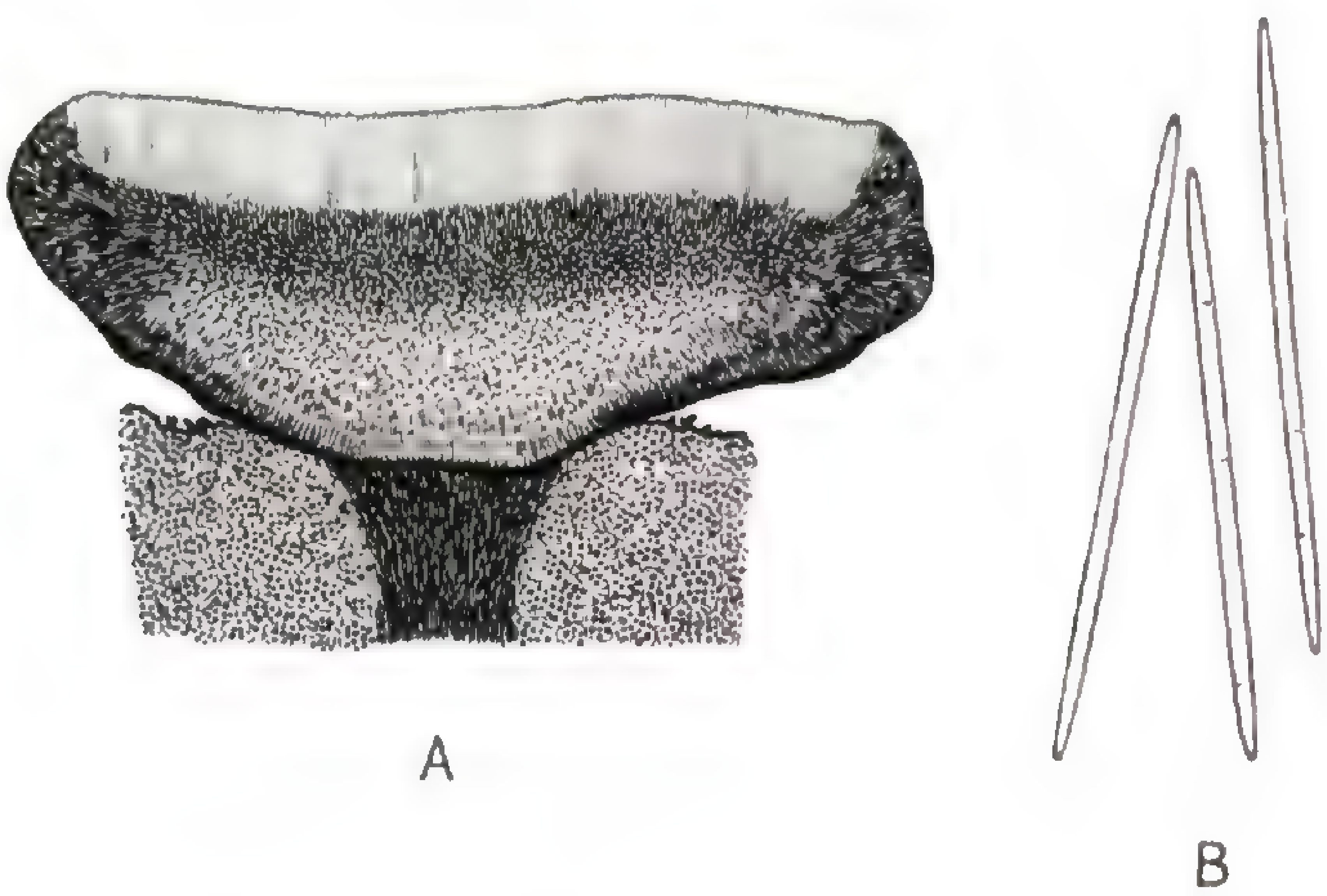

Fig. 4. *Bacidia* (*Eubacidia*) *robinsonii* (Vain.) M. Lamb. The type-specimen. A, vertical section of apothecium and subtending strand of carpogenic tissue in thallus. B, spores.

Apothecia completely biatorine, containing no algae. Excipulum entire, scutelliform, well developed all round the apothecium, 120–145 μ thick at sides and below, at the sides entirely pale to dark dull red in section, at the base pale to deep red (almost sanguineous) in the lower 50–70 μ, but ± colorless in the upper inner part; tissue ± clear, not nubilated. The excipulum is of radiate structure, with fused, gelatinous-chondroid, somewhat thick-walled hyphae 2.5–3.5 μ thick, the inner ± colorless part at the base becoming indistinctly pseudoplectenchymatous with ± isodiametric, thin-walled cells 2.5–3.5 μ diam. Hypothecium 100–135 μ deep, dark red or dull sanguineous, not nubilated, of closely compacted hyphae 2.5–4.0 μ thick, those of the lower two-thirds intricated and shortly cellular or indistinctly pseudoplectenchymatic, those of the upper subhymenial third ± vertical. Hymenium 100–135 μ high, entirely faintly yellowish, without any epithecium, composed of strictly parallel and very crowded paraphyses and narrow asci, the latter not distinctly visible in section. The hymenium is very gelatinous and its parts difficult to see, even after crushing in HNO_3. The paraphyses appear to be simple, thickish (1.2–2.0 μ), septate, and the asci cylindrical, very narrow (about 7–8 μ broad), gelatinous, soon evacuating their spores and then collapsing. The spores are rather abundantly produced, but none were seen inside the ascus; acicular, straight, attenuate and ± pointed at both ends, indistinctly 5–7-septate, or often apparently eseptate, 45–50 × 1.5–2.0 μ. The red pigment of the apothecial tissues is HNO_3—, but with KHO turns ± violet-purple. Iodine stains the hymenium streakily pale blue, the paraphyses not colored, the asci staining in their entirety. From the lower side of the basal excipulum is developed a dark red or reddish-brown, compact tissue of intricated or ± parallel pigmented hyphae which runs down in irregular strands into the subtending thallus to a depth of at least 270 μ (or 400 μ, according to Vainio).

The apothecia are of a remarkably tenacious, cartilaginous-chondroid consistency.

In this species the apothecia are not visibly stipitate, but there can be seen the beginnings of a tendency in this direction with the outgrowth of downwardly running strands of pigmented tissue from the lower side of the apothecium; this tissue is obviously of carpogenic origin, although it is not part of the actual excipulum or hypothecium.

Vainio in his original description gives no details of the anatomical structure of the thallus, and placed the species in the genus *Toninia* apparently on account of the subsquamulose thallus. It is however not a *Toninia* but a *Bacidia* (sect. *Eubacidia*), for the subsquamulose granules of the thallus are quite ecorticate and of primitive, undifferentiated, almost soredioid structure. It seems to be related to *B. trichophora* (Müll. Arg.) Zahlbr. (from Peru) and *B. vestita* (Mont.) Zahlbr. (from Brazil).

Bacidia buchanani (Stirt.) Hellb. in Bih. Kgl. Svensk. Vet.-Akad. Handl. XXI, Afd. III, no. 13 (1896) p. 98. Syn. *Stereocaulon Buchanani* Stirt. in Trans. and Proc. N. Zeal. Inst. VII (1875) p. 367. *Lecidea subglobosa* Nyl., Lich. Nov. Zeland. (1888) p. 93. *Patellaria Wilsoni* Müll. Arg. in Flora, LXXI (1888) p. 541. *Gomphillus baeomyceoides* Wils. in Journ. Linn. Soc. Lond., Botan., XXVIII (1891) p. 370. Probably also *Bacidia pedicellata* Kn. in Trans. and Proc. N. Zeal. Inst. XII (1880) p. 372 (non vidi).

MATERIAL EXAMINED: the (lecto-) type-specimen of "*Stereocaulon Buchanani*" from New Zealand, near Wellington, coll. J. Buchanan, 1874 (?), in herb. Stirton, Glasgow; the type-specimen of "*Patellaria Wilsoni*" from Australia, Victoria, Black Spur, coll. F. R. M. Wilson, comm. Knight, 1888 (this is also the type-material of "*Gomphillus baeomyceoides.*"). The following description is made from Stirton's type.

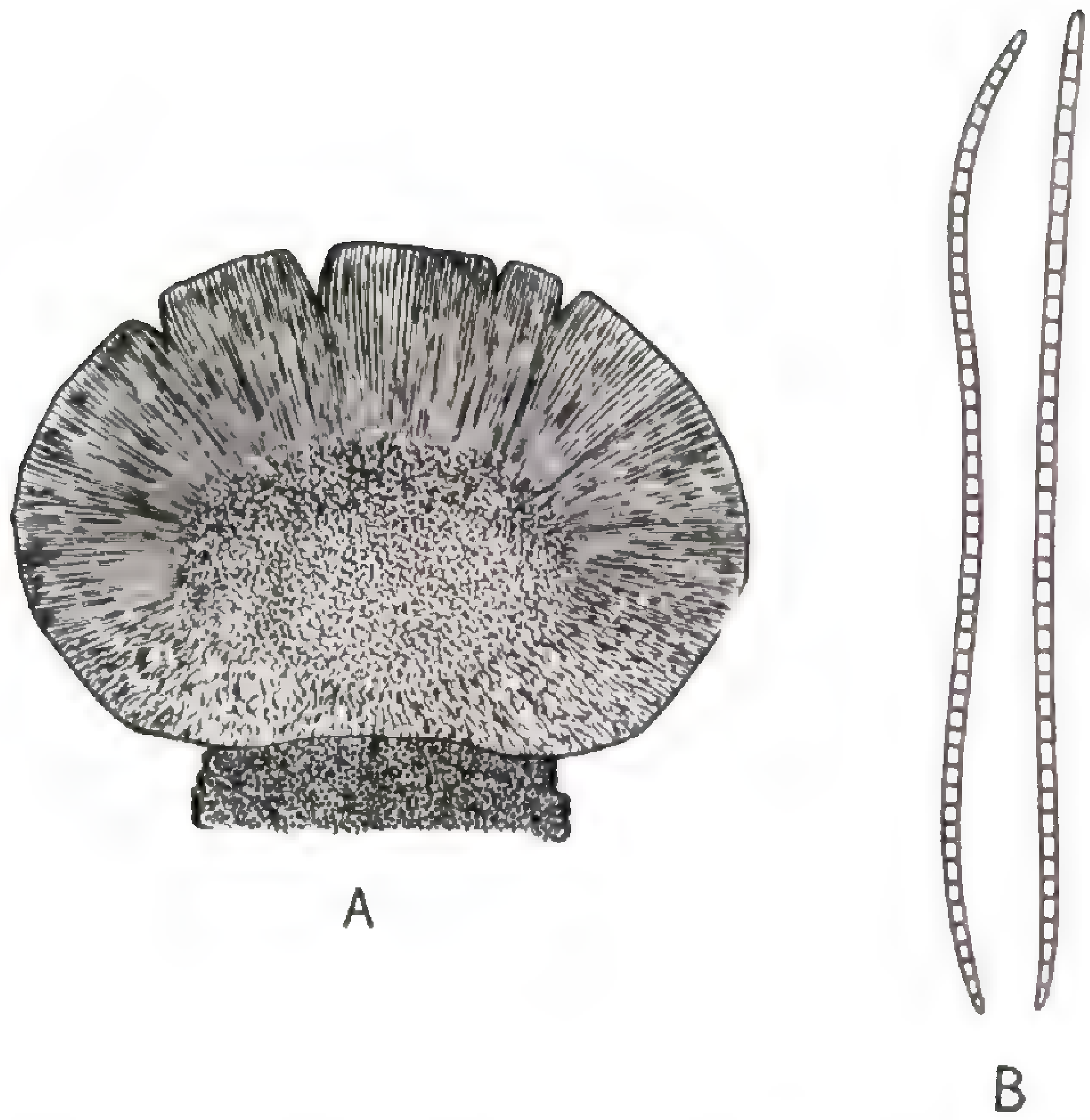

Fig. 5. *Bacidia* (*Eubacidia*) *buchanani* (Stirt.) Hellb. The lectotype-specimen. A, vertical section of apothecium and rudimentary thalline pedicel. B, spores. The clefts in the surface of the hymenium are art facts produced on sectioning.

Growing over a Jungermanniaceous hepatic on bark, and to a certain extent spreading over the bark itself. Thallus effuse, in scattered ill-defined patches, entirely furfuraceous-dissolute or ± powdery, now pale sordid ochroleucous in color ("cinerascens vel cinereo-virescens" in the fresh state, according to Stirton), matt, the hypothalline tissue (visible in a few places where the furfuraceous thallus has been worn away) whitish, of matted hyphae. Thallus KHO + dull brownish (probably a spurious coloration), $CaCl_2O_2$–, PD–. Apothecia moderately abundant, irregularly scattered over the thallus, sessile to elevated-sessile (or according to Stirton occasionally borne on very short stipes coated with granules; no such distinct stipes are now to be seen in the material), 0.7–1.0 mm. diam., convex and immarginate from the first, pale to dark brown, matt, smooth, naked; very well constricted at the base; sometimes 2–3 approximated and ± concrescent.

Thallus ecorticate, of undifferentiated sorediose structure, composed of granules 40–75 μ diam. consisting of masses of symbiotic algae surrounded by a colorless weft of indistinct, colorless, clear, gelatinous hyphae. Algae of the Micareoid type (*Coccomyxa* ?), pale yellow-green, small, 3–5 (–6.5) μ diam., round, conglomerated in clusters embedded in hyaline mucilage.

Apothecia in section entirely sordid or brown-yellowish, with the hypothecium forming a darker brownish stratum. Excipulum reflexed to underside but distinctly developed, at least 170 μ thick (merging gradually into the hypothecium), pale brown-yellowish, clear, of generally radiate structure but with the hyphae not strictly parallel; hyphae thick-walled, mucilaginously concrete, 3.5–4.5 μ thick, with lumina 1.0–1.5 μ wide. The excipulum is entire below the apothecium, but somewhat indistinctly differentiated in the central part below, and on the upper side it grades into the hymenium. Hypothecium up to 350 μ deep in center, not well delimited from the excipulum; in upper third pale- to medium-brown, in lower two-thirds pale brown-yellowish; composed of indistinct and very compacted hyphae 1.5–2.0 μ thick intricated in various directions. Hymenium very high (about 270 μ), entirely yellow-brownish in section, in places gradually darker yellow-brownish in uppermost 17–27 μ; in squashed-out preparations with only a faint brownish tinge, almost colorless. Paraphyses concrete in water, embedded in mucilage, very slender and filiform, $\pm$ sinuose, 1.0–1.2 μ thick, after treatment with KHO, HC1, and Iodine seen to be branched and sparingly anastomosing; not thickened or colored at the tips. Asci cylindrical, about 240 μ long, 9–12 μ broad, with wall about 1.5 μ thick at the sides and thickened up to 14 μ at the apex, containing 4–6 (–8 ?) vermiform spores packed closely parallel, not spirally twisted. Spores outside ascus straight or $\pm$ sinuose, colorless, 170–205 μ long, 3.0–3.5 μ thick, rounded at upper end, gradually tapered at lower end, transversely 30–75-septate. Asci persistently blue with Iodine. Sections of apothecium KHO –.

There are in herb. Stirton three specimens of "*Stereocaulon buchanani*," none being designated as the type. They are all identical, and were collected near Wellington, New Zealand, by J. Buchanan in 1866, 1874 (?) and 1882 respectively. As lectotype has been chosen the one marked by Stirton "rec'd 18 Sept. 1874," this probably being the one on which he based his description. The type-specimen of "*Patellaria Wilsoni*" Müll. Arg. in Herb. Boissier, Geneva, collected in Australia by F. R. M. Wilson, was originally written up (by Wilson ?) as "*Gomphillus baeomyceoides* ?." It is scanty and rather poor material, spread over and spoiled by too much glue, but it appears to be identical with Stirton's type-material of *B. buchanani*. The apothecia are dark brown to black, not distinctly stipitate. "*Patellaria Wilsoni*" and "*Gomphillus baeomyceoides*" were described on the same material. Stirton's original description of 1875 is followed by a short note by Knight, in which it is stated that "*Stereocaulon buchanani*" is identical with *Lecidea subglobosa* Nyl. *in litt.* (subsequently published by Nylander in 1888), and that the algae of the thallus are "gonimia," *i. e.*, Cyanophyceous; his figure (*loc. cit.*, Pl. XXV, figs. 2 and 3) represents them as nostocoid. Obviously he misinterpreted the very small Micareoid algae.

None of the specimens seen showed distinct stipes below the apothecia, but the latter are usually slightly elevated above the surface of the thallus; sections show that the rudimentary pedicel is part of the thallus, and is not a prolongation of the apothecial tissues.

In spite of the branched and somewhat connected paraphyses it seems that this species belongs to the Ascohymeniales, not the Ascoloculares, and is best placed, following Hellbom (1896) in the genus *Bacidia*, in which the paraphyses may be to a certain extent branched and connected (see Santesson, 18, pp. 437, 455). In Ascohymeniales with very high hymenium and filiform paraphyses, a tendency for the latter to branch and anastomose is often seen, *e.g.* in *Stereocaulon piluliferum* Th. Fr.

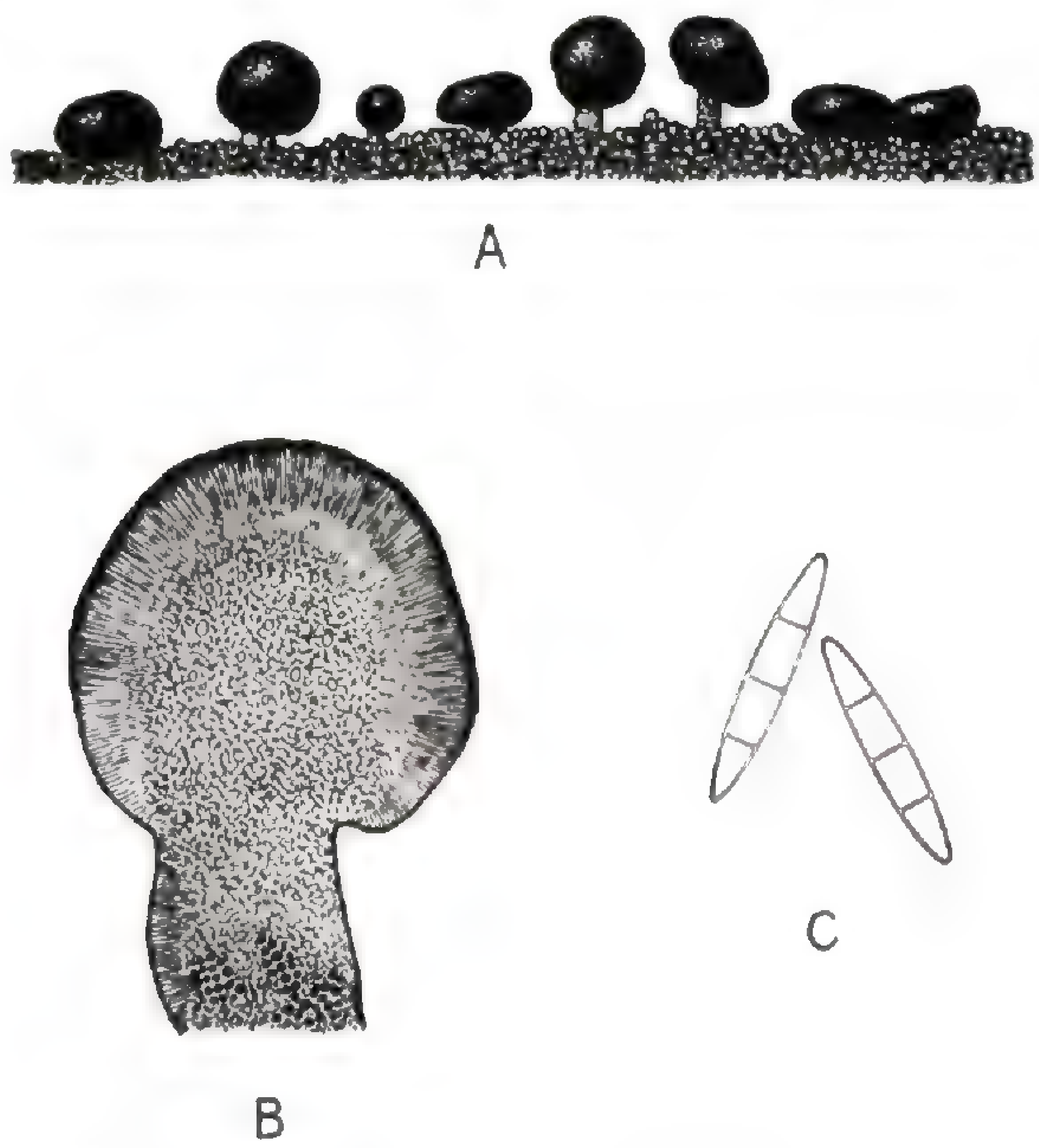

Fig. 6. *Bacidia* (*Weitenwebera*) *gomphillacea* (Nyl.) Zahlbr. The type-specimen. A, habitus of plant on rock (× 20). B, vertical section of apothecium and stipe. C, spores.

Sect. *Weitenwebera* Zahlbr.

Bacidia gomphillacea (Nyl.) Zahlbr. Cat. Lich Univ. IV (1926) p. 114. Syn. *Stereocauliscum gomphillaceum* Nyl. in Flora, XLVIII (1865) p. 211. *Bilimbia gomphillacea* Vain., Lichenogr. Fennic. II (1922) p. 251.

MATERIAL EXAMINED: the type-specimen from Finland, Hollola, Tiirismaa, coll. Norrlin, 1863, no. 40216 in herb. Nylander, Helsinki.

On quartzitic rock. Thallus crustaceous, effuse, indeterminate, patchy and discontinuous, very thin, subfurfuraceous to minutely granular, now dull yellowish-cinereous ("glaucescens" in fresh state, according to Nylander). Apothecia irregularly scattered, abundant, many of them shortly stipitate on ± cylindrical stipes ± concolorous with the thallus or darker (brownish); apothecia minute, up to 0.25 mm. diam., black, strongly convex and immarginate from the first, finally ± globose; matt, not pruinose, often several ± coalescent.

The apothecia themselves contain no algae. Excipulum reflexed, merging into the hymenium on its inner side, faintly sordid yellowish or almost colorless, composed of conglutinated, parallel-radiating hyphae with gelatinized walls, the indistinct tubular lumina about 1 μ diam. Hypothecium colorless or faintly sordid yellowish or in places with a faint aeruginose tinge, composed of compacted, indistinct, gelatinized hyphae running in various directions, in the upper part predominantly $\pm$ vertically parallel; only the tubular lumina, about 1 μ wide, distinctly visible. Interspersed among the hypothecial hyphae are a few larger, thin-walled, $\pm$ rounded cells 6–11 μ diam. (the remains of carpogonia ?). Hymenium mostly entirely faintly aeruginose, darker greenish in uppermost 5–10 μ (KHO $-$), the pigmentation in many places forming a distinct epithecium; 50–60 μ high, not well delimited from the hypothecium below. Paraphyses embedded in mucilage, $\pm$ distinct, about 1.5 μ thick, occasionally branched but no anastomoses seen (according to Vainio, *loc. cit.*, they are branched and connected towards the base), not thickened or colored at the tips; the greenish epithecial pigment is in the mucilage surrounding the tips. Asci clavate, 36–40 $\times$ 10–12 μ, with wall up to 1.5 thick at sides, at apex thickened up to 12 μ. Spores 4–6 (–8 ?) and bi- to triseriate in ascus, fusiform, equally bluntly pointed at both ends, 3-septate, colorless, 22–28 $\times$ 4–5 μ.

The stipe is anatomically similar to the hypothecium, except that the occasional larger thin-walled cells (carpogonial remains ?) are lacking. In its upper part it contains no algae, but in the lower half has numerous algal cells embedded in scattered irregular groups in its tissue. There is no indication of any central strand of parallel-running hyphae. In one part of the stipitate apothecium sectioned, the outer part of the upper stipe on one side shows an indistinct parallel arrangement of the hyphae at right angles to the axis, and looking like an old degenerated hymenium; it suggests that Vainio's view, that the stipes are composed of superimposed proliferating apothecia, may well be correct. In any case the pedicel is undoubtedly of apothecial origin, although at its base it contains symbiotic algae.

Th. Fries (6, p. 383) relates the species doubtfully to *Bilimbia milliaria:* "potius crederemus monstrosum." Hedlund (9, pp. 82, 94) places it in the genus *Micarea* on account of the characteristic small symbiotic algae, as *M. ligniaria* f. *gomphillacea* (Nyl.) Hedl. According to the present author's examination of the type-specimen, the paraphyses do not seem to be sufficiently branched and connected for paraphysoid interthecial filaments, and it seems doubtful whether the plant belongs to the ascolocular genus *Micarea*, despite the similar algae. The species has been recorded also from several localities in Sweden by Hellbom and by Magnusson.

Sect. *Thamnopsis* M. Lamb (n. sect.)

Thallus frutescens, congesto-caespitosus, stipitibus subteretibus, ramosis, ecorticatis, homoeomeris, hyphis irregulariter contextis compositis et e medulla (vel hypothallo) oriundis, apicem versus granulis gonidiiferis crebre munitis. Apothecia apicalia, lecideina aut biatorina, sporis ut in sect. *Weitenwebera* aut *Arthrosporum*. Typus sectionis: *B. stipata* M. Lamb.

Bacidia stipata M. Lamb (n. sp.)

MATERIAL EXAMINED: the type-specimen from Antarctica, Palmer Peninsula, Hope Bay, summit of hillock above Boeckella Lake, altit. circ. 115 m.s.m., on stone, coll. 29. x. 1945, *I. M. Lamb, 2550*, in Herb. Brit. Mus. (Nat. Hist.), London; South Shetlands, Deception Island, Whalers' Bay, on agglomerate cliff face, coll. 1945, *I. M. Lamb, 2311*.

Thallus minute fruticulosus, congesto-caespitosus, pulvinulos compactos, confluentes, 8–20 mm. latos et ad 7 mm. altos formans, nigrescens aut partim pallescens (sordide isabellinus), opacus, stipitibus saxo arcte adhaerentibus, congestis et intricatis, subteretibus, 0.15–0.30 (–0.40) mm. crassis, conferte ramosis, apicem versus granulis gonidiiferis congestis, pallidis aut nigrescentibus, circ. 0.1 mm. latis supersparsis. Apothecia sparsa, apicalia, pulvinulos haud vel vix superantia, lecideina, rotundata aut nonnihil lobata, 0.8–1.2 (–1.6) mm. lata, juventute interdum margine proprio indistincto pallescenti (fusco) praedita, mox immarginata, plana vel leviter convexa, omnino nigra, nuda, opaca. Excipulum prope hymenium fusconigrescens, caeterum hyalinum. Hypothecium isabellinum, 50–60 μ crassum, strato myelohyphico (cono centrali) hyalino impositum. Hymenium 60–70 μ altum, superne intense aeruginoso-nigrescens, caeterum hyalinum. Paraphyses discretae, simplices aut parce ramosae, apicibus aeruginoso-capitatae. Sporae 8nae, incolores, cylindricae aut subvermiformes, rectae aut curvatae aut leviter sigmoideae, apicibus vulgo rotundatis, septis transversis 4–7 (saepe indistinctis): 24–34 $\times$ 2.5–3.0 μ. Thallus KHO –, $CaCl_2O_2$ –, PD –, extus intusque I –; hymenium I + obscure aeruginosum; epithecium in HNO_3 solutionem violaceam effundens.

Description of the type-specimen (*Lamb 2550*):—On fine-grained metamorphic rock. Thallus fruticulose, congested-caespitose, forming pulvinate clumps 8–18 mm. diam., up to 7 mm. high, which finally become confluent to form irregularly spreading, pulvinate-crustose patches up to 7 cm. across. No hypothallus or primary thallus visible. Surface of clumps $\pm$ evenly crustose, compact, consisting of the very crowded terminal branchlets, variegated in color: in most places black or blackish, in some places pale, sordid isabelline; matt, not pruinose. Stipes firmly attached to the rock, but without root-like or expanded holdfasts; $\pm$ terete or slightly flattened, occasionally slightly longitudinally cariose, 0.15–0.30 (–0.40) mm. thick, mostly pale, copiously irregularly branched; in upper parts covered with minute, concolorous, scattered or crowded, ill-defined, simple granules about 0.1 mm. diam., not aggregated in cauliflower-like formation. In the dark parts of the thallus the uppermost branches and the granules on them are blackened. No soredia. Thallus KHO –, $CaCl_2O_2$ –, PD –; tissue of stipes I –. Apothecia not common, irregularly disposed, apical on thicker stipes, not or hardly elevated above the surface of the cushions, lecideine, round or slightly irregularly lobed, when mature plane to slightly convex, 0.8–1.2 (–1.6) mm. diam., immarginate, entirely black, matt, not pruinose; in young stages a faintly indicated paler (brownish), thin, entire, non-prominent proper margin may be present. (No pycnidia found.)

Stipes consisting of a homogeneous fungal tissue of compacted, conglutinated, somewhat thick-walled hyphae 3–4 μ diam. interwoven in various directions, only their tubular lumina distinctly visible, 1.0–1.5 μ wide. Tissue colorless and hyaline in thin section, faintly yellowish in thick sections, not nubilated. No cortex developed, but in places on the outer side the hyphae are thicker-walled and with larger lumina, mainly longitudinally parallel: 3–4 μ thick, lumina 2.0–2.5 μ wide. An outermost colorless amorphous necrotic stratum 6–10 μ thick is present in some places. Irregularly scattered here and there in the stipe tissue, mainly in the upper parts, are sporadic small groups of symbiotic algae; cystococcoid, bright green, ± round, thin-walled, 8–13 μ diam. The ill-defined assimilative granules on the upper parts of the stipes consist of a core of algae invested by a ± hyaline hyphal envelope 6–10 μ thick consisting of indistinct, often tangentially compressed, rather thin-walled cells 3–4 μ diam.

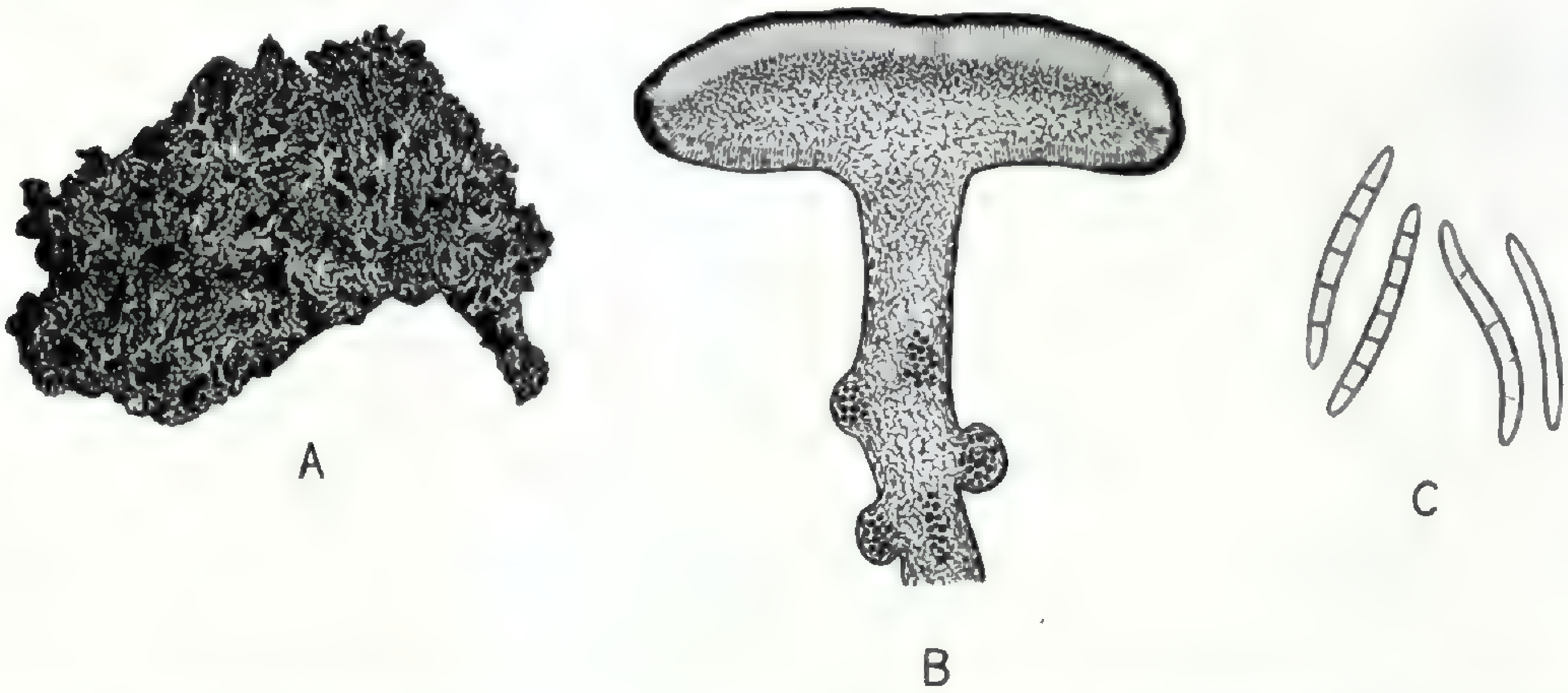

Fig. 7. *Bacidia* (*Thamnopsis*) *stipata* M. Lamb. The type-specimen. A, part of fertile thallus on rock (× 2). B, vertical section of apothecium and pseudopodetium. C, spores.

The apothecia contain no algae. Excipulum well developed at sides and below, 60–70 μ thick, the upper part next to the hymenium brown-blackish in outermost 12–15 μ, otherwise entirely colorless and hyaline; composed of flabellate-radiating, conglutinated, gelatinized, thick-walled hyphae of which only the tubular lumina, about 1.5 μ wide, are visible. Inner medullary tissue (central cone tissue) well developed and obviously a continuation of the stipe-tissue, up to 180 μ deep. Hypothecium 50–60 μ deep, isabelline in section, ± cloudy but without visible granules, composed of compactly intertexted hyphae 2.5–3.5 μ thick running in various directions, in places ± cellular. Hymenium 60–70 μ high, intensely blue-green-blackish in upper 15–32 μ, otherwise colorless and hyaline. Paraphyses discrete in water, simple or sparingly branched, not anastomosing, about 2 μ thick, at tips clavate-capitate to 3.5 (–4.0) μ and there ± dark aeruginose. Asci clavate, 40–50 × 9–12 μ, with wall about 1.5 μ thick at sides, at apex thickened to 8 or 9 μ. Spores 8 in ascus, lying straight or sometimes slightly spirally twisted; cylindric-vermiform, straight or curved or slightly sigmoid, ± equally rounded or bluntly pointed at both ends, transversely 4–7-septate (the septa often indistinct or apparently lacking), 24–34 × 2.5–3.0 μ. Hymenium blue then blue-blackish with Iodine; upper part of hypothecium I + blue. With HNO_3, the epithecial pigment is dissolved to form a violet-blue solution.

The material from the South Shetlands is very similar to the type-specimen described above: only the hymenium is somewhat lower (50 – 55 μ). All the specimens seen in the field grew usually in crevices or cracks of the rock, forming in the living state masses of small dark greenish cushions covering a fairly extensive area.

Bacidia fibrosa M. Lamb (n. nom.) Syn. *Stereocaulon laseroni* Dodge in B. A. N. Z. Antarct. Research Exped. 1929–1931, Reports, ser. B, VII (1948) p. 141; non *Bacidia laseroni* Dodge, op. cit., p. 108.

MATERIAL EXAMINED: the type-specimen from Antarctica, George V (Adélie) Land, Madigan Nunatak, 143° 20′ E. long., 67° 07′ S. lat., 1912, coll. *C. F. Laseron, 25–3,* in Herb. Missouri Bot. Gard.

Growing on or among particles of granitic rock. Forming tiny compact tufts up to 6 mm. diam., 1–4 mm. thick, consisting of a minutely fibrose-dissolute, spongy-felted, sordid cream-colored or whitish-ochraceous mass rising up off the substratum, to which it was originally apparently ± firmly attached. The mass is of purely hyphal composition, at any rate in the lower parts, which contain no algae, and seem to be of hypothalline origin. No distinct stipes are developed, and under low power magnification the felted fibrillose mass looks somewhat like frayed sisal fibers (but more spongy-anastomosing). Towards their apices the minute clumps are thickly covered with very small, somewhat irregular granules, which are concolorous with the fibrose basal mass or in places darkening to blackish, less than 0.1 mm. diam., crowded together and forming a ± compact surface. No cephalodia. Apothecia scarce, superficial on the clumps among the assimilative granules, minute, up to 0.5 mm. diam., pulvinate-convex and immarginate from the first, blackish, matt or subnitid, not pruinose. On account of its scantiness, the thallus was tested only with PD; the result was negative.

The fibrose strands are of undifferentiated structure, consisting of colorless, thin-walled hyphae 1.3–3.0 μ thick loosely or in places ± compactly interwoven in various directions to form a spongy-arachnoid tissue. Near the surface of the tufts the fibrose strands contain embedded, ± rounded clumps of symbiotic algae, either buried in the tissue or emergent on the surface. Algae very pale green, cystococcoid, globose, 5.0–8.5 μ diam., thin-walled. No cortex developed in any place.

Apothecia in section lecideine, without algae. Excipulum reflexed, consisting of radiating, parallel-conglutinated, gelatinized, thick-walled hyphae 4–7 μ thick with indistinct outlines, but with the fistulose lumina (1.0–1.5 μ wide) ± distinct; between the hyphae black or purple-blackish pigment in irregular streaks, becoming dense on the outer side of the excipulum. Hypothecium 65–85 μ deep, colorless (or faintly yellowish in thick sections), clear, composed of compacted hyphae divided into short ellipsoid cells 3–4 μ diam., their walls 1.0–1.2 μ thick, gelatinously confluent, the cells becoming more compressed and elongated towards the sides where they merge into the excipulum.

Upper subhymenial 10–24 μ of hypothecium in places very faintly brownish (at least in thicker sections). No distinct myelohyphic stratum or central cone developed. Hymenium 55–60 μ high, in its uppermost 10–14 μ densely black or aeruginose-blackish (not dark brown as stated by Dodge), the pigment also penetrating in irregular streaks downwards into the rest of the hymenium. Paraphyses discrete in water, simple or often branched, rather stout (2–3 μ), septate and often slightly articulated, at the tips clavate-capitate, often in $\pm$ moniliform fashion, up to 3–4 (–5) μ, and there dark aeruginose (KHO −). Asci 35–45 μ long, 7–12 μ broad, clavate, with somewhat gelatinous wall 1–2 μ thick at sides and at the apex spuriously thickened up to 5 μ. Spores 6–8 in ascus, packed vertically at different levels; colorless, straight, cylindric-fusiform; seen only immature inside the ascus, transversely 3–5-septate, 17–25 $\times$ 2.5–3.0 μ (according to Dodge, about 7-septate, 16–18 $\times$ 2 μ).

It is not impossible that this species may represent an extremely weathered and depauperated condition of the foregoing, but this could be satisfactorily demonstrated only by further study in its natural habitat. It seems to differ from *B. stipata* in the absence of distinct separate stipes, these being replaced by spongy-fibrose strands; also in the smaller apothecia without distinctly differentiated central cone tissue, and possibly in the shorter spores.

The *Bacidia laseroni* described by Dodge, *op. cit.*, p. 108 is epiphytic or parasitic on the weathered thallus of this species, and appears to be distinct, as it is described as having its own glebose, dark green to blackish thallus.

[*To be continued*]

BETULA LENTA VAR. UBER ASHE

Albert G. Johnson

The exact status of a peculiar small birch collected by the late W. W. Ashe in Wythe County, Virginia, in 1914 has been something of a botanical enigma. A low tree, originally designated as *Betula lenta* var. *uber* Ashe (1918), it was raised to specific rank by Fernald (1945).

Ashe in describing his find said little about the plant beyond the fact that it looked like a small-leaved form of *B. lenta* L. and that it was found on the "bank of Dickey Creek, south of Rye Valley Station, Wythe County, Virginia, January (*sic*) 1914, 2800′." The specimen being in leaf and young fruit indicates that the date should have read June rather than January, an error probably having arisen from transcribing his original notes on the collection.

Fernald, in treating this birch as a species, relates it with reservation to the *Humiles* series of *Betula,* stating that "it is difficult to feel that the low tree described by Ashe as a small-leaved variety of *Betula lenta* has much, except aromatic bark, to do with that species." He based his placement in the series primarily upon the small number of veins in the leaves and their semipalmate disposition. In raising this birch to specific rank, he emphasized the need for learning more about its nature and distribution.

No collections of this birch appear to exist other than Ashe's type, which is deposited in the U. S. National Herbarium, and the isotypes in the Gray Herbarium and the herbaria of the Arnold Arboretum and the New York Botanical Garden.

The natural distribution and ecological requirements of the *Humiles* birches make it quite unlikely that any would be expected to occur in the highly dissected, mature terrain of southwestern Virginia. Correspondence with District Ranger F. M. Wolcott of the Jefferson National Forest at Wytheville failed to disclose any current local knowledge of the existence of such a tree, although Mr. Wolcott reported having searched the type area when in the vicinity.

Similarly Prof. H. H. Bartlett writes that Mr. Walter Kleinschmidt of the University of Michigan Botanical Gardens searched the type area in the summer of 1952 and could find nothing resembling the erstwhile *B. lenta* var. *uber.*

On January 11, 1953, the writer had the opportunity to examine the type area.[1] Although winter, no difficulty was anticipated in identifying such a unique birch as *B. lenta* var. *uber* appeared to be, certainly not if it existed as a population of biological significance in the area.

Dickey Creek passes through the small community of Sugar Grove, which is typical of the rural towns of that area, not far from Marion, Virginia. Rye Valley Station is a point in Sugar Grove where a railroad formerly servicing the community maintained a depot. The banks of the creek in the town area are

[1] Travel and research supported by the Maria Moors Cabot Foundation for Botanical Research, Harvard University.

largely clear with but a fringe of brush and scattered trees. Following the course of the stream is state highway 10 which upon leaving Sugar Grove ascends into the adjoining Jefferson National Forest.

A careful search of the banks for a distance of four miles, starting in Sugar Grove and continuing past Rye Valley Station into the Jefferson National Forest, turned up no birches other than *B. lenta* and *B. lutea* Michx. f., the common ones of the region. *Alnus serrulata* (Ait.) Wild. was also noted as abundant in many spots along the creek. All *B. lenta* trees seen, both large and small, could be readily identified as characteristic even in their winter condition by the presence of persistent fruit of normal size, an occasional withered leaf, or normal habit and proportions.

In being a low tree, 20–25 feet high, *B. lenta* var. *uber* resembles somewhat the hybrid *B.* × *jackii* Schneid. (*B. pumila* × *lenta*) which can best be described as a very large shrub or bushy tree. The characters of the fruit of the two plants are also grossly similar, particularly in size and the abundance with which it is borne. The leaves, however, differ substantially, those of the hybrid being ovate or elliptic-ovate while those of *B. lenta* var. *uber* are nearly orbicular and subcordate. Furthermore, the absence of *B. pumila* in the Southern Appalachians precludes the possibility of *B. lenta* var. *uber* being a hybrid of this constitution.

The only conclusion that seems warranted at this time from these several failures to rediscover this birch is that it probably no longer exists as an individual and very likely never did so in the form of a population. Ashe's birch has probably died or been destroyed in the process of urbanization of the community in which he found it 40 years ago. It is probable that this birch variety was founded solely on an aberrant individual and certainly does not appear to deserve further consideration as a species.

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Calliandra biflora, a New Species of Leguminosae (Mimosoideae) from Southern Texas.—**Calliandra biflora** B. C. Tharp, sp. nov. Caules 4–6 dm. alti subherbacei e rhizomatibus gracilibus lignosis 4–6 mm. crassis. Foliorum rachides 1–4 cm. longi; pinnae 2–6; pinnulae ca. 16 oblongo-lanceolatae sessiles basin versus obliquae brevi-acuminatae 5–9 mm. longae, 1–1.8 mm. latae; stipulae subulatae. Pedunculi solitarii in axillis foliorum mediorum reductorum, 8–10 mm. longi, biflori. Calyx ca. 2 mm. longa lobis triangularibus 0.5 mm. longis; petalae oblanceolatae, ca. 5 mm. longae, in staminum tuba basin versus fixae. Stamina 20, staminum tuba 2 mm. longa, filamenta libera 18–20 mm. longa. Legumina plerumque solitaria, 8 cm. longa vel minus, 8–10 mm. lata, plana, cum margine crasso, basin versus longe acuminata, apicem versus breviter acuminata. Semina compressa cum ala angusta marginali.

Stems from slender woody rhizomes 4–6 mm. thick, essentially herbaceous, sparingly branched, 4–6 dm. tall; leaf rachises 1–4 cm. long; pinnae 2–6; pinnules about 8 pairs, asymmetric, oblong-lanceolate, sessile, oblique at base, short acuminate, 5–9 mm. long, 1–1.8 mm. wide; stipules subulate; peduncles single in axils of reduced leaves about midstem, 8–10 mm. long, each 2-flowered; calyx about 2 mm. long, lobes triangular, 0.5 mm. long; petals oblanceolate, about 5 mm. long, attached to the stamen tube at base; stamens 20, stamen tube 2 mm. long, free portion of filaments 18–20 mm. long; legumes usually 1 to a peduncle, 8 cm. long or less, 8–10 mm. wide, flat, thick margined, at base long-acuminate, at apex short-acuminate; seeds flattened with very narrow marginal wing.

TYPE. Texas. DeWitt Co.: In sand along fence-rows, southwestern part of county, July 5, 1942, *Marguerite Riedel and B. C. Tharp 44419* (University of Texas Herbarium, isotypes to be distributed). Additional specimens seen: DeWitt Co.: Western part of county, July 2, 1942, *M. Riedel s.n.* (TU); Goliad Co.: Blackish soil, northeastern Goliad Co., adjoining Ander Cemetery, May 12, 1946, *C. C. Albers s.n.* (TU).

The species falls into the section *Pubiflorae* as outlined by Britton and Rose (1928) in the North American Flora. It is clearly distinct from the other species of the section, especially by its 2-flowered peduncles, large thickened legumes, and slender rhizomes.

The author is indebted to Professor Lloyd H. Shinners for the Latin diagnosis.—B. C. Tharp, university of texas.

Volume 56, no. 665, containing pages 81–104, was issued 24 June, 1954.

Rhodora

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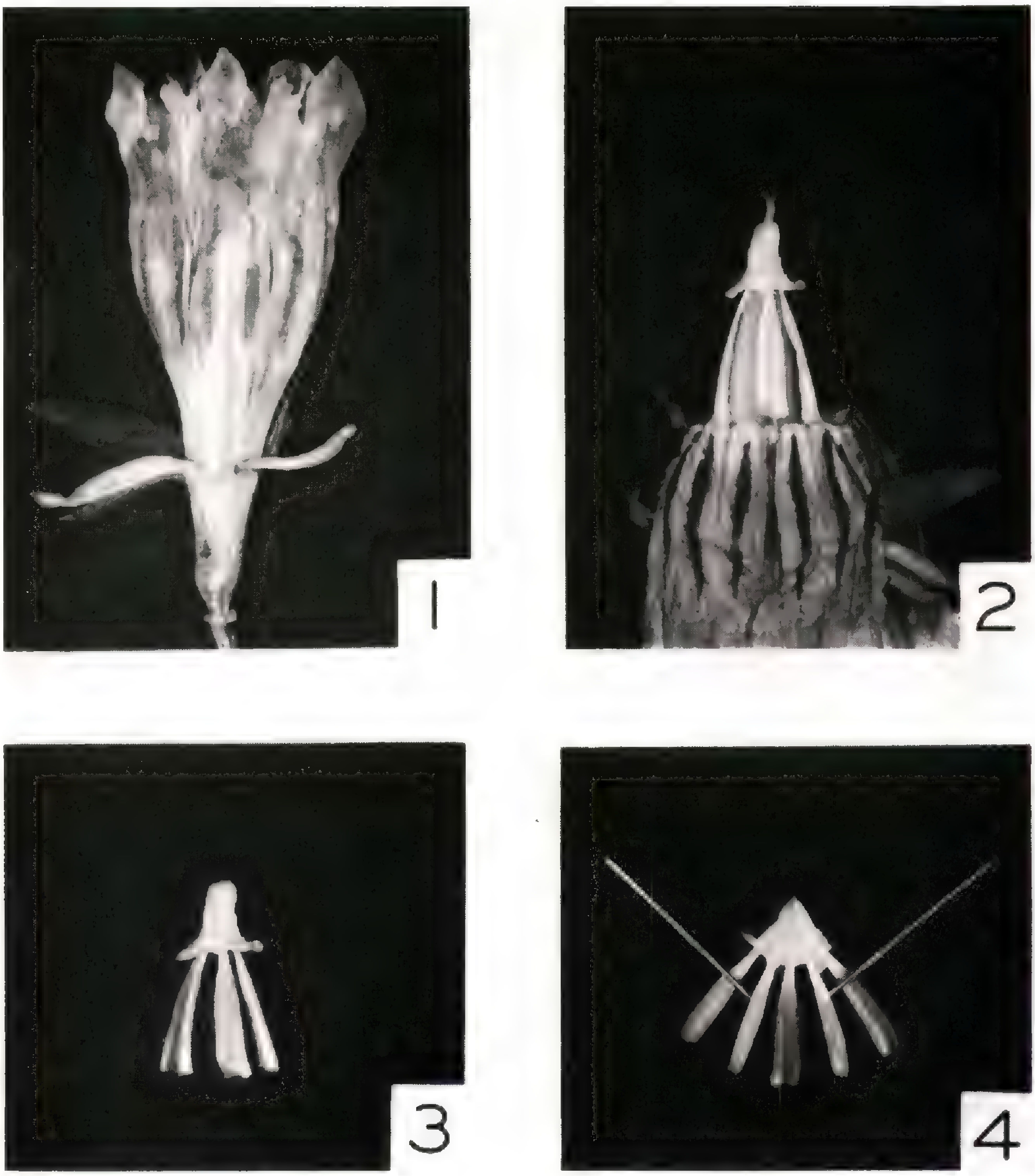

GENTIANA CATESBAEI: FIG. 1. Flower, slightly compressed. FIG. 2. Flower with corolla turned down to point of attachment of filaments. FIG. 3. Stamens, separated from corolla at point of attachment to corolla, the united anthers holding filaments in original position. FIG. 4. Stamens, the cone formed by united anthers being split down one side and opened to show the inner surface of the cone, i. e., the side nearest the pistil.

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CONNATE ANTHERS IN GENTIANA (GENTIANACEAE)

Wilbur H. Duncan and Claud L. Brown

Few families of angiosperms have taxa with united anthers. East of the Mississippi River, an amateur or beginning student soon learns that united anthers are characteristic of the *Compositae* (Ambrosiaceae, Carduaceae, Cichoriaceae) and certain *Campanulaceae*, especially *Lobelia*. Such a student is much less likely to learn that certain taxa in the *Solanaceae* and *Gentianaceae* may also possess united anthers. A review of the treatment of this characteristic in the *Gentianaceae* by various authors is pertinent here.

Fernald (1950) does not mention this characteristic in his synopsis of the *Gentianaceae* or of the genus *Gentiana* which has several species with united anthers. Fernald's key to the species of *Gentiana* does indicate that 12 species have or may have "anthers cohering in a ring or short tube," and that in one species "anthers not connected." For ten species, however, there are no data in regard to united anthers. Descriptions of the species add no further light except for *G. puberula* Michx. where it is stated "anthers separate or promptly separating." None of the illustrations shows anthers.

The "New Britton and Brown Illustrated Flora," Vol. 3, (H. A. Gleason, 1952) is not clear in regard to existence of united anthers in some taxa of *Gentiana*. In the synopsis of the family we find "anthers free or connate." In the synopsis of *Gentiana* we find "anthers separate, connivent, or connate." In the key to the species, as with Fernald (1950), there is nothing concerning union of anthers for a number of species (six), two species being given as having "anthers separate and distinct," and 10 species as having "anthers connivent or coherent in ring." Descriptions of the species add nothing. In the illustrations of the 10 species (indicated by the key as having anthers connivent or coherent in a ring) stamens are not shown in two species. Stamens are shown for eight species but are illustrated as being separate.

Small (1933) gives no data on the subject in the synopsis of the *Gentianaceae*, *Gentianella* (*Gentiana*), or *Dasystephana* (*Gentiana*), but in the key to the species of the latter genus are the following: one species, "anthers separate"; seven species, "anthers cohering in a tube or ring"; and two species, no data. The illustration for each of the two genera, in so far as we are able to determine, is in each case that of a species not having united anthers. Other species are not illustrated.

In the three major manuals covering the eastern United States, therefore, there is no way to determine for a number of taxa in *Gentiana*, whether or not anthers are united. Furthermore, united anthers, which are a useful diagnostic character for several species, are nowhere illustrated.

In Deam's (1940) "Flora of Indiana" and Jones' (1945) "Flora of Illinois" there is no synopsis for the *Gentianaceae* or *Gentiana*, and there are no illustrations. In the keys, reference to union of stamens is made in case of only two and three species, respectively. These two state floras, too, lack data on union of stamens for most taxa in *Gentiana*. The same is true for western floras. From data contained in Rydberg's (1906) "Flora of Colorado," Jepson's (1939) "A Flora of California," Kearney's (1951) "Arizona Flora," and Abrams' (1951) "Illustrated Flora of the Pacific States" I am unable to determine whether any taxa have united anthers although from the illustrations in Jepson's flora it may be concluded that they were separate for all twelve species listed. The same is true for the two species that have illustrations of stamens in Abrams' flora.

A recent and most excellent book, "Taxonomy of Vascular Plants" (Lawrence, 1951), also omits reference to union of anthers in *Gentiana*. This is especially misleading since Lawrence states "stamens—epipetalous, distinct (syngenesious in

Voyria and *Leiphaimos* spp.)." The genus *Gentiana* obviously should have been included with the other two.

Britton & Brown (1897 and 1913) give for four *Gentiana* (incl. *Dasystephana*) species illustrations that show united anthers. The text of each edition includes information concerning this character for a number of species. Information concerning this character is lacking, however, for other species. Torrey (1843) has excellent illustrations of connate anthers for two species. The trend seems to have been from considerable emphasis on connate anthers in early American botanical works to very little reliance on the character in recent publications.

It would be helpful to indicate here for the eastern North American taxa of *Gentiana*, in particular, whether or not the anthers are united, and, if so, to what extent. Such is not easily possible, for the proper application of names seems impossible for us at this time. Fernald (1950) and Gleason (1952) list different taxa for the genus, and herbarium material at our disposal is not adequate for such a study.

Material of several taxa was examined, however, and in view of the lack of illustrations of connate anthers in recent, major floras or taxonomy texts, photographs were made for purposes of publication. The photographs shown (figs. 1–4) are of *Gentiana catesbaei* Walt. [*Dasystephana latifolia* (Chapm.) Small]. The prominence of the characteristic, union of anthers, is readily evident. It may be noted that the anthers dehisce outwardly, that is, away from the pistil.

From the present study it is evident that adequate morphological data are unavailable for *Gentiana*, and that in the treatments of *Gentiana* in recent floras the union of anthers is treated as a characteristic of minor repute. It seems, however, that in a detailed study of the genus, and perhaps the entire family, special attention to union of anthers might furnish important clues as to relationships of taxa of various levels. In other words, even though the character might not be useful for keys there is some evidence that it may be an important phylogenetic one. Detailed study may even amend for certain species of *Gentiana*, statements such as "anthers connate later separate" to "anthers connate in longstyled forms, separate in shortstyled (or the reverse)" for Gilg (1895) in Engler and Prantl points out that the anthers are fastened one to another in longstyled flowers of *Hockinia* (Gentianaceae).

The authors wish to thank Mr. Haskell Venard, Atlanta, Georgia for helpful suggestions. Financial support was provided through Dr. George H. Boyd, Dean of the Graduate School, University of Georgia.

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STUDIES IN FRUTESCENT LECIDEACEAE (LICHENIZED DISCOMYCETES)

I. MACKENZIE LAMB

[*Continued from p. 129*]

TONINIA Mass. emend. Th. Fr.

Toninia conglomerata (Ach.) Boist. Nouv. Flore Lich., Part 2 (1902) p. 105. Syn. *Lecidea conglomerata* Ach., Lichenogr. Univ. (1810) p. 201. *Thalloidima conglomeratum* Mass., Ricerch. Auton. Lich. Crost. (1852) p. 97. *Thalloedaema conglomeratum* Vain., Lichenogr. Fennic. II (1922) p. 145.

MATERIAL EXAMINED: Austria, Styria, Judenburg, "in saxis alpium," coll. *Welwitsch*, no date, *254*, in Farlow Herb., *s.n. Thalloidima conglomeratum*.

The outward morphology of this not uncommon alpine species has been well and accurately described by Vainio, *loc. cit.* He mentions its caulescent habitus, its peculiar light-edged squamules, and its predominantly simple spores. Therefore only its anatomical characteristics will be considered in detail here, based on an examination of the Austrian specimen mentioned above.

The stipitate squamules are bicolorous, with gray edges and brownish centers. Squamules in section covered on upper side by a colorless, clear, amorphous or faintly horizontally striated, necrotic stratum 10–50 μ deep. Cortex at sides of squamule 30–70 μ thick, gradually $\pm$ dark brown in outer 15–18 μ and also $\pm$ heavily inspersed with sordid yellow-brownish depsidone-granules, which make the structure very indistinct; after treatment with KHO the cortex seems to be composed of intricated, conglutinated, gelatinous hyphae, forming on the outer surface distinct brown-pigmented cells like the heads of paraphyses. Cortex directly subtended by the algal stratum. In the center of the squamule the brown-pigmented outer layer is absent, and the cortex is greatly thickened to form a lentiform or bowl-shaped structure about 170 μ deep, which pushes the algal stratum downwards; in its upper half this structure is heavily inspersed with masses of brownish-yellow depsidone-substance, in its lower half it is colorless and hyaline, very gelatinized, with the thread-like, branched and reticulating hyphal lumina (about 1 μ wide) well visible in the clear gelatinous matrix. Medulla PD + orange-red or testaceous-red (also in other specimens examined, *e.g.* Rabenhorst, Lich. Europ. no. 738), the margins of the squamules also often staining. In KHO added to sections of the thallus under the microscope, the brownish-yellow depsidone-granules dissolve with effusion of yellow mist.

The radicate stipes are solid, devoid of algae, ecorticate or in places with a rudimentary and indistinct cortical layer up to 30 μ thick nubilated in its outer part with depsidone-granules. Internal medullary tissue $\pm$ colorless

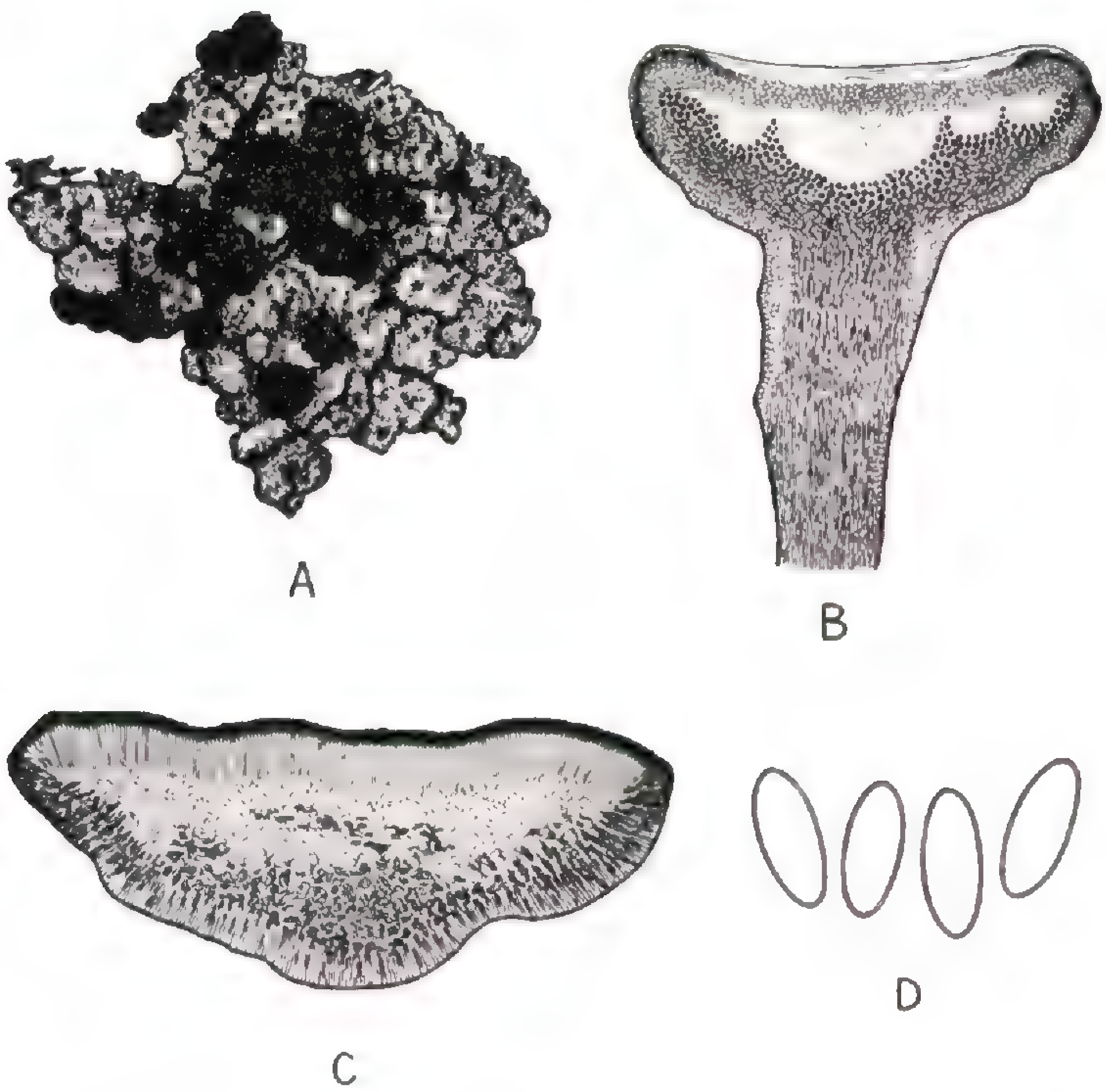

Fig. 8. *Toninia conglomerata* (Ach.) Boist. Specimen from Austria, Judenburg, coll. Welwitsch. A, part of thallus with apothecia (× 2). B, vertical section of a stipate squamule. C, vertical section of apothecium. D, spores.

and clear, composed of indistinct gelatinized hyphae 2–3 μ thick closely compacted and running mainly longitudinally parallel.

The symbiotic algae of the thallus are cystococcoid, bright green, globose, separate, thin-walled, 5.0–8.5 μ diam.

Excipulum entire at sides and below apothecium, 85–135 μ thick, sordid pale yellowish or ± colorless or isabelline in section, with irregular streaks of sordid yellow-brownish depsidone-substance between the hyphae; of flabellate-radiating structure, with parallel, conglutinated, gelatinized, thick-walled hyphae, only the fistulose lumina visible, 1.0–1.3 μ wide. Central cone tissue (myelohyphic stratum) developed in lower part of apothecium, about 200 μ deep, lax, inspersed with cloudy masses of yellowish-gray granular substance, the hyphae colorless, 3–5 μ thick, loosely intricated in various directions. Hypothecium up to 200 μ deep, colorless, hyaline or in places inspersed with irregular inclusions of sordid yellowish depsidone-substance, in the upper subhymenial part slightly sordid yellowish-cloudy; of compact gelatinized texture, with completely fused hyphae running in various directions, only the branching fistulose lumina visible, 1.0–1.3 μ wide. Hymenium 50–60 μ high, gradually or ± abruptly olivaceous brown-blackish in uppermost 8–12 μ (HNO_3 + purple-crimson), otherwise colorless and hyaline. Paraphyses discrete under pressure in water, 1.3–2.0 μ thick, not articulated, simple or sparingly branched, clavate-capitate up to 3–4 (–5) μ at the pigmented tips. Asci clavate, 40–48 × 12–14 μ, with wall about 1 μ thick at sides, at apex gelatinously thickened up to 7 μ. Spores 8 in ascus irregularly biseriate; all simple and unseptated, ellipsoid to elongate-ellipsoid, 9–13 × (3.5–) 4–5 μ. Hymenium persistently blue with Iodine. KHO added to sections of apothecium dissolves the depsidone-inclusions of excipulum and hypothecium with effusion of intense yellow mist.

This species stands on the borderline between *Toninia* and *Lecidea* sect. *Psora*, the spores being in many specimens, like the above, all eseptate. Zahlbruckner, Cat. Lich. Univ. IV (1926) p. 286, lists *Lecidea acervulata* Nyl. as a synonym, but according to Vainio's revision of the type, the latter is identical with *Toninia aromatica* (Turn.) Mass. (25, p. 133). The light-edged squamules of *T. conglomerata* resemble those of another European species, *T. nigrescens* Anzi, which is however quite distinct, having cylindric-fusiform, 3-septate spores $22 - 26 \times 3.0 - 3.5\ \mu$ (*e. g.* in Anzi, Lich. Rar. Langob. no. 116), and a negative reaction with Paraphenylenediamine.

Toninia bumamma (Nyl.) Zahlbr. Cat. Lich. Univ. IV (1926) p. 263. Syn. *Lecidea bumamma* Nyl. in Journ. Linn. Soc. Lond., Botan. XV (1876) p. 177. *Lecidea styloumena* Stirt. in Trans. Glasgow Soc. Field Natural. V (1877) p. 217.

MATERIAL EXAMINED: the type-specimen of "*Lecidea styloumena*" Stirt. from South Africa, Somerset East, Klein Vischrivier, "in rimis rupium brecciatarum ad ripas aridas," coll. P. McOwan, in herb. Stirton, Glasgow Museum.

On soil. Thallus of crowded, turgid squamules 1–3 mm. diam., produced downwards on the under side into stalk-like, ± cylindrical, rooting structures ± buried in the soil and up to 8 mm. long. Squamules up to 1 mm. thick, convex, glebose, round or ± irregular in outline, not angulose, smooth, naked, now alutaceous or sordid brownish-yellow ("albidus vel pallidus vel pallide cervinus" in fresh condition, acc. to Stirton), matt. Under side concolorous or paler, ecorticate, usually not well visible on account of adherent soil particles. Radicate stipes arising from center or near edge of underside of squamules, whitish to brownish, ecorticate, somewhat fibrous, 0.3–0.8 mm. thick, conspurcated by adherent soil. Thallus externally KHO— or brownish (Nylander reports KHO + yellow in his material), $CaCl_2O_2$ —, PD —. Medulla white, KHO — or faintly yellowish, $CaCl_2O_2$ — , PD — . Apothecia superficial on squamules, one or several to a squamule, separate or 2–3 confluent, adpressed-sessile, not or hardly constricted at the base, convex and immarginate from the first, up to 0.8 (–1.0) mm. diam., black, matt or subnitid, not pruinose. Pycnidia rather abundant, indicated externally by minute, scattered, non-prominent, black spots on upper side of squamules.

Squamules corticate on upper side only. Cortex 60–70 μ thick, in outer half densely yellow-brownish-nubilated and opaque in section, in inner half clear and colorless, pseudoparenchymatous, of ± isodiametric or oblong, obtusely angulose or rounded cells 3–6 μ diam., their walls about 1 μ thick, in KHO seen to be formed from vertical hyphae. Algal stratum ± continuous, 45–65 μ deep. Algae cystococcoid, now pale yellowish green, round, thin-walled, 6–11 μ diam. Medulla loosely hyphose, clear and colorless or in places slightly yellowish-gray-cloudy, I — , of loosely intricated, thin-

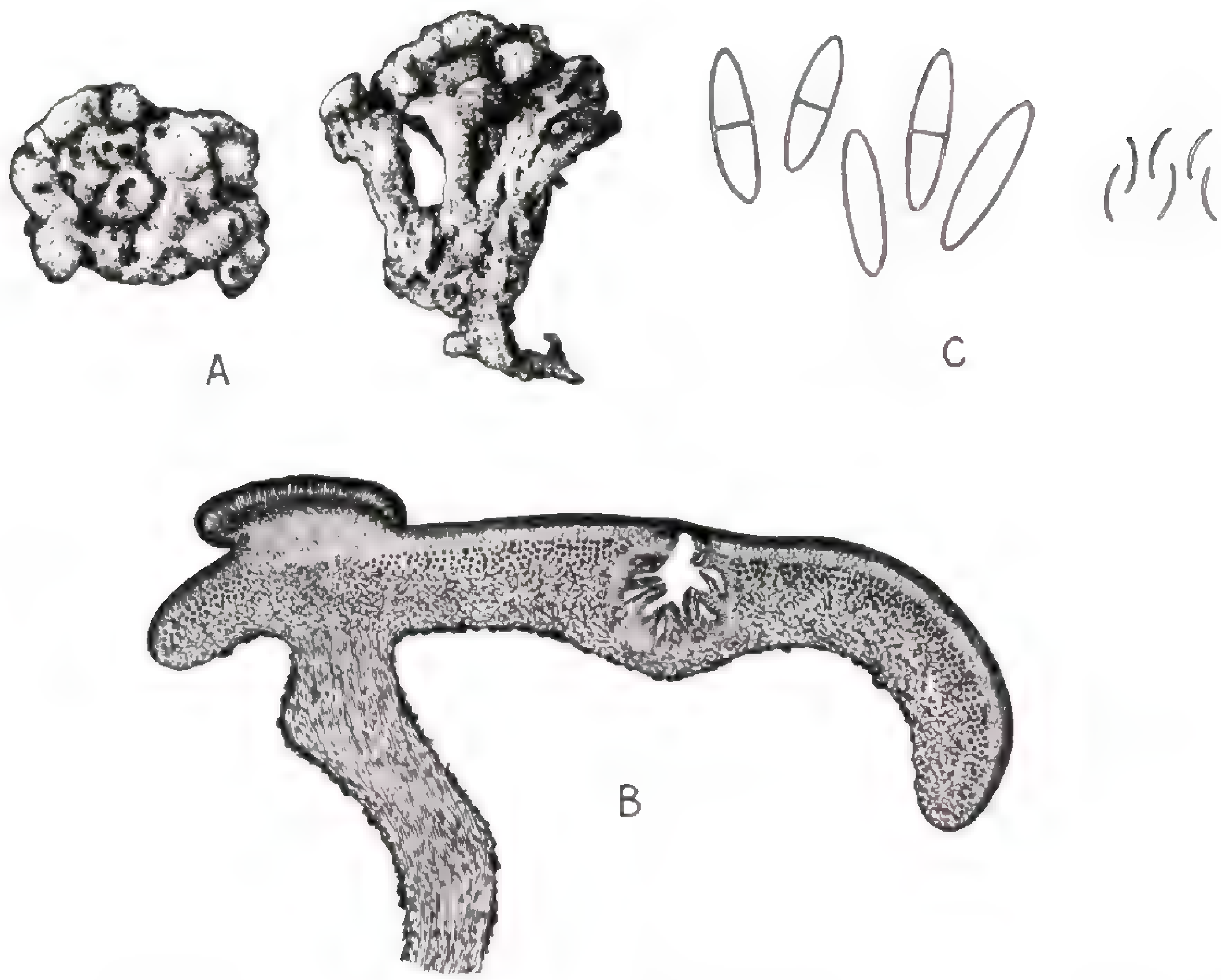

Fig. 9. *Toninia bumamma* (Nyl.) Zahlbr. The type-specimen of "*Lecidea styloumena*" Stirt. A, part of thallus seen from above and from the side (× 2). B, vertical section of a stipate squamule bearing an apothecium and a pycnidium. C, spores and pycnoconidia.

walled hyphae 3.0–4.5 μ thick running in various directions. Lower side of squamules formed by the somewhat more compacted medullary hyphae, with adherent substratum-particles. Small colonies of Nostocoid blue-green algae occur occasionally on the underside of the squamules; in some cases they are superficial, but sometimes ± enclosed by medullary hyphae. Stipes devoid of algae, ecorticate, sordid yellowish or pale brownish in section, formed of compacted, mainly longitudinally running medullary hyphae, more loosened and spreading on the outer side. The nubilation of the outer cortex of the squamules dissolves in KHO with yellow mist.

The apothecia rest with a broad base on compact thallus tissue (apparently lower part of cortex), and the algal layer is interrupted beneath them. In places where an apothecium is about to be formed, the cell walls of the cortex take on a blue-green tinge. Excipulum rudimentary, indistinct, dark blue-green or aeruginose-fuliginous, formed by the sterilized margin of the hymenium, into which it is gradually transformed. Hypothecium 60–90 μ deep, unevenly pale sordid brownish or purple-brownish in section (KHO + violet-reddish), ± pseudoparenchymatous, with ± isodiametric cells about 3 μ diam., their walls gelatinously fused and somewhat indistinct. Hymenium 65–75 μ high, irregularly dark aeruginose or blue-green-blackish in uppermost 9–18 μ (KHO −, HNO_3 + sordid violet-red), otherwise ± colorless or partly sordid isabelline; grading without sharp limit into the hypothecium. Paraphyses ± concrete, rather stout, 1.5–2.5 μ thick, at the dark aeruginose tips gradually ± swollen (up to 4 μ) and there strongly conglutinated; simple or sparingly branched, not anastomosing, not articulated; in KHO becoming ± discrete, but apparently much gelatinized. Whole hymenium persistently blue with Iodine. Asci clavate, 45–65 × 11–13 μ, with gelatinous wall about

1.5 μ thick at sides, 8–15 μ at apex. Spores 8 (or apparently often fewer) in ascus, irregularly biseriate, ellipsoid-fusiform to cylindric-fusiform, colorless, simple or usually with 1 distinct median transverse septum, 12–18 $\times$ 4–5 μ.

Pycnidia immersed, with slightly indented ostiole, globose or subpyriform, 240–500 μ diam., with colorless, finely pseudoparenchymatic wall 5–10 μ thick, convoluted internally so as to form several intercommunicating chambers. Cortical tissue of thallus aeruginose-blackish around the ostiole. Pycnoconidia borne apically on crowded subulate conidiophores, shortly filiform, usually slightly bent, 6–7 $\times$ about 0.5 μ.

The original material of "*Lecidea bumamma*" Nyl. from the Cape of Good Hope has not been examined, but Nylander's short diagnosis describes the peculiar characters of the species so well that it can without hesitation be regarded as identical with Stirton's plant, following Stizenberger, Lichenaea Africana (1890–91) p. 162. Zahlbruckner, in Engler's Bot. Jahrb. LX (1926) p. 495, gives a detailed description of *T. bumamma*, based on a specimen from South Africa, Matjesfontein in the Great Karroo, which agrees closely with Stirton's material. He describes the squamules as 3–5 mm. diam. and the apothecia as finally reaching a size of nearly 2 mm.; the only notable discrepancies are in the color of the epithecium ("umbrino-nigricans") and the size of the conidia ("9–12 μ longa et 1,5–1,7 μ lata"). In Ann. Cryptog. Exot. V (1932) p. 240 he describes the species a second time, from a specimen collected by Slabbert at Jansenville, South Africa. This description also shows good agreement with the type of "*Lecidea styloumena*", except that the paraphyses are said to be up to 4 μ thick.

T. bumamma is a terricolous species occurring on soil in crevices of rocks, apparently in rather arid positions. The plant at first sight makes the impression of a parasymbiontic *Scutula* on an alien thallus, on account of the appearance of the closely adpressed, immarginate apothecia and their gelatinously concrete paraphyses. But a careful microscopic examination seems to indicate that the apothecia belong to the lichen, and especially the aeruginose coloration of the thallus cortex in places where apothecia are about to develop confirms this view. Also the finding of similar fertile material in several different localities of South Africa suggests that the apothecia are the natural fruiting bodies of the lichen.

Toninia squalida (Schleich. apud Ach.) Mass. Ricerch. Auton. Lich. Crost. (1852) p. 108. Syn. *Lecidea squalida*

Schleich. apud Ach., Lichenogr. Univ. (1810) p. 169. *Lecidea atrorufa* var. *squarrosa* Ach. in Kgl. Vetensk.-Akad. Nya Handl. XXIX (1808) p. 267. *Toninia squarrosa* Th. Fr., Lichenogr. Scandin. I (1874) p. 331.

T. squalida, f. **caulescens** (Anzi) M. Lamb (n. comb.). Syn. *Toninia caulescens* Anzi, Cat. Lich. Prov. Sondr. (1860) p. 67. *Lecidea caulescens* Tuck., Gen. Lich. (1872) p. 182. *Lecidea squalida* var. *caulescens* Nyl. apud Stizenb. in Jahresber. St. Gallisch. Naturw. Ges. 1880–1881 (1882) p. 430. *Toninia squalida* subsp. *caulescens* Boist., Nouv. Flore Lich., Part 2 (1902) p. 105.

MATERAL EXAMINED: the authentic, possibly isotype, material from Italy, alps of Bormio and Valle Tellina, in Anzi, Lich. Rar. Langob. no. 139 (Farlow Herb.); Switzerland, Wallis (Körber, Lich. Sel. German. no. 372, Farlow Herb.); Tirol, Windischmatrei (Arnold, Lich. Exs. no. 672, herb. Arnold, München); U.S.A., California, no exact locality stated, coll. *Bolander*, 1871, no. 407, in herb. Tuckerman, Farlow Herb. The following description of this form of *T. squalida* is based on all four specimens cited, individual discrepancies being mentioned.

Squamules gray to reddish-brown, turgid and plicate, ± imbricated, 0.5–1.5 mm. diam., concrescent into an effuse, ± continuous crust. Radicate stipes well developed, buried in the earthy substratum, pale, ecorticate, up to 8 mm. long. Thallus externally and internally PD −. Apothecia usually numerous, scattered or crowded and confluent, entirely black, matt (or subnitid where rubbed), 0.5–0.9 mm. diam., at first plane with slightly prominent proper margin, then becoming ± convex and immarginate, often subdividing into smaller secondary apothecia.

Squamules corticate above and on sides, in many places covered by a hyaline, necrotic, structureless layer up to 10 μ thick. Cortex of variable thickness, 15–100 μ, either entirely colorless and clear or in places dark brown in outer 7–15 μ (there composed of cells 3–5 μ diam. with distinct, thin, pigmented walls), the pale part composed of gelatinized and conglutinated, confluent, thick-walled hyphae in ± vertical palisade-formation, the cell-lumina distinct, often slightly moniliform, 2–4 μ wide, embedded in a clear gelatinous matrix. Algal stratum interrupted or continuous, 35–110 μ deep; algae cystococcoid, ± globose, 6.5–10.0 μ diam. Medulla ± colorless, hyaline or grayish-cloudy, of thin-walled hyphae 2.0–4.5 μ thick somewhat loosely interwoven in various directions. Radicate stipes ecorticate, without algae, composed of indistinct, conglutinated and compacted, ± thin-walled hyphae 2–3 μ thick running mainly ± longitudinally in central part, at the periphery more intertexted in various directions; the tissue ± colorless, not nubilated. In Arnold, Lich. Exs. no. 672, colonies of blue-green algae (chiefly *Stigonema*) are present on the outer surface of the stipes, and on the under side of the squamules some of them are included inside the fungal tissue, and seem to be forming primitive cephalodia.

Excipulum developed at sides, also continued vaguely for some distance below apothecium; 65–100 μ thick, dark purple-brown or brown-blackish from heavy pigment between the hyphae, which are flabellate-radiating (in Arn. Lich. Exs. 672 pigmented only in outermost 4–8 μ). No myelohyphic stratum (central cone tissue) usually present; in Arn. Lich. Exs. 672 the lower hypothecium is looser in texture, with somewhat larger hyphae, and may be referable to central cone. Hypothecium colorless or faintly sordid isabelline, up to about 230 μ deep or produced indeterminately downwards into the

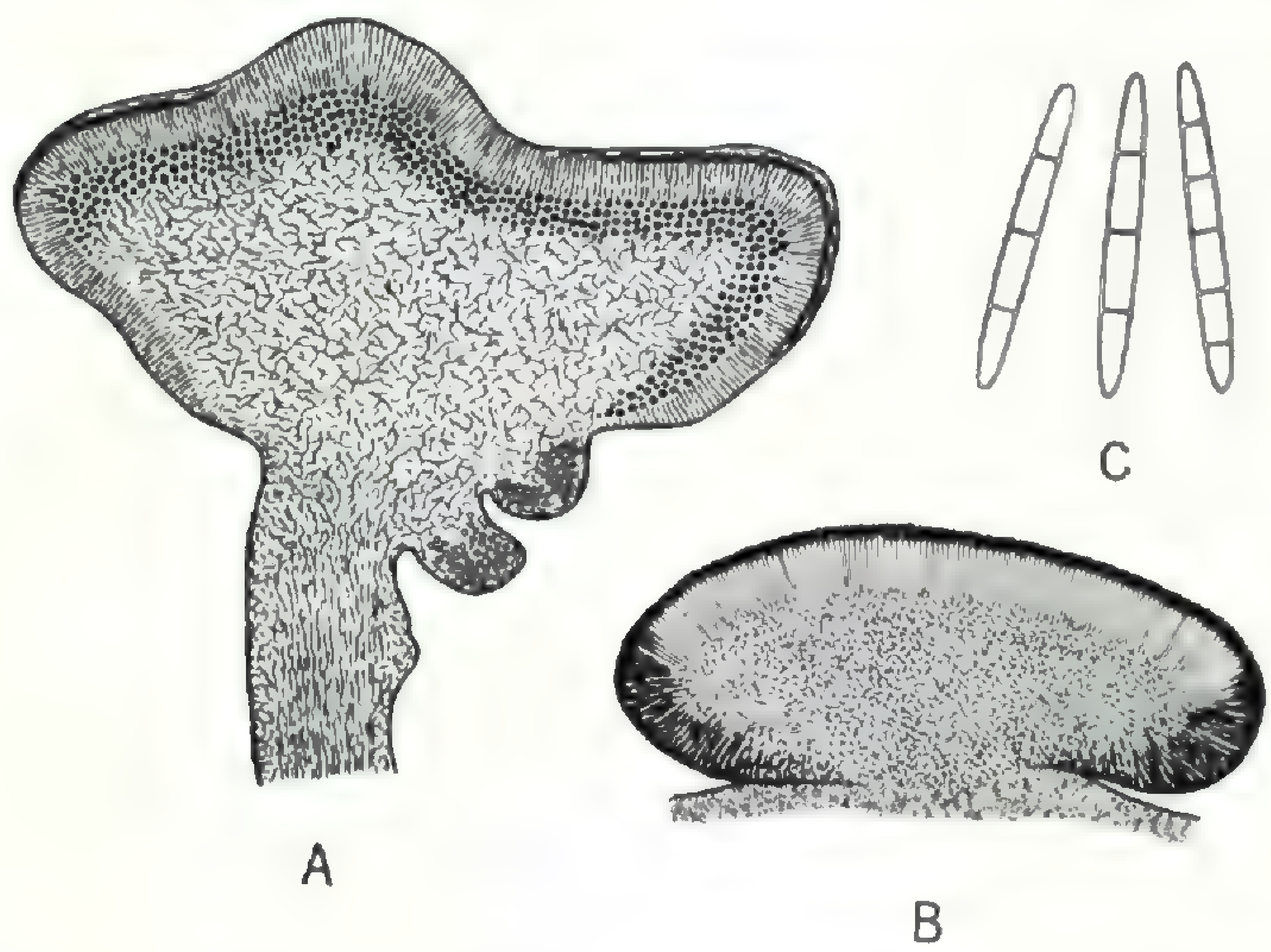

Fig. 10. *Toninia squalida* f. *caulescens* (Anzi) M. Lamb. A, vertical section of a stipate squamule, showing enclosed Cyanophyceous algae, in Arnold, Lich. Exs. no. 672 in Farlow Herb. B, vertical section of apothecium in Anzi, Lich. Rar. Langob. no. 139 in Farlow Herb. C, spores in Anzi, Lich. Rar. Langob. no. 139 in Farlow Herb.

stipe (in Bolander's California specimen with yellowish-gray, cloudy granules in upper part). Hymenium 55–70 μ high, gradually densely aeruginose-blackish in upper 10–17 μ, otherwise colorless and hyaline. Paraphyses ± discrete in water, 1.5–2.5 μ thick, simple or sparingly branched, not articulated, clavate-capitate to 4 (–5) μ at the ± densely aeruginose and more conglutinated tips. Asci 45–60 × 10–13 μ. Spores 6–8 in ascus, fusiform or cylindric-fusiform, straight, rounded or bluntly pointed at ends, 3–5-septate (up to 7-septate in Bolander's California specimen), 24–37 × 3–4 μ (in Arn. Lich. Exs. 672 somewhat longer and narrower, 30–40 × 3 μ). Hymenium I + blue then wine-red. Excipulum and epithecium KHO –, HNO_3 + dark violet then violet-purple.

As Vainio (25, p. 131) and earlier authors have pointed out, *Toninia caulescens* is not specifically separable from *T. squalida*. They have exactly the same characters except for the well developed rooting stipes in the former. Stipes are developed to a lesser extent in typical *T. squalida*, as in *e.g.* Schaerer, Lich. Helv. Exs. no. 170, and *caulescens* can at best be distinguished only as a forma of that species.

Of three North American specimens determined by Tuckerman as "*Lecidea caulescens*" in his herbarium, only one belongs to *Toninia squalida* f. *caulescens*. The other two represent the related species *T. ruginosa* Tuck. Herre's Californian records of "*Toninia caulescens*" in Proc. Wash. Acad. Sci. XII (1910) p. 102 also refer to *T. ruginosa*.

Toninia ruginosa (Tuck.) Herre in Proc. Wash. Acad. Sci. XII (1910) p. 103. Syn. *Lecidea ruginosa* Tuck., Lichens of California, Oregon and the Rocky Mountains (1866) p. 25; Synops. N. Amer. Lich. II (1888) p. 64.

MATERIAL EXAMINED: the type-specimen from California, Oakland Hills, coll. Bolander, no date, no. 102, in herb. Tuckerman (Farlow Herb.); California, San Mateo Co., near Point San Pedro, coll. A. W. Herre, 1904, in herb. Herre, Olympia, Wash., and Farlow Herb. The type-material, Bolander no. 102, is in two packets, one containing a specimen growing directly on a serpentine stone, the other containing two mounts of the same plant on stone-fragments covered with some detritus. Both are marked with the same collecting number, 102. The following description is made from one of the mounts in the latter packet, this specimen being chosen as the lectotype.

Thallus effuse, consisting of squamules attached either directly to the stone or to detritus over the latter; no dark hypothallus developed. Squamules reddish-brown, matt, (0.3) 0.5–2.0 mm. diam., turgid and plicate, concrescent into a ± continuous crust; no radicate stipes developed, but the arachnoid whitish medullary tissue from the under side of the squamules penetrates for some distance into the earthy detritus. Medulla PD –. Apothecia scattered, sessile on the squamules, 0.8–1.5 (–2.0) mm. diam., persistently plane and scutelliform, round or finally ± flexuose, with thin to moderate, persistent, ± prominent, black, matt or ± nitid proper margin and reddish-black to black, naked, matt disc.

Squamules corticate on upper side; cortex well developed, 65–85 μ thick, faintly yellowish (isabelline) in section, clear and transparent, composed of completely conglutinated and gelatinized hyphae intricated in various directions or predominantly ± vertical, only the lumina (1–2 μ wide) visible in the clear gelatinous matrix. Cortex in most places covered with an outer, colorless, hyaline, gelatinous, amorphous or horizontally striated necrotic layer up to 17 μ thick. Algal stratum directly below the cortex, continuous, 65–100 μ deep, becoming sparse downwards; algae cystococcoid, globose, thin-walled, 6–10 μ diam. Medulla loose, almost arachnoid, clear and colorless or in places ± yellow-gray-cloudy, hyphose, of fine, thin-walled hyphae about 2μ thick laxly entangled in various directions. This loose weft of medullary hyphae runs down into the substratum for some distance.

Excipulum entire, continuous below apothecium, 100–135 μ thick at sides, 50–60 μ thick below, in outer third to half densely dark reddish-purple from heavy pigment on and between the hyphae, in inner part gradually faint reddish-purple to ± clear and colorless; of ± distinct radiating structure, composed of ± parallel, conglutinated, gelatinized, thick-walled hyphae, of which only the tubular lumina are visible, 1–2 μ wide; at the sides with wider and shorter lumina (up to 3 μ wide) and becoming indistinctly cellulose. The inner part of the excipulum grades without distinct limit into the hypothecium. Hypothecium 170–200 μ deep, consisting of two parts: (a) a lower, colorless to faintly isabelline, clear and transparent 135–155 μ (perhaps stratum myelohyphicum or central cone tissue), composed of completely fused and gelatinized hyphae, only their thread-like lumina (about 1 μ wide) visible, intertexted in various directions in the clear gelatinous matrix; and (b) an upper, sordid yellow-brownish, cloudy but hardly pigmented 50–60 μ of indistinctly cellulose structure, with cell-lumina about 3 μ diam., reaching up to the base of the hymenium. Hymenium 60–70 μ high, gradually dense purple-red-blackish in uppermost 10–17 μ, otherwise colorless and hyaline. Paraphyses discrete, simple or sparingly branched, about 1.5 μ thick, not articulated, at the tips capitate to 3–5 μ and there ± purplish-pigmented. Asci clavate, 45–58 × 10–12 μ, with wall 1.0–1.3 μ thick at sides, at apex spuriously thickened to 10 μ. Spores 6–8 in ascus, packed parallel in a bundle; acicular-fusiform, commonly rounded at one end and gradually tapered at the other, straight or rarely slightly curved, 3-septate, 34–47 × 2.0–2.5 μ (according to Tuckerman, 25–40 × 2–3 μ, sometimes with more than 3 septa). Hymenium I + blue then sordid olive-brownish. Epithecium and outer excipulum KHO + reddish-purple.

(No pycnoconidia seen; according to Tuckerman in Synops. N. Amer. Lich. II (1888) p. 65, they are filiform and curved.)

The Californian specimen collected by Herre and recorded as *T. caulescens* differs only slightly from the type-material described above. It is sparingly radicate-stipitate, the stipes being inconspicuous, developed only in places, and ± ecorticate; most of the squamules, as in Tuckerman's material, are directly sessile on the substratum. The surface of the squamules is slightly nitid. The lower hypothecium is partially purplish or yellow-brownish, and the upper hypothecium is darker, reddish-brown. The hymenium is higher (75–90 μ) and the spores slightly broader (3.0–3.5 μ). These differences appear to come within the limits of normal specific variability.

The distributional area of this species, which differs from *T. squalida* chiefly in its purple-blackish (not aeruginose) epithecium, is interesting. The typical state and the f. *nigricans* described below constitute a Pacific North American element with an area extending from California to Washington; the var. *andicola*, here described for the first time, was found in the high mountains of the preandine Cordillera of prov. Catamarca in N. W. Argentina. This is an unusual type of bicentric distribution, which seems to be without exact parallel in the flowering plants. There are a number of species common to N. W. Argentina and the highlands of Mexico, but the occurrence of a species of the N. American Pacific coast in the high "puna" region of S. America is surprising and not easily explained. The characters of var. *andicola* do not appear to justify specific separation from *T. ruginosa.*

T. ruginosa, f. **nigricans** M. Lamb (n. f.)

MATERIAL EXAMINED: the type-specimen from U.S.A., California, exact locality not stated, coll. 1866, *Bolander, 112,* in herb. Tuckerman (Farlow Herb.); Washington, Cascade Mountains, coll. 1883, *Brandegee, 25,* in herb. Tuckerman (Farlow Herb.).

Thallo obscuriore (obscure fuscescens vel fusconigrescens) et apotheciis immarginato-convexis a specie typica differt.

Description of the type-specimen (Bolander 112):—On earthy detritus. Thallus effuse, of concrescent, turgid, plicate squamules similar to those of the typical species, but darker (dark brown to brown-blackish), matt or subnitid. Irregular radicate stipes are developed here and there from the underside of the squamules; they are pale, ecorticate, thin, root-like and branched, buried in the substratum. Medulla PD −. Apothecia numerous, sessile on the squamules, separate or crowded, entirely black, 1.0–1.5 (–2.0) mm. diam., matt (or nitid where rubbed), round, at first plane with thin, entire, non-prominent proper margin, then soon strongly convex and immarginate.

Excipulum developed at sides and below apothecium, 65–85 μ thick, pale to dark purple-brown in section or ± colorless in inner part, of flabellate-radiate structure with the hyphae divided into distinct cells 5–7 μ long and 3–5 μ wide. Lower part of hypothecium (probably = central cone or myelohyphic stratum) yellowish-gray-cloudy, compact to ± lax, formed of distinct, separate, thin-walled hyphae 3.0–3.5 μ thick interwoven in various directions (not gelatinously fused); upper part of hypothecium (= true hypothecium) 100–120 μ deep, varying in the same section from sordid isabelline to yellow-brownish or purplish-brown. Hymenium 55–65 μ high, gradually dark brownish-purple in upper 10–14 μ, otherwise colorless and hyaline. Paraphyses discrete, 1.0–1.8 μ thick, clavate-capitate to 3–4 μ at tips. Asci 45–50 μ long. Spores 6–8 in ascus, elongate-fusiform, straight or slightly curved, bluntly pointed at ends, sometimes gradually tapered towards one end, 5–7-septate, the septa distinct; 27–45 (–50) × 2.5–3.0 μ. Hymenium I + blue then sordid olive-brown. Outer excipulum, epithecium, and more colored parts of hypothecium KHO + reddish-purple.

The specimen from Washington agrees closely with the type. The hyphae of its lower hypothecium or central cone tissue are more gelatinously confluent, as in the type-specimen of *T. ruginosa;* its spores are 3–5-septate, 30–42 × 3 μ.

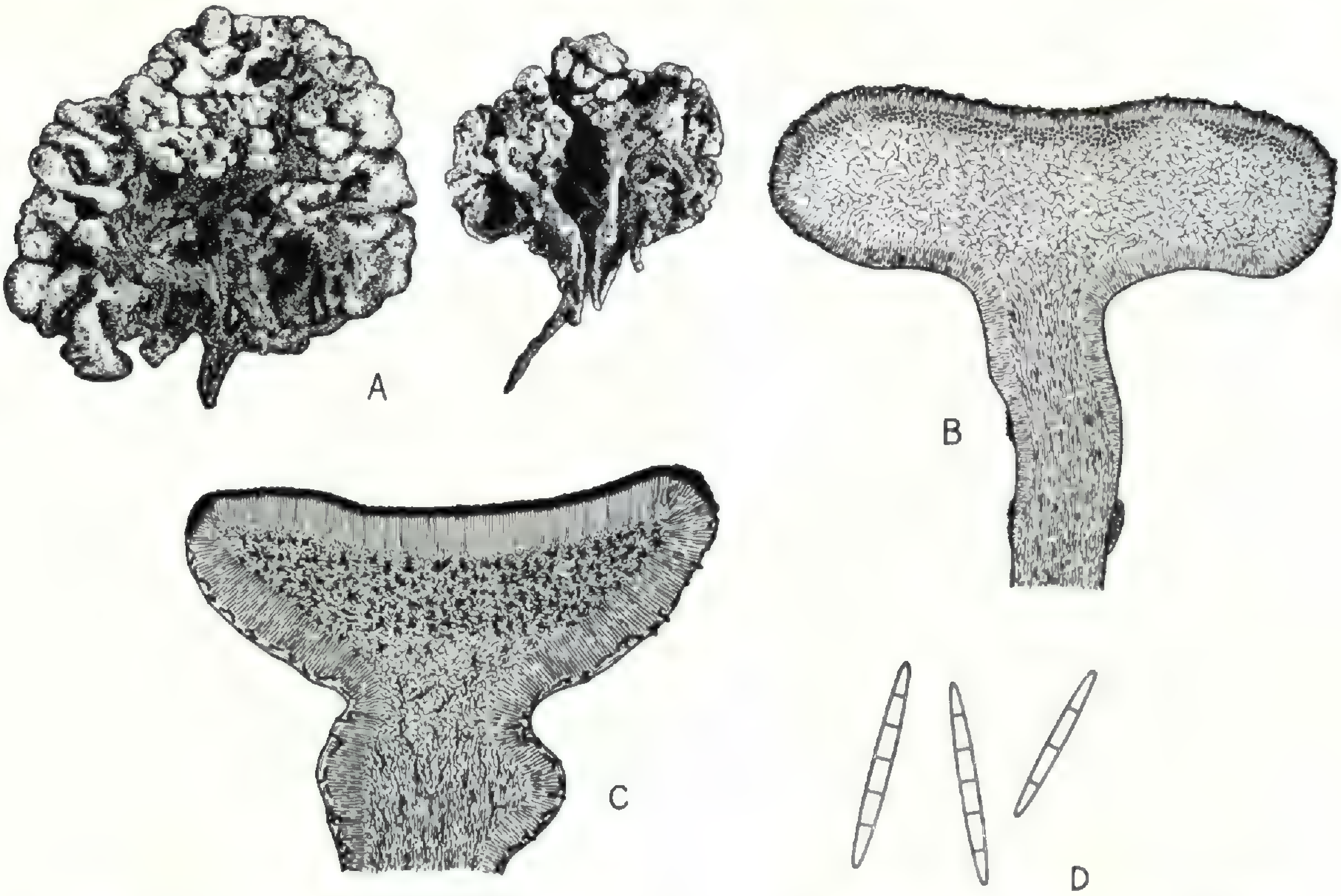

FIG. 11. *Toninia ruginosa* var. *andicola* M. Lamb. The type-specimen. A, parts of thallus showing radicate stipes (× 2½). B, vertical section of a stipate squamule. C, vertical section of apothecium (the dark masses in the hypothecium are included air). D, spores.

T. ruginosa, var. **andicola** M. Lamb (n. var.)

MATERIAL EXAMINED: the type-specimen from N. W. Argentina, Prov. Catamarca, Nevados de Anconquija, Quebrada de los Cazadores, altit. circ. 4500 m.s.m., in the puna-formation, on soil in crevices of a metamorphic rock face, not abundant, coll. 24. Nov. 1948, *I. M. Lamb, 5599,* in Herb. Nat. Mus. Canada, Ottawa, and isotype in Farlow Herb.

Squamulae clavato-bullatae, etiam latere inferiore corticatae, deorsum caulibus bene evolutis et partim corticatis munitae; ceteris notis ut in specie typica.

Description of the type-specimen:—Thallus effuse, in small patches; squamules crowded, turgid-inflated, 0.8–2.0 (–3.0) mm. diam., reddish-brown to dark brown (on lower side paler, yellowish-brown), matt, clavate-bullate, prolonged downwards into corticate, terete or irregularly rugose stipes 0.3–1.0 mm. thick which penetrate the substratum and continue downwards as brownish, root-like, ecorticate strands. Medulla PD −, I −. Apothecia scarce, sessile on the squamules, round or irregular, 1–2 mm. diam., entirely black, persistently plane or scutelliform, with slightly prominent, entire or ± flexuose, moderate, matt or subnitid proper margin and matt, naked disc.

Cortex of squamules 35–50 μ thick, clear and colorless or faintly yellowish in section, in most places with brown torulose hyphae (parasite ?) on its outer surface; of ± distinct palisade structure, composed of fused and gelatinized, thick-walled, ± perpendicularly parallel hyphae, of which only the fistulose lumina are visible, 1.0–1.5 (–2.0) μ wide. Algal stratum irregular, interrupted, up to 100 μ deep. Algae cystococcoid, bright green, globose, thin-walled, 7–14 μ diam. Medulla lax, ± arachnoid, composed of colorless, thin-walled hyphae about 3 μ thick loosely interwoven in various directions. The cortex is continued for a long way down the sides of the stipes, which are devoid of algae, except for accidentally adherent external colonies of various Cyanophyceae, which are not enclosed in the fungal tissue. Central part of stipes composed of ± compact, mainly longitudinally-running, colorless or faintly yellow-gray-cloudy, thin-walled hyphae 3–4 μ thick, obviously derived from the medulla.

The apothecial margin is an amphithecium continuous with the cortex of the thallus; 110–150 μ thick, entirely colorless and hyaline or yellow-brownish to purplish-brown in outermost 17–27 μ, composed of parallel-flabellate, fused and gelatinized hyphae of which only the tubular lumina are visible, 1–2 μ wide. Hypothecium 200–220 μ deep in center, colorless and hyaline, but with scattered dark masses of included air, mostly compact in texture, of conglutinated gelatinous hyphae 1.5–3.0 μ thick intricated in various directions. Hymenium 70–90 μ high, ± gradually reddish-purple-blackish in upper 13–27 μ, otherwise colorless or faintly purple-brownish. Paraphyses ± discrete in water, simple or sometimes branched, 2–3 μ thick, not articulated, towards the tips gradually purple-brown and there slightly to moderately thickened (up to 3.5–4.5 μ). Asci clavate, 55–68 × 10–14 μ, with wall 1.0–1.5 μ thick at sides, at apex thickened to 9–10 μ. Spores 4–6 (–8) in ascus, packed straight and parallel; elongate-fusiform, straight, bluntly tapered at ends, 3–5-septate, 30–40 (–50) × 3–4 μ. Hymenium I + blue to greenish then sordid wine-red. Epithecium KHO + reddish-purple, in HNO_3 unchanged or clearer reddish.

Apart from the morphological differences mentioned in the diagnosis, this specimen differs from the typical *T. ruginosa* in some microscopic characters, which are probably variable and non-taxonomic: the lesser pigmentation of the outer part of the apothecial margin, the quite colorless upper hypothecium, and the thicker paraphyses.

T. ruginosa may be related to the Australian *T. nitida* (Müll. Arg.) Zahlbr. and the Valdivian *T. badia* Räs.; the former differs in its impressed-punctulate squamules and larger spores, the latter in its much larger apothecia and aeruginose-brownish epithecium.

Sphaerophoropsis Vain.

Sphaerophoropsis stereocauloides Vain., Etud. Lich. Brésil, part 2 (1890) p. 7.

material examined: the (lecto-) type-specimen from Brazil, Minas Geraes, Carassa, coll. 1885, *Vainio*, Lich. Brasil. Exs.

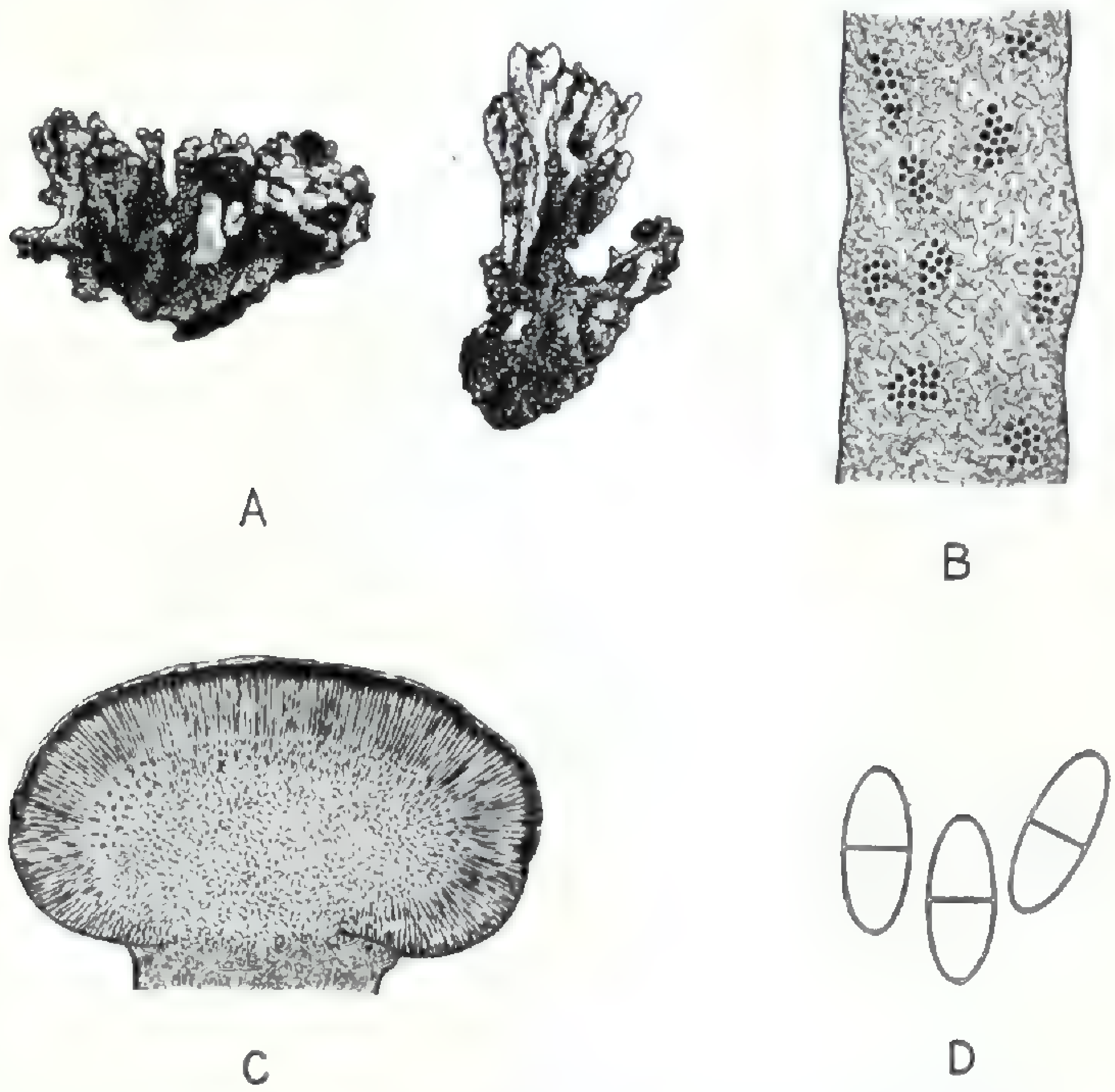

Fig. 12. *Sphaerophoropsis stereocauloides* Vain. Type-material in herb. Vainio. A, portions of plant showing habitus (on left part of the lectotype-specimen, Lich. Bra il. Exs. no. 1475; on right part of Lich. Brasil. Exs. no. 1462) (× 3). B, longitudinal section of part of pseudopodetium in the lectotype-specimen. C, vertical section of apothecium in the lectotype-specimen. D, spores in the lectotype-specimen.

no. *1475*, no. 12603 in herb. Vainio, Turku (Åbo); same locality, collector and date, Lich. Brasil. Exs. no. *1462*, no. 12602 in herb. Vainio. Vainio mentioned six numbers in the original description, all from the same locality, without designating a holotype. The specimen of Lich. Brasil. Exs. no. *1475* in his herbarium has been chosen as the lectotype, and the following description is based upon it.

On sandy humus. No primary thallus developed; the pseudopodetia are directly attached to the substratum, not expanded at the base, and penetrate into it for a short distance only, appearing to die off at their immersed bases. They are upright, stipate-caespitose, simple or sparingly branched ± dichotomously, cylindric-dactylaeform, terete, rounded at the apex, the surface smooth and appearing as if corticate, cream-colored, cinereous-whitish, or pallid ochraceous, matt, not pruinose. The pseudopodetia are minute, 0.5–1.5 mm. long, 0.1–0.3 mm. thick. Where broken across, they are seen to be solid and light-colored internally. Apothecia developed somewhat sparingly on the surface of the tufts and terminal on the stipes; black to brown-blackish, ± nitid, smooth, not pruinose, convex and immarginate from the first, finally pulvinate and sometimes dividing into two imperfectly separated convex discs. At maturity they are 0.3–0.6 mm. diam. Careful search under the binocular microscope failed to reveal any cephalodia. Pseudopodetia externally PD −, internally PD − or in places + light persistent yellow.

The pseudopodetia are of simple, primitive, undifferentiated structure, homogeneous, without cortical layer and without any central strand of mechanical or conducting tissue. They are composed throughout of closely interwoven, very thick-walled, gelatinous but distinct, colorless hyphae 6.5–9.5 μ thick running at random in various directions. A few small interstices are present here and there between the hyphae, but the structure is essentially compact. No nubilating granules or inclusions in section. On the outer side of the stipes the hyphae become somewhat compressed and gelatinously degenerated. Symbiotic algae very irregularly distributed in the pseudopodetia, not forming any continuous stratum, occurring in scattered groups buried in the tissue to a depth of 200 μ from the surface, in places emerging almost to the surface itself. Algae cystococcoid, pale green, globose, 6–10 μ diam., with colorless thin wall.

The excipulum is a sterilized lateral extension of the hymenium, and grades into the latter without sharp limit; it is reflexed to the under side, 75–100 μ thick, in section faintly brownish, sordid isabelline, or almost colorless (depending on the thickness of the section), not nubilated, composed of flabellate-radiating, gelatinized and conglutinated, thick-walled hyphae, only their fistulose lumina visible, about 1 μ wide, 3 μ apart. No amphithecium present. No clear distinction between myelohyphic stratum (central cone) and hypothecium; the whole interior of the apothecium, right up to the base of the hymenium (a depth of about 500 μ) is filled with a homogeneous, compact, pallid brownish to almost colorless, clear, gelatinized tissue, *i.e.* the hypothecium, consisting of completely fused hyphae with only the thread-like lumina visible, these about 1 μ wide and intricated in various directions. Scattered spots and patches of a brownish pigment are present in the upper part of the hypothecium, but there are no granular inclusions. In the upper subhymenial 70–100 μ the hyphae become more predominantly vertical, and between them are some cells with wider, $\pm$ isodiametric or vertically oblong lumina up to 5 μ diam. (remains of carpogonia ?). Hymenium about 70 μ high, rather ill-delimited from the hypothecium, unevenly pallid brownish in section, with vertical streaks of reddish-brown pigment extending through its whole depth; in uppermost 6–9 μ more intensely reddish-brown, and covered on the surface by a structureless, colorless, gelatinous layer 3–5 μ thick. Paraphyses not numerous, conglutinated and only with difficulty separable in water, about 1.5 μ thick, vaguely and effusely $\pm$ brownish-pigmented towards their tips, which are not noticeably thickened. Asci numerous, clavate, 50–68 $\times$ 10–14 μ, with wall about 1 μ thick at sides, gelatinously thickened up to 10 μ at the apex. Spores 8 and subbiseriate in ascus, colorless, ellipsoid to ellipsoid-fusiform, soon transversely 1-septate, the walls and septum thin and equal (about 1 μ); 12.0–13.5 $\times$ 4.5–5.5 μ. Hymenium and upper part of hypothecium persistently blue with Iodine.

The other specimen examined, no. *1462*, is very similar, but the apothecia are more numerous, and often laterally sessile near the ends of the stipes. The latter are finally sparingly branched, up to 6 mm. long, externally and internally KHO −, internally PD + persistent light yellow. Internal anatomy of apothecia similar to that of the lectotype; the hypothecial tissue however is more colored with unevenly dispersed reddish-brown pigment, more densely in the upper 100–170 μ. Hymenium somewhat lower (50–60 μ), unevenly dark brown in the upper 5–8 μ below the gelatinous covering layer. Asci 44–57 μ long. Spores 1-septate, seen only inside the ascus, about 10 $\times$ 4 μ.

Reinke (17, pp. 98–99) has described and figured this species, and his observations are quite accurate. However, the pseudopodetia are more closely crowded together than is shown in his fig. 35 (reproduced also in Zahlbruckner's treatment in Engler and Prantl, Nat. Pflanzenfam., VIII, 1926, p. 195), and the apothecia are usually terminal. As Reinke points out, the form of the thallus approaches that of *Toninia*, but it differs anatomically from the latter in its undifferentiated structure and lack of cortex. The holostelidious pseudopodetia, with the symbiotic algae buried in the tissue and not forming leprose or granulate excrescences on the surface, distinguish *Sphaerophoropsis* from *Catillaria* sect. *Hypocaulon* M. Lamb, in which the pseudopodetia are enteropodious in origin. The apothecial structure is similar to that of many species of *Catillaria* and *Bacidia*, so that the inclusion of *Sphaerophoropsis* in the *Lecideaceae*, near *Toninia* and *Catillaria*, seems quite correct. It probably represents a primitive isolated side-branch of the ancestral Catillario-Bacidioid stock.

Sphaerophoropsis stereocauloides has been recorded by Räsänen (16, p. 58) from Tierra del Fuego, on sterile material. The specimen has not been seen by the present author.

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Summary

The development of upright orthotropic stipes below the apothecia in inoperculate Discomycetous fungi is found in non-lichenized as well as in lichenized groups. Of the former, the Geoglossaceae (Helotiales) are the best examples, and in these the stipe represents an extension of the apothecial tissues. In the latter, the development of stipes below the apothecia may be due to the elongation of either apothecial tissues (true podetia) or thalline tissues (pseudopodetia). True podetia may become secondarily clothed by thalline tissue containing algae and thereby converted into assimilative organs. Fruticose development in the lichenized Discomycetes is characteristic of the families Cladoniaceae

and Stereocaulaceae, both of which are obviously derived from prototypes corresponding to members of the family Lecideaceae. In the Lecideaceae there are at the present day some forms showing this tendency to a greater or less extent, in the form of either true podetia or pseudopodetia. Detailed descriptions of such forms are here given in order to elucidate the probable phylogenetic origins of some of the more highly evolved fruticulose genera belonging to the families Cladoniaceae and Stereocaulaceae.

Descriptions of the following species are given:—*Bacidia* (*Eubacidia*) *buchanani* (Stirt.) Hellb.; *Bacidia* (*Eubacidia*) *robinsonii* (Vain.) M. Lamb; *Bacidia* (*Weitenwebera*) *gomphillacea* (Nyl.) Zahlbr.; *Bacidia* (*Thamnopsis*) *fibrosa* M. Lamb; *Bacidia* (*Thamnopsis*) *stipata* M. Lamb; *Catillaria* (*Biatorina*) *columnatula* (Nyl.) Zahlbr.; *Catillaria* (*Hypocaulon*) *corymbosa* (Hue) M. Lamb; *Sphaerophoropsis stereocauloides* Vain.; *Toninia bumamma* (Nyl.) Zahlbr.; *Toninia conglomerata* (Ach.) Boist.; *Toninia ruginosa* (Tuck.) Herre (with f. *nigricans* M. Lamb and var. *andicola* M. Lamb); *Toninia squalida* (Schleich. apud Ach.) Mass. (f. *caulescens* (Anzi) M. Lamb). NEW SECTIONS:—*Bacidia* sect. *Thamnopsis* M. Lamb; *Catillaria* sect. *Hypocaulon* M. Lamb. NEW SPECIES: *Bacidia* (*Thamnopsis*) *stipata* M. Lamb. NEW VARIETY: *Toninia ruginosa* var. *andicola* M. Lamb. NEW FORM:—*Toninia ruginosa* f. *nigricans* M. Lamb. NEW NAME: *Bacidia* (*Thamnopsis*) *fibrosa* M. Lamb (Syn. *Stereocaulon laseroni* Dodge, non *Bacidia laseroni* Dodge). NEW COMBINATIONS:—*Bacidia* (*Eubacidia*) *robinsonii* (Vain.) M. Lamb (Syn. *Toninia Robinsonii* Vain.); *Catillaria* (*Hypocaulon*) *corymbosa* (Hue) M. Lamb (Syn. *Alectoria corymbosa* Hue); *Toninia squalida* f. *caulescens* (Anzi) M. Lamb (Syn. *Toninia caulescens* Anzi).

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A NEW SPECIES OF NEUROPOGON FROM THE UNITED STATES

Henry A. Imshaug[1]

Neuropogon is a rather small genus of lichens, or, more properly, lichen-forming fungi, which is closely related to the genus *Usnea*. Motyka (1936) in his monograph of the latter genus included *Neuropogon* as a subgenus. In addition to the monograph by Motyka, *Neuropogon* has been studied monographically by Lamb (1939 and 1948). Motyka (1936) recognized twelve species while Lamb (1948) recognized eleven (or possibly twelve) species. As a result of these studies the genus is better known taxonomically than most genera of lichen-forming fungi.

Considerable interest has centered on this genus because of its distribution. Only one species, *Neuropogon sulphureus*, is known from the northern hemisphere; all the other species are known only from the southern hemisphere. Lynge (1941) made an exhaustive study of *Neuropogon sulphureus* and brought together all the information known about this species. Included in this paper were a number of maps showing its distribution. It is a typical bipolar lichen, being found in the arctic, the antarctic and in the high Andes of South America. Its distribution in the northern hemisphere is limited to the arctic islands, and despite long and intensive search by many lichenologists this species has never been found on any of the continents of the northern hemisphere. In the arctic, *Neuropogon sulphureus* is quite monotypic, both morphologically and chemically, as stated by Lamb (1939) and Lynge (1941).

The discovery of a species of this genus on a continent in the northern hemisphere is, therefore, a find of no small importance. The present writer has searched for the genus for a number of years in alpine regions of western America without success. While studying at the Farlow Herbarium,[2] however, he had the good fortune to meet Dr. P. F. Scholander, who, in the course of conversation, mentioned the fact that he had collected a *Neuro-*

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[2] I am indebted to the late director of the Farlow Herbarium, Dr. W. L. White, for the many courtesies received while there. I am also indebted to the University of Michigan for the granting of a Horace H. Rackham Postdoctoral Fellowship for the year 1951–1952 which enabled me to spend considerable time at the Farlow Herbarium.

pogon in Mt. Rainier National Park some years previously. The subsequent examination of this material, deposited in the Farlow Herbarium, showed that this was an undescribed species of *Neuropogon*. Dr. I. M. Lamb, to whom a part of the collection was sent, agreed that it was a new species, and said, in a letter, "it comes closest to *N. acromelanus* Stirt., but differs in the laxer medulla and thin central strand, and cannot be included in that species." The new species is similar to *Neuropogon sulphureus* in the lax nature of the medulla, but differs in that the branches are not scabrid-verruculose.

It gives me great pleasure to name this interesting species in honor of one of lichenology's most devoted students and an outstanding monographer, Dr. I. Mackenzie Lamb.

Neuropogon lambii Imshaug, sp. nov.

Thallus parvus (usque ad 2 cm. altus), erectus, basi anguste substrato affixus, sat parce ramosus. Rami basales 0.70–0.85 mm. crassi (infra angustiores), sulphurei, omnino laeves et nudi, subnitidi, haud verruculosi. Ramuli terminales tereti, nigro-variegati, laeves, nitidi, apicibus subcapillaribus fere omnino nigris. Apicem versus rami et praecipue ramuli globoso-sorediati, soralia vulgo 0.2–0.5 mm. lata, ab initio sulphurea, deinde aterrima. Apothecia et pycnidia non visa. Medulla valde laxa, alba; axis tenuis, circ. 1/4–1/3 diametri ramorum. Reactiones: medulla KOH et Pd non mutatur. Specimen typicum in Herb. Farlow conservatum; legit prope Yakima Park, Mt. Rainier National Park, Washington, U. S. A., *P. F. Scholander*, Aug. 19, 1942.

Thallus erect fruticulose, up to 2 cm. tall, narrowly attached at the base to the substratum, branching sparsely. Basal branches 0.70–0.85 mm. in diam. at widest part but tapering to 0.3–0.4 mm. in diam. at point of attachment. Main branches sulphureous, but occasionally blackening above, subnitidous, smooth, neither foveolate, nor verrucose, nor annular rimose. Ultimate branches 0.1–0.25 mm. in diam. and tapering to a point; blackening so as to frequently produce a banded effect. Soredia yellowish, occasionally blackening, mealy granulose, in soralia 0.2–0.5 mm. across. Soralia rather abundant on ultimate branches.

Medulla white, lax, arachnoid; central axis well defined, white, usually rather thin, diameter of axis usually being 1/4–1/3 that of the branch (but occasionally approaching ½ the diameter of the branch).

Apothecia and pycnidia unknown.

Chemical Reactions: Thallus (central axis, medulla and cortex) Pd − and KOH −.

Type Specimen: Yakima Park, 6000 ft., in Mt. Rainier National Park, Washington, U. S. A. Collected by *P. F. Scholander*, August 19, 1942 and deposited in the Farlow Herbarium, Harvard University. Specimen overgrown with *Alectoria pubescens*.

The occurrence of a lichen with arctic affinities on Mt. Rainier but not at high elevations in the Rocky Mountains is a matter of considerable interest, especially so since this is not the only example. *Buellia moriopsis* (Mass.) Th. Fr.[3] was collected by the present writer in Mt. Rainier National Park in 1948. This species, although apparently common in the eastern Canadian Arctic and in the mountains of New England is unknown from the Rocky Mountains.

Torrey (1937) reported the discovery of *Dactylina arctica* on Mt. Rainier by Miss A. Wilson. The specimen was sent to Lynge for verification and since it is not in the herbarium of the New York Botanical Gardens it is presumed to be in Oslo. The taxonomy and distribution of the species now included in the genus *Dactylina* were thoroughly reviewed by Lynge (1933 and 1934). *Dactylina arctica* does not occur in the Rocky Mountains of the United States, although it does occur further north in Alberta. In the last few years the present writer made an intensive search for *D. arctica* in the Rocky Mountains but was unable to discover any localities south of Latitude 51° 24′. This would appear to be the approximate southern limit of its range in the Rocky Mountains.

Another species conspicuously absent from the Rocky Mountains is *Alectoria ochroleuca*. This species is, however, common in alpine regions of Mexico and the Andes.

Similar types of distribution are shown for the Umbilicariaceae by Llano (1950). This apparent absence of certain arctic and bipolar species from the Rocky Mountains is an interesting phytogeographical problem and one on which the present writer has devoted much field work. A detailed discussion of this problem will appear at a later date, after additional field work is completed.

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[3] This species is commonly called *B. atrata* (Sm. in Sm. & Sowerb.) Anzi. The basonym of the latter, however, is a later homonym of *Lichen atratus* Hedwig, which is now called *Lecanidion atrata*, a nonlichen-forming discomycetous fungus.

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STUDIES IN THE COMPOSITION AND DISTRIBUTION OF THE OKLAHOMA FLORA—XXI[1]

U. T. WATERFALL

CONTINUED investigations of our state's flora have resulted in additional data concerning its composition and distribution. In this paper the taxa not found listed in monographs, floras, checklists, and similar publications as occurring in Oklahoma are prefixed with an asterisk. There are 34 such entities recorded here. Four of them are newly described forms. About one-third of these additions were collected in southeastern Oklahoma, mostly in McCurtain County. The Ozark region in the northeast, and the two or three southwestermost counties each provided about one-fifth of the species listed. The rest came from various parts of the state. Unless otherwise indicated the cited specimens are to be found in the Herbarium of Oklahoma A. & M. College at Stillwater.

BOTRYCHIUM DISSECTUM Spreng., forma OBLIQUUM (Muhl.) Fern. is little known in the state. Stemen and Myers in their Flora, p. 17, state that it occurs in McCurtain County. The only material I have seen is *Coryell 715*, edge of pine-oak woods 6 miles southeast of Bethel, McCurtain County, Oct. 22, 1950.

CHEILANTHES WOOTONI Maxon has been reported from the Wichita Mts. of southwestern Oklahoma. We also have it as *F. C. Green*, collected on Hallock's Ranch, Cimarron County.

*ARISTIDA BARBATA Fourn. is an unbranched perennial with an open panicle having glandular tissue in the axil of each panicle-branch, and with the first glume a little shorter than the second one. It is represented from Cimarron County by the following: *Waterfall 7479*, base of Black Mesa, 4 miles north of Kenton, July 9, 1947; *Waterfall 8634*, ditch 13 miles west of Boise City, Aug. 22, 1948; *Waterfall 9740*, sandstone slopes,

[1] The 20 previous papers in this series have appeared under various titles in the last 14 years. Most of them were published in RHODORA.

5 miles south of Kenton, Oct. 7, 1950. It has been known previously from "western Texas to Arizona and central Mexico" according to Chase in the second edition of Hitchcock's Manual.

*Eragrostis glomerata (Walt.) L. H. Dewey, a rather large annual with a narrow panicle having stiffly ascending branches and small spikelets 2–3 mm. long, is represented by *Chaffin*, Coal County, Sept. 9, 1949. In Hitchcock's Manual the range is given for as far west as "Missouri and eastern Texas."

*Erianthus giganteus (Walt.) Muhl. has a relatively broad inflorescence (mostly 2.5 to 3 times as long as wide) with copious brownish hairs at the bases of the spikelets, these being about twice as long as the spikelets (excluding the awns). The terete awns are neither spirally coiled at their bases, nor strongly divergent in their upper parts. This species was found in McCurtain County and collected as *Waterfall 10417*, oak-hickory-pine woods, 3 miles north of Tom, Oct. 13, 1953. Previously it has been known from as far west as Arkansas and eastern Texas according to Chase in Hitchcock's Manual.

*Leptochloa uninervia (Presl) Hitchc. & Chase was collected in water on the north arm of Hickory Creek, Love County, as *Harris*, July 10, 1949. Chase (op. cit.) ascribes this species to both Texas and Louisiana.

*Panicum agrostoides Spreng., var. ramosius (Mohr) Fern., with branches loosely floriferous, was collected as *Waterfall 9799*, edge of *Taxodium* swamp, 3 miles south of Eagletown, McCurtain County, Oct. 21, 1950. Fernald (Gray's Manual, ed. 8) includes Texas and Missouri in the western range of this variety.

*Panicum Reverchoni Vasey. So referred are: *Waterfall 7747*, gypsum hills along Elm Fork of Red River, 3 miles west and 14 south of Erick, Harmon County, June 3, 1948; *Waterfall 7802*, along Red River at base of gypsum escarpment, 4 miles east and 4 south of Eldorado, Jackson County, June 5, 1948. In the second edition of Hitchcock's Manual the species is said to occur only in Texas.

*Paspalum laeve Michx., var. pilosum Scribn. (*P. plenipilum* Nash, *P. longipilum* Nash). Referred to this taxon, because the sheaths and blades are strongly pilose, are *Waterfall 9858*, edge of pond in oak-pine woods, 2 miles southeast of Bethel, McCurtain County, Oct. 22, 1950, and *Waterfall 10480*, prairie, 1 mile south of Tom, McCurtain County, Oct. 23, 1950. Fernald (op. cit.) says that this variety extends north to southern Missouri.

*Sphenopholis filiformis (Chapm.) Scribn. So referred is *Waterfall 6916*, in an oak forest on a cherty hillside, 8 miles south of Wyandotte, Ottawa County, June 6, 1947. Fernald (op. cit.) says that it occurs from "Fla. n. to Va. and Tenn."

*Carex flaccosperma Dewey was collected as *Waterfall 9322*, edge of swamp, 7 miles south and 1 east of Idabel, McCurtain County, April 15, 1950. It is somewhat similar to *C. amphibola*, but has a greater number of perigynia in a longer spike, and the pistillate scales are only about one-third as long as the perigynia. It was previously known (according to Fernald, op. cit.) from as far west as Texas and southeastern Missouri.

*Carex Haleana Olney. So referred are the following because they have small perigynia (1–1.5 mm. wide) and consequently narrower spikes than *C. granularis*. *Waterfall 6900*, along small spring-fed stream in shade of hickories in an elm-ash-sugar maple forest, south of Wyandotte, Ottawa County, June 6, 1947; *Waterfall 10034*, open woods along creek bottom, 10.5 miles west and 3 north of Tahlequah, Cherokee County, June 18, 1951.

*Carex oxylepis Torr. & Hook. is represented by *Aven* and *Ruth Nelson* and *George Goodman 5599*, marshy ground along stream, Ouachita Mountains, about 15 miles north of Broken Bow, McCurtain County, April 21, 1946 (OU). It has been recorded previously (Gray's Manual, ed. 8) from as far west as Texas and southeastern Missouri.

*Carex rosea Schkuhr was collected as *Waterfall 9630*, in deep woods along Little River, 3 miles northeast of Idabel, McCurtain County, April 16, 1950. Mackenzie (N. Am. Fl. **18** (1): 45–46) says that specimens were examined from Louisiana, Arkansas and Missouri.

*Carex rosea Schkuhr, var. texensis Torr. The author believes that Torrey's original concept indicates the relationship of this taxon better than separating it as a distinct species as has been done by Bailey (Mem. Torr. Bot. Cl. **5:** 97. 1894), or treating it as a variety of *C. retroflexa* as was done by Fernald (Rhodora **8:** 166. 1906). The principal difference between var. *rosea* and var. *texensis* seems to be the serrulate beak and upper part of the perigynium of the latter. We have var. *texensis* as *Waterfall 10691*, wooded bottom along Mountain Fork in Beaver's Bend State Park, 7 miles north and 4 east of Broken Bow, McCurtain County, April 26, 1952; *Robbins 2882*, rich soil in flood plain woods on north bank of Little River, 6.5 miles south of Broken Bow, McCurtain County, April 10, 1945 (OU); *Robbins 2951*, rich moist soil in oak-hickory woods about 0.5 mile southeast of Ada, Pontotoc County, April 28, 1948 (OU).

*Carex striatula Michx. So referred is *Little* and *Olmstead* 1581, *Quercus alba* climax forest association, uncut and unburned, southwest part of T4S, R25E, McCurtain County, June 5, 1930 (OU). The fruiting culms are mostly twice as long as the basal leaves, and are not winged.

*Cyperus polystachyos Rottb., var. texensis (Torr.) Fern. was collected as *Waterfall 11162*, along creek running through woods, 3 miles south of Broken Bow, McCurtain County, Oct. 10, 1952. It somewhat resembles *C. rivularis*, but has linear to linear-oblong achenes about 0.5 mm. wide.

*Eleocharis lanceolata Fern. with capillary culms, lanceolate-acuminate spikelets and acute scales is represented by *Waterfall 10277*, along creek in open woods, 2 miles east of Braggs, Muskogee County, July 24, 1951 and by *Waterfall 8521*, along creek in wooded hills, 2 miles north of Broken Bow, McCurtain County, Aug. 9, 1948. It has been known previously[2] only from Arkansas and Texas.

*Tradescantia ohiensis Raf., forma **pilosa** Waterfall, f. nov., vaginis inferioribus pilosis. The type is *Waterfall 10018*, prairie along railroad right-of-way, 2.5 miles south of Braggs, Muskogee County, June 12, 1951. It is in the herbarium of Oklahoma A. & M. College. Isotypes have been distributed to several other herbaria. We have additional material from Pushmataha, Pontotoc, Payne and Cleveland Counties. The lower sheaths are rather abundantly pilose in most of the specimens. In a few the pilosity is somewhat sparse.

*Tradescantia Ernestiana Anderson and Woodson, forma **alba** Waterfall, f. nov., petalis albis. The type of the white-flowered form is *Wallis 395* on flint bluff, 3.6 miles northeast of Tahlequah, Cherokee County, May 9, 1951. It is in the herbarium of Oklahoma A. & M. College.

*Chenopodium pumilio R. Br. (*C. carinatum* of auths., not R. Br.). We have the following collections: *Waterfall 11204*, along creek running through oak-hickory woods in mountains, 3 miles north of Broken Bow, McCurtain County, Oct. 11, 1952; *Waterfall 11211*. along Little River, Honobia, Pushmataha County, Oct. 12, 1952; *McCoy 3113*, rocky feed lot near Breco Lake, 3 miles south of Ada, Pontotoc County, July 6, 1952.

*Lepidium austrinum Small. So referred are: *Demaree 12567*, Arbuckle Mts. near Turner Falls, Murray County, May 26, 1936; *Elwell 107*, near Guthrie, Logan County, June 15, 1938; *Waterfall 2700*, railroad, 2 miles south and 4 east of Britton, Oklahoma County, May 17, 1941. The fruits are slightly appressed-hairy, and the stems are rather noticeably hirsute. Hitchcock[3] reports this species from "central and southwestern Texas and Mexico."

*Psoralea tenuiflora Pursh, forma alba Steyermark was collected as *Pinson*, prairie 5 miles north of Shawnee, Pottowatomie County, May 13, 1953.

*Centaureum texense (Griseb.) Fern. was collected in the Wichita Mountains of southwestern Oklahoma as *Waterfall 9129*, limestone slopes, 13 miles west and 3 north of Elgin, Comanche County, July 5, 1949. Tidestrom and Kittell, in their Flora of Arizona and New Mexico, state that this species ranges from Texas to southern New Mexico.

*Phacelia strictiflora (Engelm. & Gray) Gray, var. Robbinsii Constance, forma **albiflora** Waterfall, f. nov., corollis albis. The type is *Waterfall* 11277, sand in opening in post oak—black jack woods, 7 miles south of Antlers, Pushmataha County, April 17, 1953. It is in the herbarium of Oklahoma A. & M. College. The white-flowered form was rather rare among large numbers of lavender-flowered plants.

*Hedeoma sancta Small. So referred is *Waterfall 9440*, bank of Red River under *Juniperus Pinchoti*, 4 miles east and 4 south of Eldorado,

[2] Svenson, H. K. *Monographic Studies in the Genus Eleocharis.* Rhodora **31**: 207–208. 1929.

[3] Hitchcock, C. Leo. *The Genus Lepidium in the United States.* Madrono **3**: 287–288. 1936.

Jackson County, May 13, 1950. The calyx tubes are about 5 mm. long, while the subtending ovate leaves are about 1 cm. long. Small, in his "Flora" states that the species occurs "in dry soil, Texas."

*Lycopus rubellus Moench, var. arkansanus (Fresn.) Benner was collected as *Waterfall 11176*, growing on cypress knees (*Taxodium*) in dried-up cypress swamp, 3 miles south of Eagletown, McCurtain County, Oct. 10, 1952. Another number, *11183*, was taken from a more conventional habitat, the edge of the swamp, at the same time. The species has been known previously according to Fernald (Gray's Manual) from as far west as Arkansas and northeastern Texas.

*Datura quercifolia HBK., characterized by the fruit having unequal prickles with the larger ones being 1.5–2 cm. long and much flattened and widened toward their bases, was collected as *Waterfall 9700*. It was collected in sand in the bed of the Cimarron River, one-half mile north of Kenton, Cimarron County, Oct. 6, 1950. It was also observed in several places in the valleys near Kenton. Gray, in the Synoptic Flora (**2** (1): 240. 1886), states that it occurs from the southwestern borders of Texas to Arizona, and that it is naturalized from Mexico. Essentially the same information is given by Tidestrom and Kittell in their Flora of Arizona and New Mexico.

*Lycium pallidum Miers. On a trip to the Black Mesa area of Cimarron County in the northwestern end of the Oklahoma panhandle the author found a small stand of a species of *Lycium* in a vegetative state. After seeing it for several years, but never finding it in flower, he dug up a plant, and transplanted it in Stillwater. On May 1, 1952 it flowered and proved to be *L. pallidum*. On May 30, 1952 the original find, "on a stony ridge 6 miles north of Kenton, Cimarron County," was revisited and found in flower. It was collected as *Waterfall 10760*. The corollas are greenish, and the ovaries are on, or surrounded by, red discs. Hitchcock's[4] statement concerning distribution includes "western Texas, southern Colorado, New Mexico . . ."

*Nicotiana trigonophylla Dunal was mentioned earlier by the author in "A list of species of southwestern affinities,"[5] but has not been otherwise reported from the state. Although he has known the species for several years, the author unintentionally omitted it from his recent enumeration of the Oklahoma Flora.[6] We have it as *Waterfall 7801*, 4 miles east and 4 south of Eldorado, Jackson County, June 5, 1948. It has been observed several times since along the Red River in this area, but is known nowhere else in the state.

*Castilleja purpurea (Nutt.) Don, forma **corallina** Waterfall, forma nov., bracteis et calycibus pallido-corallinis. The forma with coral-pink bracts and calyces is occasional in colonies of forma *purpurea* near Hugo

[4] Hitchcock, C. Leo. *A Monographic Study of the Genus Lycium of the Western Hemisphere.* Ann. Mo. Bot. Gard. **19**: 299–304. 1932.

[5] Waterfall, U. T. *Some Additions to the Oklahoma Flora.* Rhodora **52**: 20. 1950.

[6] Waterfall, U. T. *A Catalogue of the Flora of Oklahoma.* 1–91. 1952. Publ. Research Found., Okla. A. & M. College, Stillwater.

and Ft. Towson near the type locality of *Euchroma purpurea* Nutt., "on rocks in the hilly prairies of Red River."[7] The TYPE is *Waterfall 9287*, prairies on "blackland" (shallow limestone-derived soil), 0.5 mile north of the junction of Highways 271 and 70, northwest of Hugo, Choctaw County, April 15, 1950. It is in the herbarium of Oklahoma A. & M. College at Stillwater.

IBERVILLEA LINDHEIMERI (Gray) Greene has been known from the Arbuckle Mts., where it is uncommon, for several years. We have additional material from the following counties of southwestern Oklahoma: *Waterfall 9406*, twining on *Lycium Berlandieri*, gyspum flat, 5.5 miles south of Hollis, Harmon Co., May 13, 1950; *Waterfall 9438*, gypsum bluffs along Red River, 4 miles east and 4 south of Eldorado, Jackson Co., May 13, 1950; *Waterfall 7679*, granite mountainside, north of Granite, July 28, 1947.

*BIDENS ARISTOSA (Michx.) Britt., var. MUTICA (Gray) Gattinger. The variety with awns lacking has been known previously from as far west as Missouri and western Louisiana according to Sherff.[8] We have it as *Waterfall 9832*, wet spot, 1 mile south of Idabel, McCurtain County, Oct. 21, 1950.

*CENTAUREA SOLSTITIALIS L. We have this introduced species as *Engleman 510*, in irrigated pasture of Elmo Jones near Goodwell, Texas County, July 20, 1953; also we have a specimen "collected by a farmer" near Sapulpa, Creek County, July 15, 1947.

*CIRSIUM VULGARE (Savi) Tenore (*C. lanceolatum* of auths., not Hill) was collected as *Waterfall* 7581, edge of swamp, 8 miles south and 3 east of Idabel, McCurtain County, July 18, 1947, and as *Wallis 879*, roadside ditch, 3.8 miles south of Tahlequah and 5.2 miles southeast, Cherokee County, Aug. 6, 1951.

*COREOPSIS GRANDIFLORA Hogg., var. LONGIPES (Hook.) T. & G. Referred here is *Waterfall 9451*, northern slopes of granite mountains, south of Lake Altus, Kiowa County, May 14, 1950. The collection has long peduncles (up to 30 cm. long) as Sherff[9] describes var. *longipes*. The flowering heads (including the rays) are 5–7 cm. across; the rays are 2–3 cm. long. Sherff cites material from Texas only.

*LIATRIS PUNCTATA Hook., forma ALBA Horr & McGregor. This white-flowered form was collected by *Beck* and *Patterson* in a prairie, 3 miles north of Stillwater, Payne County, Oct. 2, 1951.—DEPARTMENT OF BOTANY AND THE RESEARCH FOUNDATION, OKLAHOMA A. & M. COLLEGE, STILLWATER.

[7] Trans. Am. Phil. Soc. **5** (n.s.): 180–181. 1837.
[8] Field Museum of Nat. Hist.—Botany **16**: 214–217. 1937.
[9] Field Mus. Nat. Hist.—Botany **11**: 354. 1936.

William Arrents Silveus.—William Arrents Silveus was born in Greene County, Pennsylvania, November 6, 1875, and died August 16, 1953, in San Antonio, Texas. Son of David Moredock and Euphen May (Ely) Silveus, he was graduated from Waynesburg College in 1901 with the degree of Bachelor of Arts. In 1906 he was graduated from the University of Texas Law School and began the practice of law in San Antonio. He early took an interest in real estate and by the time he had reached his early fifties he was in a position to retire from active business with a confortable competence.

For a number of years he had accompanied his wife to Colorado Springs in early summer, returning for her in September, at both of which times it was his custom to spend a few days. Not caring for the usual pastimes of resort vacationers, he spent much of his time in long walks into the surrounding mountains, where, to satisfy the inquisitiveness of a small son, he learned most of the local forest trees. But the thousand miles between San Antonio and Colorado Springs lay almost entirely across grassland, much of which was devoted to grazing. Practice in distinguishing differences between different kinds of trees gave him an eye for differences between component grassland species. Most striking in the fall, they particularly attracted his attention at that season and he became deeply interested in discovering their significance. To that end he bought books on grasses, a binocular microscope, dissecting instruments and other equipment necessary to facilitate his studies. With these, and without any previous botanical training, he set energetically to work, collecting the vast bulk of his own material and working on it in an attic laboratory he built in his home.

As his work progressed his interest grew and grew till it attained an intensity like unto a religious fervor imbued with a missionary spirit. Having found them so engrossingly interesting to himself and being mightily impressed with their vast importance in the economy of meat, wool and mohair production under bad and increasingly worsening range conditions, he literally sold himself on the idea of becoming virtually an apostle of the grasses.

He found to his surprise, when he first aspired to begin his own study, that there was no single treatment of the grasses of Texas. He found, further, that all treatments were not only scattered but were couched in terms so highly technical that to comprehend them necessitated the acquisition of a practically foreign vocabulary. In overcoming this last handicap, *The First Book of Grasses*, authored by Agnes Chase, and published by Macmillan some years earlier, proved to be of inestimable value.

His goal was to provide all the essential information concerning Texas grasses in one book—information which he would make as easily available as possible to the interested, intelligent and inquisitive layman.

In order thoroughly to familiarize himself firsthand in the field with the subject matter for this proposed book, Mr. Silveus embarked upon a series of field investigations which was to last over a period of several years and take him repeatedly into every section of the state. He had hardly begun this phase of his work before it became apparent that a good photographic record would be essential. Accordingly he purchased for this purpose adequate equipment which he taught himself to use to effective advantage. In order to bring out detail, he devised a lighted box for use in his hotel room at night. Uniform light intensity and a favorable background enabled him to accumulate the excellent photographs from which to make illustrative plates.

In order to emphasize essential details not readily discernible in photographs, he employed a capable artist to whom he painstakingly pointed out such details, supervising the drawings to make sure they reflected the facts. In the matter of details which could be revealed only by dissection, he had her make line drawings from appropriate material which he carefully dissected under a binocular microscope and patiently explained. Cuts of these drawings accompanied appropriate photographic illustrations.

Another unusual feature, calculated to soften the impact of otherwise long and difficult strange words, was the introduction of common diacritical marks as an aid to pronunciation. This he did with the help of a generous and competent friend.

Still another unique feature is an illustrated key to the tribes, in which line drawings suggest the form and appearance both of the inflorescence and the spikelet, not only of a single representative genus, but frequently of two or more genera.

Thus it was that, in 1933, at the age of fifty-eight, this lawyer-turned-agrostologist published, entirely at his own expense, a really remarkable book: *Texas Grasses*. This achievement could never have been possible under such circumstances except as a result of the impelling drive of a sustained fervor in pursuit of a high and compelling ideal.

About this time Mr. Silveus discovered that the first edition of *The First Book of Grasses* was running out. The publishers believed, and rightly, that the original and limited demand had been met so completely as to render future demand so small that another edition was commercially not indicated. Mr. Silveus agreed; but to him the book had been so great a help that he felt it to be a must in the equipment of any beginner of the study of the grasses. Accordingly, he sought and obtained permission from both the author and the publisher to reprint it at his own expense, well knowing that the return of his money would be slow. This edition, a slightly modified version of the most excellent original, appeared in January, 1937, and is still available through his son, William I. Silveus, 832 Cambridge Oval, San Antonio, Texas.

By the example of his own experience of enthusiasm and success in learning grasses, and by pointing out to other laymen the means he had found useful in revealing the real interest inherent in a subject popularly believed to be both dry and forbiddingly difficult, it was his hope to stimulate a wave of interest on the part of other intelligent laymen in discovering for themselves, as he had done, that to learn about the grasses is actually both highly interesting and profitable.

During the course of his work on Texas grasses, Mr. Silveus became especially interested in two closely related and rather difficult genera, *Paspalum* and *Panicum*, with (according to Hitchcock) somewhat more than fifty and one hundred seventy-five species, respectively in the United States. Accordingly, he set himself to study them for the whole United States as he had studied grasses in general for Texas. By the time the manuscript was finished he estimated that he had traveled some 175,000 miles. This work extended in time over most of the interval between 1933, the publication date of *Texas Grasses*, and 1942, the publication date of *Paspalum* and *Panicum* of the United States.

The general plan for the latter was the same as for *Texas Grasses;* personal field acquaintance, collection, photographing and dissection, with the addition of line drawings to supplement photographs and to bring out details in dissected material.

Again Mr. Silveus, with a truly missionary spirit, bore all the costs of publication; but the high degree of specialization, the difficulty naturally inherent in these genera and their comparative economic unimportance, greatly limited demand. The consuming interest of the author just wasn't as contagious as he had hoped it would be, the wealth of illustration in the book notwithstanding. The result was that this venture was far from being a financial success—which doubtless was no surprise to Mr. Silveus.

The financial crash of 1929 and the subsequent depression of the thirties caught Mr. Silveus about midway in his work on Texas Grasses. Having attained considerable economic success on the principle that it is man's first duty both to himself and to society to live righteously, to labor industriously, to practice frugality and thus to achieve and maintain individual economic independence, he deplored the drastic remedial measures to which national resort was had in the early thirties to combat wholesale unemployment. He felt that whereas great industrial and commercial concerns were able in large measure to shift their taxes to the consumer, and whereas persons of low economic status escaped taxes simply by having nothing to tax, the great middle class, with no escape, was thus forced to shoulder a greatly disproportionate share of the huge national tax burden. He felt that this procedure ran counter to, and prevented the operation of, the natural processes by which he had attained success—processes which justly reward industry and thrift, and which equally justly penalize sloth and waste. He phrased some of his views in poetic but positive and forthright language and published them in an interesting pamphlet which he called *Nature's Way.*

A rugged, positive, poetic individualist with courage to pursue the right as he conscientiously saw it; a man who, having become modestly wealthy at fifty years of age, turned aside from the path of successful wealth accumulation to embark with missionary zeal upon an entirely different and financially expensive path, but a path along which he hoped to lead a great conservationist army of laymen and thus to render a real and lasting service to his fellow man while gladly contributing his time and defraying all the costs: this was William Arrents Silveus. His eminent success in a field totally foreign to that of his profession of the law probably stands with rare parallel in history.—B. C. THARP, UNIVERSITY OF TEXAS.

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NOMENCLATURAL NOTES CONCERNING JUNIPERUS

Marion T. Hall

The nomenclature for the calciphilous juniper from the Edwards Plateau of central Texas is considerably confused. It has long been referred to in the manuals as *Juniperus mexicana* Sprengel. The name *Juniperus Ashei* Buchholz is now in fairly common use for the Texas species, and it is my purpose to show why it may continue to be used and why *Juniperus mexicana* Spreng. and other names may not.

Early collectors had the idea that this Texas calciphile represents the northernmost distribution of a juniper from the mountains of central Mexico. American authors have consistently referred this juniper to Sprengel's species described in 1826 on page 909 in volume 3 of Linné Systema Vegetabilium as:

> "*mexicana** 20. J. arborea, foliis arctissime 4fariam imbricatis 3angulari-ovatis obtusis crassis. Mexico. (Cupressus sabinoides Kunth.)"

Sprengel's species, based on *Cupressus sabinoides* HBK,[1] refers to a juniper of high altitudes in central Mexico which resembles the Texas juniper somewhat in habit but is otherwise very different. At that time Sprengel was justified in naming his transferred species *mexicana*, since there were no rules. However, after the establishment of the International Rules of Botanical Nomenclature, it would have been necessary (in lieu of Art. 54 of the rules) for subsequent authors to re-establish the

[1] Humboldt, Bonpland, and Kunth. Nova Gen. et Sp. Plant. ii: 3, 1817.

name *sabinoides* for Sprengel's species, *Juniperus mexicana*, which, by these retroactive rules of nomenclature, was superfluous when created and thereby illegitimate. If Sprengel could have looked ahead, he might have transferred HBK's specific name to *Juniperus* and avoided creating a name destined to become illegitimate. When Martínez[2] examined the problem in 1946 and determined which juniper Sprengel and Kunth were describing, he had to find a new name because both *sabinoides* and *mexicana* were by then homonyms.[3] Martínez decided that Sprengel's and HBK's names applied to a juniper which he considered to be a form of another species. He had to apply a new name to his species, too, since the only existing one, *Juniperus tetragona* Schl.[4] (1838), was a homonym (of *Juniperus tetragona* Moench,[5] 1794). Thus, in 1946 Martínez named the Mexican species *Juniperus monticola* and created two forms within it. One of these forms, *Juniperus monticola* Martínez forma *compacta* Martínez is the element to which he referred *Juniperus mexicana* Spreng. and *Cupressus sabinoides* HBK.

Both the Texas calciphile (*J. Ashei* Buchholz) and *J. monticola* Mart. are in the Sabina section and have their affinities with the xerophytic junipers which have toothed leaf margins and branching to the seventh degree. While these two species are superficially similar (e.g., in habit, fruit color, size, and odor), they are very different when these characters are studied carefully and in their proper relation to other characters. On morphological evidence the Texas calciphile is closely related to *J. monosperma* (Engelm.) Sarg. and its close relatives *J. occidentalis* Hook., *J. Pinchoti* Sudw., *J. californica* (Carr.) Antoine, *J. erythrocarpa* Cory and varies in the direction of the *J. deppeana* Steud. group. It is not close to *J. monticola* Mart. or *J. monticola* forma *compacta* Mart. (*J. mexicana* Spreng.) to which it has been assigned by American authors. The chief differences

[2] Martínez, M. *Los Juniperos Mexicanos.* Anales Del Instituto de Biologia *17:* 3–128. 1946.

[3] Grisebach, A. H. R. Spicil. Fl. Rumel. ii: 352. 1844. Grisebach had given the name *Juniperus sabinoides* to another species in 1844. Grisebach's name applies to *J. foetidissima* Willd. Schlechtendal had given the name *J. mexicana* to another species in 1830. The modern interpretation requires the epithets *sabinoides* and *mexicana* to become homonyms based on Article 73 of the International Code of Botanical Nomenclature in lieu of the retroactive nature of these rules.

[4] Schlechtendal, D. F. L. Linnaea XII. 495–496. 1838.

[5] Moench, C. Meth. Pl. 699. 1794. (= *J. phoenicea* L.)

between *J. Ashei* and *J. monticola* are listed in Table 1 and illustrated in Plate 1.

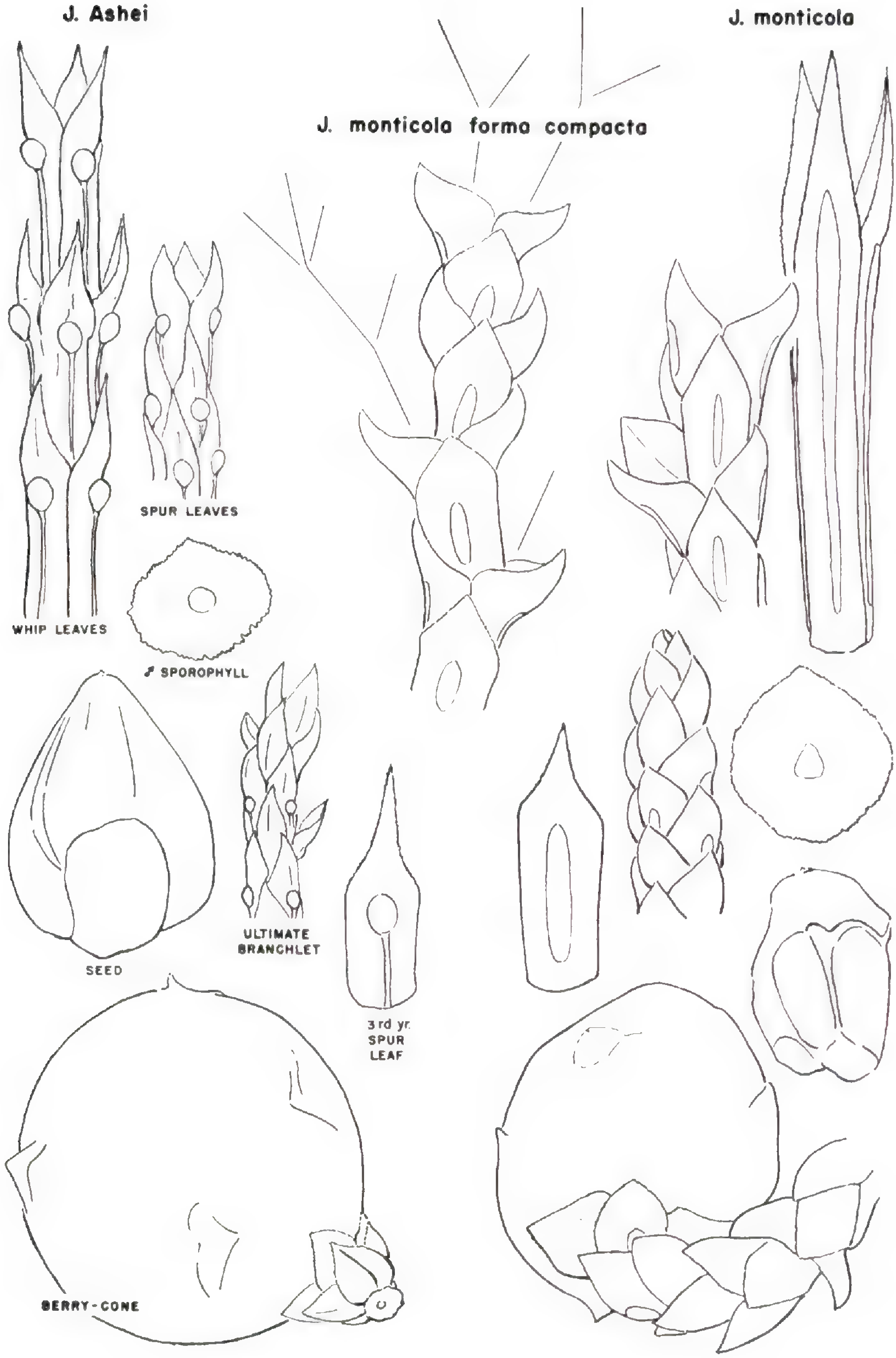
TABLE 1. COMPARATIVE GROSS MORPHOLOGY OF J. ASHEI AND J. MONTICOLA.

Juniperus Ashei	*Juniperus monticola*
1. Trunk branched near the base; angle of branching wide; aspect bush-like; height to 35 feet.	1. Trunk branched near the base, branches twisted; angle of branching acute; aspect like a dwarf tree; height to 25 feet (usually less than 3 feet in forma *compacta*).
2. Foliage dense; mostly ternate, even on ultimate branchlets.	2. Foliage more dense; mostly decussate (densest in forma *compacta* where branching occurs typically from the axil of every other leaf in the same plane giving a fan-like, blunt aspect to the foliage).
3. Foliage yellow-green. Young woody twigs bright rust-brown aging to ash-gray.	3. Foliage blue-green. Young woody twigs tawny-red with a violet blush.
4. Whip leaves average 7 mm. long with a circular raised gland (about ½ mm. in diameter), and a keel extending from the gland to the base of the sheath.	4. Whip leaves average 10 mm. long with a long narrow sunken gland most of its length, no keel.
5. Spur leaves 1½ to 2 mm. long with round gland or frequently eglandular.	5. Spur leaves slightly larger with long narrow gland, elongate-elliptic, rarely eglandular.
6. Fruit large (6–8 mm. in diameter), aromatic, azure-blue, slightly bloomy, with slightly resinous juicy pulp, which is black when fresh and rust-brown when dry, fruiting branchlets straight.	6. Fruit slightly larger (7–9 mm. in diameter), aromatic, azure-blue, slightly bloomy, with slightly resinous juicy pulp which is green when fresh or dry, fruiting branchlets usually crooked.
7. Seed chocolate-brown, 5 mm. in length, 1, rarely 2 per berry-cone, sharply pointed tip, no pits, occasionally a very narrow longitudinal groove, smooth white hilum covering at least one-fourth the length of the seed.	7. Seed tan to chestnut-colored, 3–4 mm. in length, 3 or 4, rarely 6 to 8 per berry-cone, extremely angular, numerous deep pits, irregular light tawny hilum covering one-half to three-fourths the length of the seed.

But is *J. tetragona* Schl. var. *oligosperma* Engelm. to be placed in synonymy with *J. monticola* Mart. and what is its relation to the Texas calciphile *J. Ashei*? The specimens[6] on which Engelmann based this variety, *Gregg 106* (June 2, 1848) and *398* (Aug. 31, 1848) collected near Saltillo, Mexico, have been

[6] ENGELMANN, G. Trans. Acad. Sci. St. Louis 3: 591.

Plate I. Comparative Gross Morphology of Juniperus monticola and Juniperus Ashei



studied and must be referred to *J. monosperma* (Engelm.) Sarg., placing the var. *oligosperma* in synonomy with Sargent's species. A slight complication exists because of Gregg's collecting methods. The duplicate of *Gregg* (*106*) in the Gray Herbarium is a hybrid of *J. Ashei* and *J. monosperma,* showing intermediate morphology. There are at least four and probably more species of *Juniperus* growing on the foothills in the vicinity of Saltillo. Hybridization is common where juniper species grow together. Gregg most likely collected from a mixed population and gave a hybrid and fairly typical specimen of *J. monosperma* the same number later when he prepared his labels. The typical specimen of *J. monosperma* went to Engelmann and the other (the hybrid) went to Gray.

This error on the part of American authors in referring to the Texas juniper by means of the various names for the very different Mexican species is the source of the confusion. The Texas juniper is a distinct species from the Mexican one; consequently, none of the above names apply. Other names, all synonyms of *J. monticola* forma *compacta,* which have been erroneously applied to the Texas species are *J. sabinoides* (HBK) Nees (1847), *Sabina sabinoides* (HBK) Small (1903), and *J. sabinoides* (HBK) Sargent (1897). The latter combination has no status since the same combination cannot be made twice.

Engelmann[7] described a juniper from "West Texas" as *J. occidentalis* Hook. var. *conjungens* Engelm. His description was rather sketchy but it fits *J. Ashei* better than any other southwestern species. His illustration of var. *conjungens*[8] precisely fits the collection by Berlandier (671 = 2081) which Engelmann cites. Other collections (numbers and dates are supplied by the present author) which Engelmann cites are those of Lindheimer from the base of the Balcones Escarpment, New Braunfels, Texas, 1848 (362 and 228) Feb. 1850, May 1875, and Lindheimer (1194, 1195, 1196, 1197, 1198) from Comanche Spring and New Braunfels, Feb. 1850; Wright, New Braunfels, Texas; Bigelow, the only specimen seen in the Engelmann Herbarium, was collected in 1853 in the Valley of the Pecos, Texas, labelled *J. occidentalis* Hook. (the specimen is actually *J. monosperma* Sarg.); Hall (615 = 7741) from Austin, Texas, May 15, 1872.

[7] Engelmann, G. loc. cit. p. 590.
[8] Engelmann, G. loc. cit. p. 585.

While Ferdinand Lindheimer and Elihu Hall collected in Texas in the vicinity of San Antonio, Austin, and New Braunfels, Charles Wright and John M. Bigelow collected mostly in west Texas during the Mexican boundary survey. Wright's specimen from New Braunfels (undated and without number) was probably collected May 29, 1849, according to the list of localities visited by him published by Wooton.[9] All of these specimens excluding Bigelow's are from the Balcones Escarpment in a region where hybrid swarms between *J. Ashei* and *J. virginiana* are legion. These specimens are not typical of *J. Ashei* but are probably backcrosses from hybrid material to *J. Ashei* and should be identified with the latter species. Berlandier's specimen particularly shows a few characters of *J. virginiana*, such as elongate glands on the long shoot leaves, foliage fine and dark green instead of thick and olive green, teeth on the leaf margins irregular in size and remotely spaced. Even though these specimens probably are of hybrid origin, they are so close to *J. Ashei* in morphology that I consider them to belong to that species.

Other specimens which Engelmann mentions in relation to *J. occidentalis* var. *conjungens* were a Sartorius collection from Mexico in the Torrey Herbarium and an Aschenborn (381) specimen from Zimapan, Mexico. Engelmann felt that these specimens were probably the same thing as his var. *conjungens*. I have examined these specimens, and the Sartorius collection is a specimen of *J. monticola* Mart.; the Aschenborn (381) is a specimen of *J. monosperma* (Engelm.) Sarg. He also cites a Charles Wright collection ". . . found in the damp rocky woods of the mountains of eastern Cuba a few individuals of a middle-sized tree, apparently very rare, of which only male specimens were obtained (Pl. Cub. 3187, *J. virginiana*, Griseb. Pl. Cub. 217), . . ." This specimen belongs to the species *J. lucayana* Britton.

Since the specimens on which the var. *conjungens* was based are not hybrids in the technical sense, the name *conjungens* (1877) is a valid varietal epithet for the calciphilous juniper of central Texas. However, if the view be adopted that this juniper deserves specific rank, the only available name is *J. Ashei* Buchholz (1930).

[9] Wooton, E. O. Bull. Torr. Bot. Club 33: 563.

The following outline will serve to summarize the nomenclatural status of *J. Ashei.*

JUNIPERUS ASHEI Buchholz, Bot. Gaz. **90**: 326–334. 1930. *Cupressus sabinoides* of authors, not of Humboldt, Bonpland & Kunth. *Juniperus mexicana* of Standley, Contr. U. S. Nat. Herb. **23**: 62; of Palmer and Steyermark, Ann. Mo. Bot. Gard. **22**: 454, 1935, of authors but not Sprengel nor Schlechtendal. *Juniperus sabinoides* of authors not Grisebach or Nees. *Juniperus sabinoides* of Sargent, Silva N. Am., **X**: 91. 1897, not *Cupressus sabinoides* HBK. *Sabina sabinoides* of Small, Fl. Southeastern U. S., 33, 1903, not *Cupressus sabinoides* of Humboldt, Bonpland & Kunth. *Juniperus occidentalis* Hook. var. *conjungens* Engelm., Trans. Acad. Sci. St. Louis **III**: 590. 1877.

Buchholz[10] described *J. Ashei* from material collected on the bluffs of the White River near Sylamore, Arkansas, but he did not clearly designate a type in his published account of it. However, there are two herbarium sheets of this species in the Herbarium of the University of North Carolina labeled as types, one labeled ♀ type and the other ♂ type specimen.

There are no special considerations in relation to the type method given to dioecious plants in the International Rules of Botanical Nomenclature. In *Juniperus* the female specimen possesses the best characters for differentiating taxa, so that specimens bearing mature berry-cones are the better material for types.

Buchholz[11] wrote "Material examined.—Arkansas (J. Ashei): Sylamore, W. W. Ashe, Jan. 9, 1923, Apr. 25, 1924, and Apr. 28, 1925, Sept. 16, 1923, and Mar. 6, 1924, male- and female-type specimen, in herb. W. W. Ashe (cotype material on deposit at Herb. Mo. Bot. Gard. and elsewhere)." The ♀ type specimen bears three dates one of which, Sept. 16, 1923, he cites. The ♂ type specimen bears the date Mar. 16, 1924 which may have been cited as Mar. 6, 1924. The specimen marked ♀ type is accession number 22520 of University of North Carolina Herbarium. It consists of 3 twigs collected at different dates and 2 pieces of bark all from the same tree. The twig with smaller immature fruit was collected March 28, 1924, just after fertilization had occurred; the twig with intermediate sized fruit was collected May 6, 1924; the twig with mature fruit was collected September 16, 1923; and this latter twig bearing

[10] BUCHHOLZ, J. T. Bot. Gaz. **90**: 326–334. 1930.

[11] BUCHHOLZ, J. T. loc. cit.

the September date is hereby designated the *Lectotype*. The other two specimens on this sheet and the specimens on the sheet marked male-type are *Paratypes*. These specimens were in the W. W. Ashe Herbarium now on deposit at the Herbarium of the University of North Carolina.

Type locality is the limestone soil in the basin of the White River near Sylamore, Arkansas. This material which constitutes the nomenclatural type is not biologically typical of the species *J. Ashei* since it was derived in the vicinity of hybrid swarms between *J. Ashei* and *J. virginiana* and shows introgression from *J. virginiana*.

In his study of Mexican Junipers Martínez[12] stated that there is no juniper known to him in Mexico which could be referred to the Texas calciphile, *J. Ashei* or *J. mexicana* Spreng. sensu American authors. He referred all those specimens from Mexico so named to either *J. erythrocarpa* Cory or *J. monosperma* (Engelm.) Sarg. However, there are three collections from Mexico known to me which I refer to the Texas species, *J. Ashei: I. M. Johnston, 9195*, from Protrero de La Mula, northwest of Ocampo, Coahuila; *F. Lyle Wynd and C. H. Mueller, 284*, Hacienda Mariposa near Puerto Santa Ana, Coahuila, determined as *J. pachyphloea; F. Lyle Wynd and C. H. Mueller, 360*, near Puerto Santa Ana, Coahuila. None of these three specimens is typical of Ashe juniper; nevertheless, each resembles *J. Ashei* more than any other species and deserves to be considered a variant of that species. In several characters they vary toward *J. monosperma*, and I believe that they represent introgressants of *J. Ashei* by *J. monosperma*. Since taxonomists do not propose to name every hybrid variant and particularly every introgressant, these specimens should be referred to *J. Ashei* Buchholz.

Martínez annotated I. M. Johnston's specimen 9195 as *J. monosperma* (Engelm.) Sarg. and cited it as such in his revision. He had sent the specimen to John Buchholz who told Martínez that it was not *J. Ashei*, the species which Buchholz himself had named. This situation does not seem so strange when one considers the facts. Buchholz named material from the Ozarks where specimens of *J. Ashei* are really introgressants with genes

[12] Martínez, M. loc. cit. p. 101.

of *J. virginiana* and have fine foliage, smaller fruit, more often with two seeds, and Johnston's specimen is from Coahuila where *J. Ashei* has received genes from *J. monosperma.*

The distribution of *J. Ashei* may be considered a narrow ellipse about 1,000 miles long roughly running from southwestern Missouri to central Coahuila with a northeast, southwest axis. In the northeast the species is disjunct and shows strong introgression from *J. virginiana;* in the southwest the species again occurs in isolated colonies and shows introgression from *J. monosperma* from Coahuila up the western border of the range of *J. Ashei* to the Valley of the Pecos in Texas.

The nomenclature of the Mexican species involved in this problem may also be outlined following Martínez, 1946.

Juniperus monticola Martínez, Anales Del Instituto de Biologia **17**: 79, 1946, based on *Juniperus tetragona* Schl. not Moench, 1794.

J. monticola Mart. forma compacta Mart. loc. cit. p. 85.

Cupressus sabinoides HBK., Nova Gen. et Sp. Plant. **II**: 3, 1817. *Juniperus mexicana* Spreng., Syst. Veg. Ed. 3: 909, 1826, based on *Cupressus sabinoides* HBK. *Juniperus sabinoides* (HBK) Nees, Linnaea **XIX**: 706, 1847, not A. H. R. Grisebach. Spicil. Fl. Rumel. 1844. *Sabina sabinoides* (HBK) Small, Fl. Southeastern U. S. 33, 1903, as to basinym only.—

CRANBROOK INSTITUTE OF SCIENCE BLOOMFIELD HILLS, MICHIGAN.

NEW OR ADDITIONAL RECORDS OF GRASSES IN MARYLAND AND DELAWARE

Clyde F. Reed[1]

For many years chrome ore has been imported into the Port of Baltimore, and Canton has been one of several places where the ore has been piled until needed by the various industries in and about Baltimore. Some of the piles have existed in place for several years permitting seeds to germinate and grow, and thus allowing the plants to spread to nearby fields. Well over 200 species of plants have been found by the author and others on these chrome piles, a great many of which have never been recorded in the floras of eastern North America. Some of these species have been collected in Canton as far back as 1890 by Charles C. Plitt, and his collections are in the Reed Herbarium. Therefore, some of these plants have been around Canton for over fifty years.

In this paper only the grasses from the chrome piles will be presented along with some species of grasses from other areas of Maryland and Delaware, the records of which extend the known ranges for these species and are in the main new to Maryland and Delaware.

I wish to thank Agnes Chase and Jason Swallen of the United States National Herbarium for aiding in the identification and verification of these specimens cited below. Specimens of most of the species have been deposited in the U. S. National Herbarium.

There were 31 species of grasses found on the chrome ore piles at Canton this year by the author, 16 of which are new to Maryland and the eastern United States in general. Many of the genera are new to eastern North America. Canton is an industrial area in the southeast corner of the city of Baltimore near the Baltimore County border, and in the past has been considered as being in that county. The ranges of the species as they affect our region only are given, unless the extension is unusual for the known range of a given species. Species marked with an asterisk are new to Maryland.

[1] Reed Herbarium, Baltimore 34, Maryland.

*Eragrostis diffusa Buckl. This species being found in Maryland extends the range east from Indiana and north from North Carolina. It is a western species which has been introduced occasionally in the Eastern States. (Hitchcock, p. 153, fig. 204.) Maryland specimens: Canton, *Reed 32750*, *Reed 32740*, *Reed 32785* collected Sept. 27, 1953; *Reed 32908*, Oct. 12, 1953, panicle is fewer-flowered than typical plants.

Other species of *Eragrostis* which were found on the chrome ore piles which have been reported previously from Maryland are: *E. cilianensis* (All.) Lutati, *Reed 32711*, Sept. 27, 1953 and *Reed 32893*, Oct. 12, 1953; *E. pectinacea* (Michx.) Nees, *Reed* 32905, Oct. 12, 1953 and *Reed 33029*, Nov. 10, 1953; *E. poaeoides* Beauv., *Reed 32713* and *32792*, Sept. 27, 1953.

*Tridens pulchellus (H.B.K.) Hitchc. This western species is native from California and Nevada to Texas. (Hitchcock, p. 208, fig. 275.) Maryland specimen: Canton, *Reed 32827*, Sept. 27, 1953.

Tridens flavus (L.) Hitchc. (*Triodia cuprea* Jacq.) This species was collected in Canton, Aug. 25, 1893 by C. C. Plitt. It has been found many times by the author in other regions of Maryland. Specimen in Reed Herbarium cited above.

*Enneapogon desvauxii Beauv. This western species is native from Utah and Texas to Arizona and south to Argentina. (Hitchcock, p. 227, fig. 304.) Maryland specimens: Canton, *Reed 32907*, Oct. 12, 1953; *Reed 33002*, Nov. 2, 1953.

*Sporobolus pyramidatus (Lam.) Hitchc. This species is native from Colorado and Kansas southeastward to southern Florida, Louisiana and Texas, and thence to tropical America. (Hitchcock, p. 424, fig. 608.) Maryland specimens: Canton, *Reed 32766*, Sept. 27, 1953.

*Aristida adscensionis L. This species is native from California to Texas and Missouri. (Hitchcock, p. 468, fig. 685.) Maryland specimens: Canton, *Reed 32752*, and *Reed 32826*, Sept. 27, 1953.

*Tragus racemosus (L.) All. Although this is an Old World species, it has spread from Arizona to Texas in western United States and from Maine to North Carolina in eastern United States. (Hitchcock, 484, fig. 713.) New to Maryland: Canton, *Reed 32800*, Sept. 27, 1953.

*Leptochloa dubia (H.B.K.) Nees. This is another western species, being native from Arizona to Oklahoma and Texas. (Hitcock, p. 491, fig. 721.) Maryland specimens: Canton, *Reed 32751*, Sept. 27, 1953.

*Chloris virgata Swartz. This species is native in central and southwestern United States and has been introduced in several states in eastern areas as far as Florida, North Carolina and Ohio. It has been found on wool waste in Massachusetts and Maine. Now from chrome ore piles it can be recorded from Maryland: Canton, *Reed 32714*, Sept. 27, 1953. (Hitchcock, p. 527, fig. 764.)

*Bouteloua barbata Lag. This is another western species, native from California and Utah to Texas. (Hitchcock, p. 538, fig. 781.) Maryland specimens: Canton, *Reed 32824*, Sept. 27, 1953.

*Bouteloua aristidoides (H.B.K.) Griseb. This species is native from California and Nevada to western Texas. (Hitchcock, p. 533, fig. 772.) Maryland specimens: Canton, *Reed 32727*, Sept. 27, 1953.

*Eriochloa gracilis (Fourn.) Hitchc. This western species is native from southern California along the Rio Grande to western Texas and Oklahoma. (Hitchcock, p. 590, fig. 850.) Maryland specimens: Canton, *Reed 32728*, Sept. 27, 1953.

*Brachiaria erucaeformis (J. E. Smith) Griseb. This Old World species has been cultivated in grass gardens and is occasionally escaped. (Hitchcock, p. 593, fig. 857.) However, from the chrome ore piles are the following Maryland specimens: Canton, *Reed 32763*, Sept. 27, 1953.

*Paspalum distichum L. In eastern United States this species is known from Pennsylvania and New Jersey south to Florida. However, it is found through the South and thence to western United States. New to Maryland is the following record: Canton, *Reed 32749*, Sept. 27, 1953. (Hitchcock, p. 603, fig. 866.) *Paspalum circulare* Nash is also found on the chrome ore piles at Canton, *Reed 32810*, Sept. 27, 1953.

*Setaria grisebachii Fourn. This is a weed, native from Texas to Arizona and Mexico. (Hitchcock, p. 724, fig. 1103.) Maryland specimens: Canton, *Reed 32731*, Sept. 27, 1953; *Reed 32909*, Oct. 12, 1953.

Setaria lutescens (Weigel) Hubb. (*Reed, 32799*, Sept. 27, 1953) and *S. verticillata* (L.) Beauv. (*Reed 32674*, Sept. 27, 1953) have also been found on the chrome ore piles at Canton.

Sorghum vulgare Pers. and **S. vulgare* var *technicum* (Koern.) Jav. were both found on the chrome ore piles at Canton, Maryland. Sorghum is usually cultivated in the South and has escaped in waste places there. The variety *technicum* is the one used in the making of brooms. Maryland specimens: Canton, *Reed 32761*, Sept. 27, 1953 and *Reed 32753* (var. *technicum*), Sept. 27, 1953.

Sorghum halepense (L.) Pers. also grows on the chrome ore piles, being found elsewhere in Maryland as well. Canton, *Reed 32741*, Sept. 27, 1953 and *Reed 32683*, Oct. 2, 1953.

There are several other species of grasses on the chrome ore piles which have been reported previously from other places in Maryland. These are: *Phragmitis communis* Trin. (*Reed 33034*, Nov. 10, 1953); *Triticum aestivum* L. (*Reed 32672*, Sept. 27, 1953); *Hordeum vulgare* L. (*Reed 32825*, Sept. 27, 1953); *Eleusine indica* (L.) Gaertn. (*Reed 32717*, Sept. 27, 1953); *Dactyloctenium aegyptium* (L.) Beauv. (*Reed 32718* and *32720*, Sept. 27, 1953); *Cynodon dactylon* (L.) Pers. (*Reed 32784*, Sept. 27, 1953; *Reed 32914*, Oct. 12, 1953; *Reed 32696*, Sept. 27, 1953 (along shores near chrome piles)); *Phalaris canariensis* L. (*Reed 32887*, Oct. 12, 1953); *Panicum dichotomiflorum* Michx. (*Reed 32748*, Sept. 27, 1953).

Several other grasses worthy of mention as being new or as extensions of ranges are the following from various regions of Maryland or Delaware.

*Bromus rigidus Roth. Fernald gives "Maryland and D. C."; Hitchcock gives "Maryland and Virginia"; the other publications mention Maryland; Tatnall does not list it from Delaware. Therefore, new to Delaware—Edge of Indian River, west of Millville, Sussex County. June 28, 1953. *Reed 31529.*

*Bromus japonicus Thunb. var. porrectus Hack. Although this species is stated by all references as being found in Maryland, references to Delaware are absent. Hitchcock mentions that this variety is more common from Maryland and southward. New to Delaware—Edge of Indian River, west of Millville, Sussex County. June 28, 1953. *Reed 31528.*

Arrhenatherum elatius var. bulbosum (Willd.) Spenner. Although Hitchcock does not include either Maryland or Delaware in the distribution of this species or variety, it has been listed from Maryland by Chase in Hermann, by Norton and Brown and by Fernald and from Delaware (Sussex Co.) by Tatnall. An additional record from Delaware: roadside, off route no. 26, between Dagsboro and Millville, Sussex Co., June 28, 1953. *Reed 31515.*

ARTHRAXON HISPIDUS (Thunb.) Makino. This species is reported as rare in Maryland, being listed in Hitchcock from near Washington, D. C. To this record may be added the following. Fields, Cub Hill, Baltimore County. Oct. 15, 1953. *Reed 33143*. *A. hispidus* var. *cryptatherus* (Hack.) Honda is stated to be the more widely distributed form in eastern United States, from Pennsylvania to Florida and westward to Missouri and Louisiana.

FESTUCA ARUNDINACEA Schreb. Hitchcock is the only reference cited that mentions this species as being found in eastern United States (Maine, Massachusetts, New York, Ohio, Kentucky and westward). Fernald does not even mention it from that region. New to Delaware: roadside, off route no. 26, between Dagsboro and Millville, Sussex Co., June 28, 1953. *Reed 31510.*

TRIPLASIS PURPUREA (Walt.) Chapm. This species has been listed by Chase in Hermann from Maryland and by Tatnall from Delaware. An additional record from Delaware is—sandy beach, Broadkill Beach, Sussex Co. Aug. 31, 1952. *Reed 30449.*

DANTHONIA SERICEA Nutt. This species is listed by Tatnall from Sussex County, Delaware and southward. Hitchcock (p. 310) listed it from both Maryland and Delaware. Additional material may be cited: open wet fields, Gray's Creek, just north of Gibson Island, Anne Arundel County, Maryland. July 7, 1951. *Reed 25958.* Fernald (p. 150) gives the range of this species as "Florida and Louisiana to New Jersey and southern Kentucky." Hitchcock extends its range to Massachusetts (Sherborn) along the Coastal Plain.

ARUNDINARIA TECTA (Walt.) Muhl. The range for this species is given by Hitchcock from southern Maryland to Alabama and Mississippi on the Coastal Plain. In northcentral Maryland in the Piedmont Region but on a Coastal recess at about 400 feet altitude there are several coastal plants, among them being this bamboo. This record extends the range northward in Maryland as well as up upon the Piedmont Plateau. Patch about four acres, swampy place along Harford Road, one-half mile north of Carney, Baltimore County. Aug. 19, 1951. *Reed 26865.*

POLYPOGON MONSPELIENSIS (L) Desv. The range for the Rabbit's-foot Grass on the Delmarva Peninsula is given by Tatnall (p. 31) as "from Cape Charles northward to Worcester and Wicomico Counties." Within this range I wish to report the following collections: marshy land, Chincoteague Island, Accomac County., Virginia. Aug. 16, 1947. *Reed 9150* and July 12, 1953. *Reed 31752* and *31753.* Then, I wish to extend the range northward and westward on the Delmarva Peninsula to Dorchester County: edge of woods, between Drawbridge and Bucktown, Maryland. June 28, 1953. *Reed 31600.*

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Heterotheca subaxillaris on Long Island, New York.—The New York International Airport in Queens County, Long Island, New York is apparently the northernmost station for *Heterotheca subaxillaris* (Lam.) Britt. & Rusby.

The writer first observed the species at this locality in the late summer of 1950, its weedy annual or biennial yellow ray-flowered plants amassed in large ribbon-like colonies along the access and service roads and the airstrips of the nearly five thousand acres of dry sandy reclaimed salt marsh which constitute the terrain of this vast air terminus. Observations over three subsequent growing seasons indicate these colonies are well-established and increasing.

Fernald[1] indicates that the original range of *H. subaxillaris* would seem to have been Florida to Arizona and Mexico, having spread northeastwardly to Delaware long ago (and northwardly to Kansas). Yet it was only in 1939 that the same author[2] collected in Isle of Wight County, Virginia the first specimen of *H. subaxillaris* to be recorded from between North Carolina and Maryland. Perhaps this is more a picture of incomplete reporting than of actual distribution. Gleason[3] cites a specimen taken from ballast in Philadelphia in 1864. Tatnall[4] observed that the species was well established in southern New Jersey (near Philadelphia) in 1946, and ventured the opinion that the species was apparently spreading rapidly northward. The present writer's collection ninety miles to the northeast may bear out this suggestion. In 1953, several plants were seen just outside the perimeter of the airport. In view of the abundant local ecological conditions favorable to this xerophyte, and taking into account its windborn achenes, the spread of *H. subaxillaris* eastward on Long Island, and perhaps even farther north on the Coastal Plain should be watched for.

The possible source of *H. subaxillaris* on Long Island is a matter of some interest. In attempting to hold the shifting sands of the New York International Airport, the Port Authority engineers planted thousands of tufts of beach grass obtained from various sources, only one of which, in Delaware,

[1] Fernald, M. L. 1950. Gray's Manual of Botany, 8th edition. p. 1378.

[2] Fernald, M. L. 1939. Rhodora **41**: 469, 571.

[3] Gleason, H. A. 1952. The New Britton & Brown Illustrated Flora. vol. 3, p. 412.

[4] Tatnall, R. R. 1946. Flora of Delaware and the Eastern Shore, p. 256.

lies within the usual range for this species. Years ago, before the area was altered for its present purpose, it bore the name of "Idlewild", and it was a popular botanizing station with local enthusiasts, who visited it to see many fine specimens of the beautiful Yellow-fringed Orchid, *Habenaria ciliaris* (L.) R. Br., a species even then doomed in the metropolitan area. Idlewild Point was noteworthy as the only American station for the typical *Elymus arenarius* L.[5] and it would be interesting to revisit the spot to check for this species. Adventitious plants other than *H. subaxillaris* may be expected to appear on the altered Idlewild site, which may serve to respark the area as an interesting botanical workground.

The most diagnostic characteristic of *H. subaxillaris* in the field is the strong camphorous odor emitted by bruised tissue. This is a fact which generally seems to be passed over in the literature, but it is singular enough to immediately separate it in the field from any other plant it might superficially resemble, such as species of *Chrysopsis*. It is this attribute which gives the common name of "Camphorweed" to the plant, surely a far more apt designation than "Golden Aster," which should be strictly limited to species of *Chrysopsis*.

The writer wishes to express his appreciation to Mr. Joseph Monachino of the New York Botanical Garden Herbarium for verifying his identifications and for other very helpful services. A sheet verifying this record has been deposited in the herbarium there and a duplicate is deposited in the herbarium of Tackapausha Preserve of Nassau County, Seaford, New York.
—LEONARD J. UTTAL, UNIONDALE, NEW YORK.

[5] MONACHINO, J. 1941. Torreya 3: 97–99.

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INTERSPECIFIC HYBRIDIZATION IN EASTERN ELYMUS

George L. Church

Among the diagnostic features of the genus *Elymus*, the structure of the glumes presents a rather perplexing series of variations. The first part of this paper deals with an analysis of associated stands of *E. Wiegandii* Fern. and *E. riparius* Wiegand in New England that reveals, not only variant forms with unusually indurated and setaceous glumes, but certain morphological and cytological features that are useful in the detection of rare stands of both species in Ontario, Minnesota and Wisconsin, considerably beyond their presently recognized range (Fernald 1950).

Furthermore, in the western Great Lakes area, the exceptional, mid-western representatives of the above eastern species apparently have been easily confused with members of the *E. interruptus* (of recent authors; not Buckley) complex, a series of forms in which the glumes show extensive reduction from a nearly flat to a very setaceous condition. Accordingly, a second part of this paper is devoted to a preliminary study of *E. interruptus* in Minnesota and adjacent areas. Due to a lumping of these taxa with those of more southern range (Chase 1950), however, it is necessary first to present an analysis of *E. interruptus* Buckl. and the related *E. canadensis* L. v. *brachystachys* (Scribn. & Ball) Farwell of Texas. In this complex, an independent development of setaceous glumes has been effected in experimental hybrids, a phenomenon that suggests a parallel to the occurrence of setaceous glumes in northern *E. interruptus*.

It will be shown, however, that to date there appears to be no sound basis for the merger of the two taxa.

E. Wiegandii × E. riparius in New England

In New England, *E. Wiegandii* and *E. riparius* often grow in the same area along shady, alluvial banks, such as those of the Connecticut River and Lake Champlain drainage systems, where a part of the present study has been focused. Typical *E. Wiegandii* grows in erect clumps, averaging one and a half meters in height and can be identified readily by the pendent appearance of the rather loosely organized spikes that are lax from the time of emergence from the leaf sheaths. Drying and mounting often obscures this distinctive character of the spikes and gives them an arched or flexuous appearance that is common to many variations of *E. canadensis* L. or *E. riparius*. Later development may or may not produce a well exserted condition. In specimens that appear to intergrade, an average palea length of 11–12(15) mm. will serve to separate *E. Wiegandii* from *E. canadensis*, which has an average palea length of (9) 10–11 mm. The thin-textured, relatively wide (1.5–2.0 cm.) leaves of *E. Wiegandii* are equally distinct. Narrow-leaved forms gave rise to more typical wide-leaved plants when the seed was grown in well fertilized and limed soil.

The fact that the glumes of *E. Wiegandii* are commonly rather constricted and indurated at the base hardly ever obscures the striations in this area. On the other hand, the glume bases of *E. riparius* are terete and unstriated, while those of *E. canadensis* are never appreciably indurated but are striated their entire length. Nevertheless, the existence of forms with characters intermediate between those of typical species may be encountered.

In the alder thickets along the banks of Otter Creek in Rutland County, Vermont, a small population of atypical *E. Wiegandii* 2261[1] has been found. The specimens have the usual

[1] All accession numbers without designation refer to the author's specimens on file in the Brown University Herbarium (BRU). Specimens on file elsewhere are indicated by numbers followed by the herbarium abbreviations established by Lanjouw (1939). Specimens raised from seed kindly supplied by Dr. W. G. Dore of Ottawa or Dr. N. C. Fassett of Madison carry these collectors' original numbers and are on file at Brown. The author also wishes to express his appreciation to the curators of the herbaria in the Universities of Minnesota and Wisconsin and the Smithsonian Institution for the loan of specimens.

pendent spikes but are intermediate in other characters between typical *E. Wiegandii* 2263 and *E. riparius* 2262 from the same station, as shown in the following table:—

	E. Wiegandii		E. riparius
	2263	*2261*	*2262*
Average height	120 cm.	100 cm.	90 cm.
Number of nodes	9	7	6
Middle leaf width	14–18 mm.	10–12 mm.	8–10 mm.
Florets per spikelet	5–6	2–3	2
Glume base	sl. indurate, striate	indurate, rarely striate	indurate, non-striate
Palea length in basal floret	11.5–12 mm.	10–10.5 mm.	7–7.5 mm.
Shrivelled pollen	40%	80–100%	10%

Although there is some genetical imbalance noted in all populations, it would seem as though the very high pollen sterility in 2261 is correlated with the intermediate characters and indicates a probable hybrid origin. The determination of the precise path of hybridity is by no means easy, however, since other species available for intercrossing include the common *E. virginicus* L. and the less frequent *E. canadensis* of the same area. The rarity of the latter species at this station seems to be explained by its preference for more open terrain.

An experimental program, aimed at learning something of the interrelationships of the eastern species of *Elymus* through the production of interspecific hybrids has been in progress for three years. Hybrids, with varying degrees of success, have been obtained between all four of the above mentioned species. In most cases, the F_1 is completely sterile and attempts at back crossing have met with failure. In a few instances, however, F_2's have been obtained from a very meager seed set in the F_1. Bagging experiments have indicated that selfing does not cut down more than 10–20 per cent on seed setting in the parental forms. Furthermore, anthers are found frequently in a shedding state completely inside the florets as the caryopsis develops, a fact which again indicates selfing. Since all of the species of *Elymus* concerned are tetraploid ($2n = 28$), it is reasonable to suppose that many genes are present in quadruplicate and that a certain amount of heterozygosity would not result in complete sterility. As a matter of fact, very few of the hybrids obtained show a lack of affinity between more than three or four pairs of chromosomes out of a total of fourteen pairs in the pollen mother cells. In other words, *E. Wiegandii, riparius, virginicus* and *canadensis* have at least one genome and varying parts of another in common. This conclusion is based on the results of crosses of parental forms both adjacent and widely separated in the range. It is difficult, therefore, to determine a precise pattern of interrelationship.

Attempts at crossing *E. Wiegandii* and *E. riparius* were particularly successful in producing hybrids approaching the natural intermediate 2261, however, when pistillate *E. Wiegandii* 2216, from the banks of the West River in Windham County, Vermont, was pollinated with *E. riparius* 2249 from thickets along the Winooski River to the north in Chittenden County. Several dozen seedlings were obtained, two thirds of which possessed a heavy anthocyan pigmentation and eventually died. The surviving green forms have narrow leaves, two florets per spikelet, paleas averaging 8.5 mm. in length and glumes strongly indurated at the base. Spikes are typically pendent. Although one plant is still alive, all maturing offspring are sterile. The reciprocals resemble *E. riparius* very closely but were quite late in producing spikes. In fact, several plants never developed beyond the vegetative stage. It is evident, then, that *E. Wiegandii* and *E. riparius* may give rise to hybrid populations, although no F_2's or backcrosses have been obtained.

In *E. Wiegandii* 2263 from Otter Creek, however, an apparently unique chromosome behavior was observed in the course of making the preliminary cytological survey for the hybridization program (Vilkomerson 1950). An examination of material from many other stations to date has revealed one or two and often six or seven pairs of chromosomes with their ends prematurely directed toward the poles in the first and sometimes the second meiotic divisions. Variation in the number of pairs involved has been noted particularly in strains from Windham County, Vermont 2216, Franklin County, Mass. 2200, and Coos County, N. H. 2226. In some of the above cases, the points of spindle fiber attachment appear subterminal as well as terminal. In all instances, the attachment points that are distal to the usual median or near median position are termed neocentromeres.

As would be expected in the case of the highly sterile strain 2261 from Otter Creek, varying degrees of lagging chromosomes, bridges and rings at anaphase, and micronuclei in the quartets were found in many, though not all, of the pollen mother cells. The characteristic neocentric pairs of chromosomes were always present in addition to the configurations due to hybridity.

In the light of the above discovery, it was suspected that the neocentric chromosomes could be used as a cytological marker to identify the presence of the "Wiegandii genome" in hybrids in which this species was employed as the staminate parent. This assumption was demonstrated to be correct, not only in crosses with *E. riparius*, but with *E. canadensis* or *E. virginicus* employed in each case as the pistillate parent.

E. Wiegandii and E. riparius in the Great Lakes Area

When a study of *Elymus* in the Minnesota area was begun, the cytological marker proved to be very useful as an aid in the identification of strains of *E. Wiegandii* that appear to intergrade with other species or occur considerably beyond their present recognized range. The test was first applied to material from Fort Francis in the Rainy Lake area of southwestern Ontario, at the Minnesota border, where it was found growing close to typical *E. canadensis.* The collector, Dr. W. G. Dore of the Canadian Department of Agriculture, identified it as *E. interruptus* Buckl., Dore 9175 OTB., and very kindly sent herbarium specimens and seeds to the writer. The plants grown in the greenhouse as well as those in the outdoor plots at Brown University have pendent spikes, leaves 10–12 mm. wide, glume bases indurate and usually striate, four florets per spikelet, and paleas 9.5–10 mm. long. Neocentric chromosomes appear consistently at meiosis and hence it is evident that the Fort Francis stand is *E. Wiegandii.* Its presence along the Canadian border, nearly a thousand miles west of the range as stated in Gray's Manual, is supported by another rare occurrence in Cook County, Minnesota, reported by Butters and Abbe (1953).

A cross of *E. Wiegandii*, Dore 9175, and *E. virginicus*, Mulligan & Forsyth 282 OTB., from Carleton County, Ontario, revealed the same inheritance of neocentric chromosomes as in crosses involving eastern strains.

Specimens of "atypical canadensis" collected by Dr. N. C. Fassett, 28971-72 WIS., in northwestern Grant County, Wisconsin, yielded seeds that gave rise to typical *E. Wiegandii*, including characteristic neocentric chromosomes, in the Brown University plot. As far as herbarium specimens indicate, this species apparently occurs also in Chippewa County, Davis, no number WIS., and Eau Claire County, Kunz 356 WIS.

Although the distinct features of *E. Wiegandii* were clearly delineated by Fernald (1933), it is not recognized in the Manual of Grasses (Chase 1950). With material at their disposal, Booher and Tryon (1948) could not separate this species from *E. canadensis* in Minnesota. In view of the above evidence, however, the occurrence of *E. Wiegandii* in both Minnesota and Wisconsin seems definitely established.

E. riparius, like *E. Wiegandii*, is also a rare species in the western part of the Great Lakes area. It is not listed from Minnesota by Booher and Tryon (1948), although a few scattered stations occur in Wisconsin (Fassett 1951) in addition to one in northern Illinois (Steyermark 1953). Eastward from Indiana (Deam 1940), it is rather frequent.

Apparently the first record of *E. riparius* in Minnesota is the writer's collection in Nerstrand Woods, Rice County, 2362–66. These specimens have uniformly narrow, indurated glume bases, paleas 7.5–8.0 mm. long, and straight awns, as in the eastern representatives. The habitat is the frequently overflooded banks of a shallow brook in a mixed woodland. The writer has identified an equally rare stand on steep, wooded, limestone cliffs in Grant County, southwestern Wisconsin, 2370.

The fact that these scattered, outpost stations of both *E. Wiegandii* and *E. riparius* have been overlooked in the western part of the Great Lakes area until recently is due probably to their being identified as part of the widespread series of forms with setaceous and often reduced awns in central and northern Minnesota, as mentioned earlier. This series has been interpreted as *E. interruptus* Buckl. in the Manual of Grasses (Chase 1950), a treatment which is followed in the eighth edition of Gray's Manual (Fernald 1950). A comparative study of specimens from both Texas and Minnesota, however, will indicate the lack of affinity between these two taxa and the need for a further inquiry into their relationships.

The E. interruptus–canadensis complex in Texas

The type locality of *E. interruptus* (Buckley 1862) is Llano County, Texas. Seed collected in this area, through the kindness of Dr. W. V. Brown of the University of Texas, has produced a series of populations, all of which appear as variations within or closely allied to the *E. canadensis* complex in the state. These forms are quite distinct from all the northern representatives of *E. canadensis* growing at Providence in their earlier attainment of anthesis of a month to six weeks. They are usually shorter and the awns are not reflexed, even at maturity.

E. canadensis L. v. *brachystachys* (Scribn. & Ball) Farwell is represented by several strains, 1026–29, which average about 80 cm. in height and have spikes 10 cm. long. Glumes may be more or less indurated at the base and vary in width from 0.5–1.0 mm., with the widest part in the middle of the length. Strains have been selected which have lemmas that are glabrous, glaucous or hirsute. There is also frequent though inconstant occurrence of three instead of the usual two spikelets per node. A seed collection from a station near Palo Duro Canyon in Randall County, over 400 miles northwest in the Panhandle, gave rise to plants that do not differ from Llano County material except in the glumes, which are flat and striate at the base and have a width of 1.0–1.5 mm. There arose from this population, however, a strain 1030, that differs from all others in reaching often 1.5 m. in height, 25 cm. in length of spike and having always three spikelets per node. The glumes average 1.8 mm. in width. Except for the much earlier time of anthesis, there is a general resemblance to vigorous northern forms. Crosses between late blooming individuals of 1030 and northern *E. canadensis* were a failure, however.

E. interruptus Buckl. is represented in the Llano County populations by a strain, 1040, that has the appearance of a small form of *E. canadensis* v. *brachystachys* in averaging 60 cm. in height. It is reasonably distinct also in the longer distance of 0.9–1.0 cm. between nodes on the spike and the narrow (0.2 mm.), essentially setaceous glumes. Except for the glaucous lemmas, 1040 does not differ materially from cotype specimens of *E. Pringlei* Scribn. & Merr., 731015 US., from Hidalgo, Mexico. Furthermore, Llano County specimens of *E. inter-*

ruptus, 1019510 US., that bear the notation "identical with type" and have glumes 0.5 mm. wide, are intermediate in this feature between *E. interruptus* 1040 and *E. canadensis* v. *brachystachys* 1026–29. As far as general habit is concerned, all of these southern taxa appear to belong to a single species complex.

Another seed collection of *E. interruptus*, 1041, from a station along the Pedernales River, some 50 miles south of the Llano County stand, gave rise to plants that exhibited considerable variation from glabrous to glaucous or hirsute lemmas and from 0.3–0.9 mm. in width of glumes. Furthermore, the glumes are without any bulge in the center as in *E. canadensis* v. *brachy*stachys. When spikes exhibiting five different combinations of the above characters were bagged, only 6–10 per cent seed was set. An exceptional strain with glabrous lemmas and glumes 0.7–1.0 mm. in width yielded 22 per cent seed. (For calculation purposes, two seeds per spikelet is considered a normal yield.) Only this latter strain continued vigorous growth for three years. It appears, then, that the variability and vigor of the original population 1041 is maintained, in marked degree, by the interbreeding of its members.

Hybrids of Hystrix with the E. interruptus–canadensis complex

In view of the fact that Booher and Tryon (1948) have implied that the setaceous type of glume in populations of so-called *E. interruptus* in Minnesota has arisen through the natural crossing of *E. canadensis* and the usually glumeless genus *Hystrix*, the writer attempted some breeding experiments to test such a hypothesis for the origin of *E. interruptus* in Texas. A survey of all the strains of *E. interruptus* or *E. canadensis* v. *brachystachys* under study has revealed no meiotic irregularity or significant pollen sterility.

Since the range of *Hystrix* does not quite reach Texas, it was decided to use material available in Providence County, Rhode Island, which is *H. patula* Moench v. *Bigeloviana* (Fern.) Deam, 2302. This northern variety is useful in crossing experiments since the pubescence of the lemmas is readily transmitted through the staminate parent. The glaucous lemmas and wide

(1 mm. at center) glumes with indurated and striated bases of strain 1029 of *E. canadensis* v. *brachystachys* furnished ideal contrasting characters in the pistillate parent. Seed set in the cross was fairly high at 19 per cent. The F_1 inherits the spreading condition of the mature spikelets as well as the pubescence of the lemmas of *Hystrix*. The glumes are very setaceous and irregular in length. The few surviving plants are completely sterile. Reciprocal crosses were failures.

More successful was a cross in which selected plants of *E. interruptus* 1041 were pollinated with *Hystrix* 2302. Half of the F_1 has slightly hirtellous lemmas and the glumes are setaceous and occasionally reduced to stubs. These plants yielded 8 per cent seed. The other half of the F_1 has glumes 0.3–0.5 mm. wide and the seed set was 50 per cent. All of the F_2 plants are vigorous and have glumes in the same width range of 0.3–0.5 mm. It would appear, then, that a population has been formed in which the glumes are not setaceous as in the more typical *E. interruptus* 1040, but through the acquisition of some genes from *Hystrix*, are narrower on the average than the glumes of parental *E. interruptus* 1041. Attempts at crossing typical *E. interruptus* 1040 and *Hystrix* 2302, however, met with failure.

No hybrids were obtained between the vigorous *E. canadensis* v. *brachystachys* 1030 and *Hystrix* 2302. In a cross of pistillate *Hystrix* 2301 from Maryland with *Elymus* 1030, a few plants were obtained with rather distorted spikes, all of which exhibited a great variety of glumes from those 0.5 mm. wide down to minute bristles. Examination of young anthers revealed several lagging univalent chromosomes at meiosis and much shrivelled pollen.

Although it is possible to hybridize *Hystrix* and members of the *E. canadensis—interruptus* complex in Texas, it appears that the cross is made with difficulty. Progeny with very setaceous glumes obtained so far have been sterile. It is conceivable, however, that populations of *E. interruptus*, with narrow but not quite setaceous glumes as in 1041, represent forms that have been established after backcrossing of *Elymus-Hystrix* hybrids to either parent.

The question next arises whether or not setaceous or even reduced glumes could appear in the progeny resulting from crosses within the *E. canadensis—interruptus* complex but not directly involving *Hystrix.* Typical *E. canadensis* v. *brachystachys* 1028 was crossed with both strains of E. *interruptus.* Only those crosses with *E. canadensis* as the pistillate parent produced any seed. Out of a total of 400 florets, 14 rather shrivelled seeds were obtained. Two plants from the cross involving 1041 as the staminate parent survived and these have flat glumes.

In striking contrast to the very low degree of affinity between the above strains is the success of the cross between the vigorous, wide-glumed strain 1030 of *E. canadensis* v. *brachystachys* and staminate *E. interruptus* 1040 with narrow to setaceous glumes. Although many seeds were shrivelled, 53 were formed in 65 florets. From a progeny of 26 seedlings, 20 vigorous plants matured, all with flat glumes, but much narrower (0.5–1.0 mm.) than those of the pistillate parent (1.0–1.5 mm.). Sterility ran high, but 7 seeds were obtained from 730 florets. The F_2 was composed of plants equally as vigorous as the F_1 but possessing setaceous glumes of irregular length. The reciprocal cross produced an F_1 more intermediate in glume width although completely sterile. Unfortunately, the F_2 setaceous segregates are also sterile.

To what extent the above experiments indicate that *E. interruptus* Buckl. in Texas is a product of a series of crosses between *E. canadensis* v. *brachystachys* and some strain of *Hystrix,* it is difficult to state. Most crosses reach a sterility barrier in the first generation. Since there are no outstanding meiotic irregularities involved, the barrier consists of relatively few genes. It is of particular significance to note further that populations of *Elymus* with reduced glumes may arise independently of *Hystrix* as a direct parent and that the degree of reduction to setae, as in the cross of 1030 and 1040, exceeds anything yet observed in Texas plants. In fact, the glumes of this hybrid population are similar to those that are encountered in so-called *E. interruptus* of Minnesota. The similarity is due to a case of parallel development, however, since the northern and southern taxa appear to the author to be unrelated if the wide differences in time of bloom and habit of growth as well as genetic barriers are considered.

E. interruptus in Minnesota

In a survey of *E. interruptus* in the North, one is impressed by the similarity of plants from Wyoming and the Dakotas to those plants with very reduced glumes in northern Minnesota. Representatives from the type locality of *E. diversiglumis* (Scribner and Ball 1900) in Crook County of northeastern Wyoming, 1019960, 64973 US., or from Bottineau County, North Dakota, 1019513 US., are definitely part of the Minnesota complex. In fact, collections from Pembina County, North Dakota, 253470 MIN., adjacent to the Minnesota border, exhibit a reduction of many of the glumes from setae to mere stubs. Such extreme forms are found not infrequently as scattered individuals in the moist, mixed hardwood forests of north central Minnesota.

As Booher and Tryon (1948) have shown, specimens may be encountered with very narrow but not completely setaceous glumes which appear to grade directly into forms of *E. canadensis.* The writer found this relationship to be true particularly in mixed populations bordering the western edge of Mille Lacs Lake in east central Minnesota. Plants with glumes more than 0.5 mm. wide and paleas over one cm. long appear to be inseparable from robust forms of *E. canadensis.* Until more information about the relationships of the latter species is available, however, it seems desirable to continue to refer to the populations with very narrow or setaceous glumes in the Great Lakes area as *E. interruptus* of recent authors but not Buckley.

Seed collections from forty clones were made in the fall of 1951 from Mille Lacs, Aitken, Crow Wing, Hubbard, Clearwater, Becker and Ottertail Counties in Minnesota. The progeny are represented by apparently healthy plants in the Brown University experimental plots, but to date only half of these have produced spikes. All types of glumes from setaceous to very reduced are represented. Palea length, a character that has proven reliable in separating many species, overlaps that of *E. canadensis.* Although the evidence at hand indicates that each form breeds true, yet several clones which arose from spikes showing great variation in glume structure still remain in a vegetative condition. No meiotic irregularities or appreciable pollen sterility have been noted in any of the plants examined. By way of contrast, it is noteworthy that many apparently stable forms of *E. canadensis* in the Connecticut River Valley of New England reveal meiotic irregularities in about 5 per cent of the pollen mother cells.

Attempts at crossing *E. canadensis* and *Hystrix patula* from northern areas in the hope of obtaining progeny with setaceous glumes have met with failure thus far. One certain barrier to natural crossing of these two genera is the fact that *Hystrix* comes to anthesis four to six weeks earlier. Furthermore, an examination of specimens from many parts of the range will reveal the fact that although this latter genus is usually characterized by a complete lack of glumes, occasionally stubs or even setae of varying length may occur. Plants from Rice County, Minnesota, 2368, have setae of varying length at every node of the spikes, but are typical in every other character. The station is roughly 100 miles from any stand of *E. interruptus* known to the writer. Specimens from Davidson County, Tennessee, 1021371-2, 1161614 US., also exhibit glume variations from long setae to stubs. The herbarium sheet record indicates that these specimens have at one time been identified as *E. interruptus*, but the present writer feels that they are definitely forms of *Hystrix patula*. Incidentally, this elimination of Tennessee from the distribution map of *E. interruptus* as published in the Manual of Grasses (Chase 1950) will show a clearer geographic separation of the northern and southern taxa, in support of other data presented earlier on this point.

It is significant, then, that *Hystrix* with variable glumes may exist many miles away from stands of *Elymus*. In contrast, *Hystrix patula*, 2306, from a stand adjacent to that of *E. interruptus*, 2305, along the north boundary of Itasca Park, Minnesota, is consistently lacking in glumes. If *Hystrix* is studied from its entire range, it can be deduced that the unusual occurrence of setaceous glumes is a variation not necessarily linked to hybridization with *Elymus*. Indeed, the writer's data showing the early failure of seedlings in hybrids between *Hystrix patula* and both *E. canadensis* and *E. virginicus* from northern populations would seem to indicate the presence of strong genetic barriers between these two genera, although probably only slightly greater than barriers between some species of *Elymus* per se.

The problem of the origin of *E. interruptus* in Minnesota is not simple, as the above attempts at solution indicate. The continuing genetic analysis of the clones available to the writer may still yield information concerning a connection with *Hystrix*. It seems equally possible, however, that gene combinations controlling increased induration and setaceousness of the glumes can arise in populations of *Elymus* not in contact with *Hystrix* at all. Such is the case, at least, in the previously mentioned instance of *E. Wiegandii* and *E. riparius* in Vermont and of *E. canadensis* 1030 and *E. interruptus* 1040 in Texas.

All of the eastern species of *Elymus*, except *E. villosus* Muhl., have been found to produce interspecific hybrids with varying degrees of success. It is quite possible, therefore, that the "gene pool" of *Elymus* may be tapped by chance through several different paths of interspecific hybridization to bring about reduction of the glumes, as the foregoing experiments indicate.

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SYNOPSIS OF HELIANTHUS GIGANTEUS L. AND RELATED SPECIES

Robert W. Long, Jr.

This report is based upon a recently completed investigation of the perennial sunflower *Helianthus giganteus* L. and morphologically related species (Long, 1954). Since it will be some time before the entire work is published, a synopsis of the revised taxonomy of the group seems desirable.

Simply stated, this section (tentatively called, the "giganteus section") of the genus includes those perennial sunflowers that are characterized by lanceolate leaves, the uppermost alternate and not conspicuously three-veined, with showy heads and narrow, attenuate phyllaries. Components of this group are widely distributed over North America, including practically all of the United States. The largest number of species is found in the western part of the Great Lakes region. They are frequently encountered as weeds in the fall flora of many states.[1]

1. H. Nuttallii Torrey and Gray, Fl. N. A. **2:** 324. 1842.

KEY TO SUBSPECIES

A. Leaves 1.0–2.5 cm. wide, generally 10.0-15.0 cm. long; margins entire, obscurely serrate, or serrulate; phyllaries 1.0–1.2 cm. long; uppermost leaves reduced, linear-lanceolate; Nebraska, South Dakota to Alberta, south to Nevada, and Colorado. *H. Nuttallii*, ssp. *Nuttallii* 1a.

AA. Leaves 2.5–4.0 cm. wide, generally 12.0–20.0 cm. long; margins often distinctly serrate; uppermost leaves not greatly reduced, lanceolate; phyllaries mostly 1.0–1.5 cm. long, variable; Colorado and Wyoming, Idaho, Utah, and New Mexico. *H. Nuttallii* ssp. *coloradensis* 1b.

1a. H. Nuttallii T. & G., ssp. Nuttallii.

H. giganteus, var. *utahensis* D. C. Eaton, Bot. King Exp. 169. 1871.
H. californicus, var. *utahensis* Gray, Syn. Fl. **2:** 277. 1884.
H. fascicularis Greene, Pl. Bak. **3:** 28. 1901.
H. utahensis A. Nels., Bull. Torrey Bot. Cl. **29:** 405. 1902.

Type.—*H. californicus* Nutt. (not DC.). The type is presumably in Nuttall's collection at the Academy of Natural Sciences of Philadelphia.

[1] I am grateful, for the loan of herbarium specimens for study and comparison, to the directors or curators of the following herbaria: Stanford University; University of Georgia; Chicago Museum of Natural History; Gray Herbarium; Missouri Botanical Garden; University of Nebraska; Michigan State College; State College of Agriculture of the University of North Carolina; New York Botanical Garden; Academy of Natural Sciences of Philadelphia; Rocky Mountain Herbarium; University of Texas; and West Virginia University.

1b. H. Nuttallii, ssp. **coloradensis** (Ckll.) Long, stat. nov.

H. coloradensis Cockerell Proc. Biol. Soc. Washington **27:** 6. 1914.
H. Parishii Gray var. *coloradensis* Cockerell Torreya **18:** 181. 1918.

Type.—*H. coloradensis* Cockerell, type 1; collected by T. D. A. Cockerell few miles east of Boulder, Colorado; supposedly in the U. S. National Museum.

2. H. Parishii Gray, Proc. Am. Acad. **19:** 7. 1883.

H. californicus DC., var. *Parishii* (Gray) Jepson, Man. Fl. Pl. Calif. 1923.

Type.—*S. Parish 11125*, from borders of streams and wet plains, San Bernardino, California; in the Gray Herbarium.

3. H. grosseserratus Martens, Sel. Sem. Hort. Lov. ex Linnaea XIV Litt. 133, 1839.

KEY TO SUBSPECIES

A. Leaves lanceolate, generally broadest near middle; margins serrate, teeth not exceeding 0.2–0.3 cm. long, usually more or less equal in size and regularly spaced; Massachusetts and New Hampshire, Wisconsin, Texas, and Kentucky. *H. grosseserratus*, ssp. *grosseserratus* 3a.

AA. Leaves lanceolate-ovate, generally broadest near base; margins conspicuously sharply and deeply serrate, teeth 0.3–0.6 cm. long, frequently unequal in size and irregularly spaced; Michigan to Minnesota, Nebraska, Iowa, and Texas. *H. grosseserratus*, ssp. *maximus* 3b.

3a. H. grosseserratus Martens, ssp. grosseserratus.

H. grosseserratus β Torrey and Gray, Fl. N. A. Vol. II. 1841.
H. grosseserratus α Torrey and Gray, l. c.
H. grosseserratus f. *pleniflorus* Wadmond, Rhodora **34:** 19. 1932.
H. instabilis E. Watson, Papers Mich. Acad. Sci. **9:** 423 Pl. 65, 1929. (in part, including type).

Type: The location of the type is unknown.

3b. H. grosseserratus Martens, ssp. **maximus** Long, ssp. nov.

A typo differt margine foliorum caulinorum irregulariter et profunde serrata, dentata 0.3–0.6 cm.

Type.—*H. C. Reynolds 2643*, Preston, Richardson County, Nebraska, October 5, 1940. In the herbarium of the University of Nebraska. No. 43244.

4. H. californicus DC., Prod. **5**: 599. 1836.

H. californicus var. *mariposianus* Gray, Synoptical Fl. N. A. Vol. I, Part 2. 1884.

Type.—A collection by Douglas from California, deposited at Kew.

5. H. × Kellermani Britton, pro. sp.
(grosseserratus × salicifolius)

H. Kellermani Britton, Man. 994. 1901.

Type.—*W. Kellerman*, collected near fairgrounds, Columbus, Ohio, September 5, 1898; deposited in the Gray Herbarium.

6. H. Rydbergii Britton. Man. 993. 1901.

Type.—*Rydberg 1767*, Hooker County, Nebraska; in the herbarium of the New York Botanical Garden. A co-type is deposited in the Herbarium of the University of Nebraska, No. 10633.

7. H. × **divariserratus** Long, hyb. nov.

H. giganteus var. *ambiguus* Torrey and Gray, Fl. N. A. II. 1841. (in part, excluding type)

H. ambiguus (T. & G.) Britton, Man. 993. 1901 (in part, excluding type).

Type:—*E. Watson 344*, Danbury, Fairfield County, Connecticut, Aug. 8, 1924; in the herbarium of Michigan State College, no. 127020.

Stem 0.5–0.8 m. high, glabrous or with scattered hairs near the top, glaucous. *Leaves* broadly lanceolate, 6.9–10.0 cm. long, maximum width near the base; short, distinct petioles, usually 0.5–1.0 cm. long; opposite, sometimes alternate near the top; tapering to apex, more rounded to base; margins obscurely to distinctly serrate; undersurfaces with many, short hairs; rather strongly three-veined. *Phyllaries* 1.0–1.5 cm. long, variable; surfaces glabrous or puberulent; marginal cilia short. Heads in terminal raceme or reduced panicle. Connecticut to Michigan, Indiana. In moderately dry places.

Hybrida media inter *H. grosseserratum* et *H. divaricatum;* caulis glabris, foliis oppositis, aliquatenus trinervis, cum petiolis distinctis.

8. H. giganteus L., Sp. Pl. 905. 1753.

A. Leaves sessile, or with very short petioles, 0.1–0.8 cm. long; undersurfaces with short hairs; phyllaries usually conspicuously long-ciliate, surfaces occasionally subglabrous; Massachusetts and Connecticut, Minnesota, Illinois, Delaware. *H. giganteus* ssp. *giganteus* 8a.

AA. Leaves with petioles, commonly 0.8–1.2 cm. long; undersurfaces usually with rather abundant, spreading hairs; phyllaries short-ciliate, surfaces generally short-pubescent; Delaware, West Virginia, Georgia, and Kentucky. *H. giganteus* ssp. *alienus* 8b.

8a. H. giganteus L. ssp. giganteus.

H. altissimus L., Sp. Pl. Ed. 2, 1278. 1763.

H. virgatus Lam., Encyc. **3:** 85. 1789.

H. gigas Michx., Fl. II, 141. 1803.

H. crinitus Nutt. fide Steud., Nomen. Ed. 2, 737. 1840.

H. tuberosus Parry, Owen, Rep. Minn. Survey 615. 1849.

H. giganteus var. *altissimus* (L.) Farwell, Rept. Mich. Acad. Sci. 180. 1915.

H. giganteus var. *oppositifolius* Farwell, Rep. Mich. Acad. Sci. **17:** 180. 1917.

H. giganteus var. *verticillatus* Farwell, Amer. Midl. Nat. **10:** 218. 1927.

H. giganteus var. *resiniferus* Farwell, Amer. Midl. Nat. **10:** 218. 1927.

H. borealis E. Watson, Pap. Mich. Acad. **9:** 411, Pl. 63. 1929 (in part, excluding type).

H. luxurians E. Watson, Pap. Mich. Acad. **9:** 464, Pl. 85, 86. 1929 (in part, excluding type).

Type.—Deposited in the Linnaean Herbarium, London, England.

8b. H. GIGANTEUS L. ssp. **alienus** (Watson) Long, stat. nov.

H. alienus Watson, Pap. Mich. Acad. Sci. **9:** 406, Pl. 60. 1929.

Type.—*H. alienus* E. Watson, Biltmore Herbarium, No. 2482-a, Missouri Botanical Garden Herbarium No. 113903; collected in moist soil near Biltmore, Buncombe County, North Carolina, September 12, 1898.

9. *H.* × **intermedius** Long, hyb. nov.

Stem stout, with rather abundant, short, white hairs, scabrous towards top; variable in color, green mottled, light-red, light-brown, or yellow; often glaucous. *Leaves* lanceolate, gradually acuminate to both apex and base; petioles short, 0.5–1.5 cm. long; margins shallowly serrate, sometimes irregularly or only obscurely toothed; lower surfaces with abundant, short hairs; slightly conduplicate; light-green to gray-green in color. *Phyllaries* variable, usually with short, white, marginal cilia and scattered pubescence over surface. Ohio and Michigan, Minnesota, south to Texas.

Hybrida inter *H. grosseserratum* et *H. Maximilianum*, caule breve pubescentibus, foliis serratis cum petiolis brevibus, phyllariis subpubescentibus.

Type.—*J. H. Schuette 9a5670*, Green Bay, Brown County, Wisconsin, "railroad tracks to Murphy's Mill," July 20, 1896; in the Chicago Museum of Natural History, No. 377645.

10. H. × LUXURIANS Watson, pro. sp.
(giganteus × grosseserratus)

H. borealis E. Watson, Pap. Mich. Acad. Sci. **9:** 411, Pl. 63. 1929 (in part, including type).

H. instabilis E. Watson, Pap. Mich. Acad. Sci. **9:** 423, Pl. 65. 1929 (in part, excluding type).

H. luxurians E. Watson, Pap. Mich. Acad. Sci. **9:** 464, Pls. 85, 86. 1929 (in part, including type).

H. membranaceus E. Watson, Pap. Mich. Acad. Sci. **9:** 438, Pl. 69. 1929 (including type).

Type.—*H. luxurians* E. Watson; *Watson 387*, near Cedar Point, Erie County, Ohio; growing in wet, black muck of an open field, September 21, 1924. Deposited in the Herbarium of Michigan State College, No. 126951.

11. H. Maximiliani Schrader, Ind. Sem. Hort. Götting. 1835.

H. subtuberosus Bourgeau, in herb. Hook., in Royal Bot. Gard. Kew, England. 1803.

H. Dalyi Britton, Jour. N. Y. Bot. Gard. **2:** 84. 1901.

H. Maximiliani var. *iubaris* Lunell, Amer. Midl. Nat. **5:** 63. 1917.

H. Maximiliani var. *paniculata* Farwell, Pap. Mich. Acad. Sci. **3:** 107. 1924.

H. Maximiliani f. *pallidus* Clute, Am. Bot. **36:** 17. 1930.

Type.—Exact location of type unknown. Watson (l. c.) believes it is probably in the Herbarium of the University of Göttingen, Germany.

12. H. × filiformis Small, pro. sp. (Maximiliani × salicifolius)

H. filiformis Small, Fl. S. E. U. S. 1265. 1903.

Type.—*H. filiformis* Small, Reverchon 1635, Texas; in the New York Botanical Garden.

13. H. × ambiguus T. & G., pro. var. (giganteus × divaricatus)

H. giganteus var. *ambiguus* Torrey and Gray, Fl. N. A. II. 1842 (in part, including type).

H. ambiguus (T. & G.) Britton, Man. 993. 1901.

Type.—*H. ambiguus* (T. & G.) Britton; in the Herbarium of the New York Botanical Garden.

Other Possible Members of the "Giganteus" Section

The following list of names is considered to apply to populations closely allied to the "giganteus" section. However, none has been studied sufficiently to determine its exact status or relationships to other sunflowers. Most of the names may prove to be referrable to previously described taxa.

1. *H. attenuatus* Watson, Pap. Mich. Acad. Sci. **9:** 416, Pl. 64, 1929. Type.—*A. Fendler*, "cult. ex. sem. New Mexico," October 16, 1852; in the Herbarium of the Missouri Botanical Garden, No. 113942.
2. *H. bracteatus* Watson, Pap. Mich. Acad. Sci. **9:** 393, Pl. 53. 1929. Type.—*A. Isabel Mulford 177*, Logan, Utah. In the Herbarium of the Missouri Botanical Garden, No. 113971.
3. *H. Cusickii* Gray, Proc. Am. Acad. **21:** 413. 1886. Type.—*Cusick*, dry hills near Malheur River, southeastern Oregon; in the Gray Herbarium.
4. *H. exasperatus* Watson, Pap. Mich. Acad. Sci. **9:** 455, Pl. 80. 1929. Type.—*J. Schuette*, Brown County, Wisconsin, September 13, 1886; Herbarium of Chicago Museum of Natural History, No. 377704.

5. *H. Oliveri* Gray, Proc. Am. Acad. **20:** 299. 1885. Type.—*J. Oliver*, Cienega, between Los Angeles and Santa Monica, California; in the Gray Herbarium.

The status of *H. attenuatus*, *H. bracteatus*, and *H. exasperatus* is especially questionable. *Helianthus exasperatus* appears to be a hybrid, with one of the parents being *H. giganteus*.—OHIO WESLEYAN UNIVERSITY DELAWARE, OHIO.

LITERATURE CITED

LONG, ROBERT W. JR. 1954. A biosystematic investigation of *Helianthus giganteus* L. and related species. Ph.D. thesis. Library, Indiana University.

WATSON, E. E. 1929. Contributions to a monograph of the genus *Helianthus*. Pap. Mich. Acad., **9:** 305–475.

CYPRIPEDIUM ARIETINUM R. BR. IN NOVA SCOTIA.—About one-quarter of a mile south of the southern end of the Wentworth gypsum quarries in Hants County, several clumps of *Cypripedium arietinum* R. Br. were found growing in broken country of gypsum sinkholes and thin poplar scrub. The plants were in full flower on the 24th of May, while the neighboring *Cypripedium calceolus* L. var. *parviflorum* (Salisb.) Fern. was still in small bud. It is probable that the extension of the quarries will destroy this area within a few years.

The present find would be merely another range extension of minor interest but for the fact that this is the fourth species to be found in these few acres of undisturbed gypsum and known from no other part of Nova Scotia. The others are: *Viola canadensis* L. (Roland: Flora of Nova Scotia); *Dirca palustris* L. (Erskine, J. S.: RHODORA **55:** 18); *Aloina rigida* (Hedw.) Kindb., a moss collected by W. B. Schofield and the author. Its identity was confirmed by Dr. A. L. Andrews. The northern limit of all four species is roughly the same, from the north of Lake Superior eastward to Massachusetts, with the exception of an unrecorded collection of *Aloina* from the Hudson Bay region. This distribution suggests that these four species survived just south of the Wisconsin ice-sheet and pushed north in a warm and favorable spell while the destroyed land was still unforested. Our cliff-floras, however, contain many northern plants which could hardly have come in from the south at this time. The assumption that an incomplete glaciation of Nova Scotia and neighboring areas existed during the late Wisconsin period would fit all the facts thus far available.—J. S. Erskine, WOLFVILLE, NOVA SCOTIA.

Notes on Two New Hampshire Trees.—*Pinus Banksiana* Lamb. is known from three stations in New Hampshire: Welch Mountain in Waterville on ledges near the top, Carter Ledge on Mt. Chocorua, and on ledges on the shore of Lake Umbagog. This last station is partly in Maine. In November 1953, the author and Alexander Lincoln Jr. explored the cliffs of Mt. Webster in Crawford Notch. On a steep rocky promontory near the top of the slides, we discovered a single tree of this species. The tree was approximately fifteen feet high and was bearing cones. No others were visible over a wide area. Rock slides occur here and evidently destroy vegetation at frequent intervals. A collection is being placed in the New England Botanical Club.

Juniperus virginiana L. var *crebra* Fern. & Grisc. is found in pastures and old fields in New Hampshire, becoming increasingly less common as far north as the southern slopes of the Ossipee Mountains in Tuftonboro. A collection from Tamworth is from a stand of trees in an overgrown field not far from an old farmhouse. These trees seem to be growing in a natural way, but may be descendants of trees that were originally planted. Professor Pease has told me of a report of its occurence in Crawford Notch that he has been unable to verify. In the past year I have discovered three stations in northern Carroll County: Band M Ledge in Madison, Humphrey Ledge in Bartlett, and White Ledge on Mt. Stanton in Bartlett. At all of these stations there are precipitous cliffs from 100 to 400 feet high, with talus slopes at the bottom. Small specimens of the tree were found growing in small pockets of soil and in cracks on the steep parts of the cliffs, often in completely inaccessible places. In one case a small colony was found in the middle of large rocks that made up the talus slope. If the Crawford Notch report is correct, this plant should be searched for on the steeper ledges that can be found on both sides of the notch. Collections from the Carroll County localities are being placed in the New England Botanical Club.—Frederic L. Steele, ST. MARY'S-IN-THE-MOUNTAINS, LITTLETON, N. H.

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SOME BOTANICAL STUDIES IN THE BLACK MESA REGION OF OKLAHOMA

C. M. Rogers

A lava-capped plateau, about forty-five miles in length and varying from one to six miles wide, with the long axis lying generally from northwest to southeast, extends from southeastern Colorado through the northeastern corner of New Mexico into the tip of the Oklahoma panhandle. Most of this plateau lies in Colorado and New Mexico, where it is usually called the Mesa de Maya, while the easternmost part, which extends a short distance into Cimarron County, Oklahoma, is more commonly known as the Black Mesa.

For many years the Black Mesa region has been recognized as one of Oklahoma's most interesting botanically; yet, until recently, because of its distance from a center of education, very few details of the vegetation were known and herbarium material was practically non-existent. The author first visited the area in 1944, when he was a student new to Oklahoma, and with little knowledge as to which species were widespread or plentiful in the state. Yet in the one brief forenoon spent there, eleven species which reach their easternmost limit in Oklahoma in the Black Mesa region were collected, of which seven were then unknown in the state. There appeared to be ample reason why further study might be profitably undertaken. Intermittently, therefore, during the summers of 1947 to 1949 additional field work was conducted. A general account of the whole Mesa de Maya region may be found in an earlier paper (Rogers, 1953). The Oklahoma part is described briefly in the paragraphs that follow.

In the extreme northwestern corner of Cimarron County, the cutting action of the Cimarron River and its tributaries has resulted in the formation of many canyons and mesas, including the Black Mesa. It is this area, perhaps one hundred square miles in Oklahoma, that is referred to as the "Black Mesa region." Peninsula-like, the Black Mesa projects across the New Mexico boundary into the heart of this region, at a point about four or five miles south of the Colorado state line. It extends about three miles into Oklahoma and is approximately one mile wide here. The Black Mesa is the most conspicuous element of the region. Because of the layer of basalt which covers it to a depth of sixty to seventy feet or more here, the Mesa stands above the surrounding plains. On top of the Mesa is the highest elevation in Oklahoma, nearly five thousand feet.

The probable source of the lava is Piney Mountain or the Bar Seven-L Buttes, as it is locally known, a small hill near the center of the Mesa de Maya, about thirty miles westward in Colorado. Underlying the lava is the Dakota sandstone formation which, like the basalt, erodes vertically and results in steep talus-strewn slopes which rather abruptly merge with the plains below. The Cimarron River lies at the base of the south slope of the Mesa and Carrizo Creek, a tributary of the Cimarron, is on the north side. These two streams join at the eastern tip of the Black Mesa, about six hundred feet below its summit.

The nearly flat top of the Black Mesa is covered with a layer of soil varying from a few inches to several feet in depth, mostly clay containing pieces of weathered basalt, and apparently derived from the decomposition *in situ* of the lava. The upper slopes of the Mesa are strewn with blocks of basalt of all sizes, while downward transportation of detritus has produced outcrops of bare rock in many places, and considerable deposition of clay, sand, and gravel in others. The gentler lower slopes tend to have a more stable soil. The surrounding high plains are covered with soils derived from direct weathering of sandstone formations or from inwash of sands and gravels from the Rocky Mountains in recent geologic times.

Rainfall, based on a thirty year record kept at Kenton, one and one-half miles south of the Mesa, is about eighteen inches annually. Data from other nearby weather stations indicate that from fifteen to twenty inches is the average annual precipitation over most of this region. Much of the rain comes as thundershowers, accompanied by large runoff. In this area, near the center of the dust bowl, the limited moisture available to the plants is probably the principal factor determining the type of vegetation that exists.

The Black Mesa region has three rather distinct vegetational types, the riparian, the prairie, and the foothill communities. Since the first two are widespread in Oklahoma, collections of plants in these communities add comparatively little to the total knowledge of the flora of the state. The stream-side plants here are principally *Populus deltoides, Salix exigua,* and *S. amygdaloides.* Though the Cimarron River and Carrizo Creek usually contain some water, most of the streams are dry except immediately following a rain and there is little chance for a hydrophytic vegetation to develop other than in a few pools, man-made ponds, seepage areas on the mesa sides, or other places where moisture can collect. There species of *Typha, Scirpus, Echinochloa,* and other wide ranging plants may be found.

The prairie grassland, found on the plains around the Mesa and on the level top, where mature soils have developed, must be considered the climax vegetation under the climatic conditions which now exist. The principal species are *Bouteloua gracilis, B. hirsuta,* and *Buchloe dactyloides,* with many other, mainly perennial, grasses and forbs. A dozen or fifteen species, such as *Muhlenbergia torreyi, Oryzopsis hymenoides, Verbena ambrosifolia,* and *Chrysothamnus nauseosus,* are restricted in their eastern distribution to the high plains and hence "enter" Oklahoma here. Otherwise, most of the plants of this community are also well known eastward throughout the state.

The Rocky Mountain foothill community is the one which is of particular interest to the author and others, for one can not help but be impressed by the abrupt change in the vegetation as the Black Mesa is approached from the nearly unbroken stretches of grassland to the east. The dominant plants are shrubs and small trees, mainly *Pinus edulis, Juniperus monosperma,* and *Quercus undulata,* with which are associated a variety of herbaceous species. The community is restricted to the canyon and mesa sides where erosion, deposition, accumulation of moisture, shading, and associated factors produce a variety of conditions not duplicated in the plains region of Oklahoma. From sixty-five to seventy species, consequently, including all of the dominant plants in this community, are unknown eastward in the state. There are also many species for which Black Mesa collections are noteworthy within-the-state range extensions, principally species of the Wichita and Arbuckle Mountain areas.

The vegetation on the mesa sides shows much variation, both in density of growth and in kinds of plants. Some spots may be completely or nearly bare, while nearby is a growth of shrubs so dense as to be nearly impenetrable. Intermittently along the slopes, where a mature or stable soil has developed, prairie plants have invaded, as have some weedy plants whose distribution is not bounded by either foothills or plains. *Andropogon furcatus*, *A. saccharoides*, *A. scoparius*, and *Panicum virgatum*, abundant on the eastern plains, are more common on the mesa slopes than on the surrounding dry prairie.

The common woody or semi-woody plants on the Black Mesa, in addition to the species mentioned, are *Yucca glauca*, *Celtis reticulata*, *Ribes cereum*, *Cercocarpus montanus*, *Physocarpus monogynus*, *Prunus virginiana*, *Rubus deliciosa*, *Dalea formosa*, *Mimosa borealis*, *Ptelea trifoliata*, *Rhus trilobata*, *Forsellesia planitierum*, *Vitis longii*, several Opuntias, mainly *O. imbricata*, *Brickellia brachyphylla*, *B. californica*, and *Pericome glandulosa*. A few individuals of *Pinus ponderosa*, wide ranging at low altitudes in the Rocky Mountains, are also found near the Black Mesa. In rocky crevices are such ferns as *Cheilanthes eatoni*, *C. feei*, *Notholaena sinuata*, *N. standleyi*, *Pellaea atropurpurea*, and *Woodsia oregana*, as well as *Selaginella densa*, while a few of the other herbaceous plants which are characteristic of or restricted to this habitat, filling in under and between the woody species, are the grasses *Bromus anomalus* var *lanatipes*, *Oryzopsis micrantha*, *Setaria macrostachya*, *Stipa neomexicana*, *S. scribneri*, and *Trichachne californica*, and also the following herbs, *Paronychia sessiliflora*, *Lesquerella ovalifolia*, *Psoralea tenuiflora*, *Asclepias macrotis*, *Mentzelia oligosperma*, *Gilia laxiflora*, *Onosmodium occidentale*, *Cryptantha thyrsiflora*, *Erigeron nudiflorus*, and *Zinnia grandiflora*.

While most of the species characteristic of the Mesa slopes are eastern outliers of the Rocky Mountain foothills, a few appear to be more appropriately considered a part of the flora which lies to the south and west of the Black Mesa. Some of these are *Aristida arizonica, A. divaricata, Muhlenbergia arenicola, M. porteri, Enneapogon desvauxii, Allionia incarnata, Mimosa borealis, Ditaxis laevis, Asclepias involucrata, A. macrotis,* and *Verbena plicata,* all of which appear to reach the northeastern edge of their range here. In some instances the Black Mesa collections are many miles from the nearest known station. Further field work may close the gaps in the ranges of these species, but the Black Mesa region, for the present, must be considered a relict area for certain southwestern plants.

During the past few years from thirty-five to forty species from the Black Mesa region have been added to the known flora of the state (see chiefly Waterfall 1949, 1950a, 1950b). Some species, which appear not to be included in Waterfall's recent (1952) list of the plants of the state, were collected by the author on or about the Black Mesa. Among them are the following. The numbers cited are in each case the author's. Voucher specimens are in the herbarium of the University of Michigan.

Selaginella densa Rydb. This plant is fairly frequent on the rocky slopes of the Black Mesa, where *4767* was collected on July 9, 1947. The species has been reported from Baca County, Colorado, just north of Cimarron County, but apparently has not been recorded for Oklahoma.

Aristida arizonica Vasey. This grass ranges from southern Colorado to southern Texas and Arizona. Chase, in Hitchcock's Manual of Grasses (ed. 2. 1950) and Waterfall, in his catalogue, fail to record this species from Oklahoma, although Featherly (Manual of the Grasses of Oklahoma: 43. 1946) states that it has been collected in Roger Mills County. Specimens from the Black Mesa, with spikelets very near the minimum size for this species, are *5061*, collected on the slope of the Black Mesa, 3 miles north of Kenton, July 28, 1947, and *6454*, from one mile southwest of Kenton, September 9, 1948.

Aristida divaricata H. & B. This grass is omitted from Waterfall's Catalogue, but is recorded for western Oklahoma by both Featherly (*op. cit.:* 41) and Chase (*op. cit.:* 472). An additional record is *6909*, August 1, 1949, from 5 miles east of Kenton.

Enneapogon desvauxii Beauv. This grass, better known as *Pappophorum wrightii,* appears to be quite uncommon in the Black Mesa region. Only a few plants were seen, from which *6460*, on a rocky slope 1 mile southwest of Kenton, September 9, 1948, and *6922*, on the side of the Black Mesa, north of Kenton, were taken. The distribution of this plant has been known from Utah to Texas and southward, so that the Oklahoma stations are at the northeastern edge of its range.

Leptochloa dubia (HBK) Nees. A northward extension of range within the state is represented by *6411*, from the side of the Black Mesa, north of Kenton, September 7, 1948. Chase (*op. cit.*: 492) includes the state within the range, and Featherly (*op. cit.*: 28) records it from Comanche and Murray Counties.

Poa fendleriana (Steud.) Vasey. This grass, widely distributed in the foothill and mesa regions of the Rocky Mountains, has been reported by Rydberg (Flora of Colorado: 46–47. 1906), including *P. longipedunculata* and *P. brevipaniculata*, and by Harrington (Manual of the Plants of Colorado: 58. 1954) from a number of localities in southeastern Colorado, so that this extension eastward into Oklahoma is not unexpected. It is represented here by *5608*, collected on a rocky hillside 3 miles east of Kenton, April 24, 1948.

Setaria macrostachya HBK. This species has been reported by Featherly (*op. cit.*: 90) from Payne County. A suitable habitat is unlikely there and since Waterfall omits this grass from his catalogue, the report may be erroneous. The plant is frequent on the mesa sides, *4785* having been collected on the slope of the Black Mesa north of Kenton, July 10, 1947. Other collections are recorded by Harrington (*op. cit.*: 112) from Baca County, Colorado, adjacent Cimarron County on the north.

Brayulinea densa (H. & B.) Small. This unexpected find was collected as *5935*, June 10, 1948, and again as *6910*, August 1, 1949, about 3 miles east of Kenton. Kearney and Peebles (Arizona Flora: 268. 1951) give the range as western Texas to Arizona and southward, indicating that the Black Mesa collections extend this some distance northward. A number of plants were found, all restricted to a small grassland area where the dominant plant was the mesquite, *Prosopis juliflora* var. *glandulosa*, also a southwestern plant reaching the limit of its range here in the Black Mesa region.

Fallugia paradoxa (D. Don.) Endl. This rosaceous shrub was collected as *5931*, June 10, 1948, near the former U. S. Highway 64 at the Old Santa Fe Trail marker, between Boise City and Kenton. Only a plant or two were seen, and can scarcely be said to have been established in the area. Perhaps until additional evidence is secured that it is maintaining itself, this species should not be admitted to the state flora. This station is not too far east of the present known limit of the species in New Mexico and it is likely that more plants may be found within the state.

Astragalus hallii A. Gray. One of the duplicates of *5691*, collected along the upper slopes of the Black Mesa, north of Kenton, May 16, 1948, was determined to be this species by C. L. Porter. On the basis of this determination the species is included in the state flora. Other collections of this species in southeastern Colorado fill in the gap between the Black Mesa and the Rocky Mountains, from which it has long been known.

Astragalus lotiflorus Hook. Stemen and Myers (Oklahoma Flora: 247–248. 1937) list this species from the "plains" of Oklahoma, although Waterfall omits it from his catalogue. Two collections from near the highway between Boise City and Kenton, *5605* about 10 miles southeast of Kenton, and *5719*, about 8 miles east of Kenton, both determined by C. L. Porter, reinstate this species in the flora of the state.

Ditaxis laevis (Torr.) Heller. This southern species has been previously reported only as far north as western Texas and southern New Mexico. The present specimens were collected as *4751* on the slope of the Black Mesa north of Kenton on July 9, 1947. These as well as other specimens of this species which were examined resemble *D. humilis* in characters other than pubescence and Pax (in Engler, Das Pflanzenreich, 57 (IV, 147, VI): 75. 1912) indicates that this is the main difference between them. If true it is very doubtful whether the plant deserves specific rank. *D. humilis* is also found in the Black Mesa region and is the more common of the two species.

Coryphantha deserti Britt. & Rose. This western species of cactus is represented in the flora of Oklahoma by *5992½*, collected atop the Black Mesa north of Kenton, June 13, 1948. This, a living plant, was sent to E. U. Clover, who determined it to be this species.

Oenothera engelmanni (Small) Munz. Munz (Amer. Journ. Bot. **18**: 316. 1931) cites specimens of this species from Texas and New Mexico, while Harrington (*op. cit.*: 396–397) records it from southeastern Colorado also. A short extension eastward is *4684*, collected in the prairie about 14 miles west of Boise City, somewhat outside the Black Mesa region, but near enough to warrant mention here.

Asclepias involucrata Engelm. This southwestern species was collected as *1068*, during the author's first trip to the Black Mesa, June 5, 1944, on the high plains 18 miles northwest of Boise Vity. Since that time, the plant has been collected twice in nearby southeastern Colorado. One of these specimens was verified as this species by R. E. Woodson. The plant is nowhere common, but is found almost throughout the grassland area in the Black Mesa region.

Cryptantha thyrsiflora (Greene) Payson. This perennial is a conspicuous and frequent herb on and about the Black Mesa and may inadvertently have been omitted from earlier lists. It is represented by several collections, the first of which, *2083*, was collected on the Black Mesa, June 5, 1944.

Antennaria parvifolia Nutt. Plants keying to this species were observed in several localities in the Mesa de Maya region, but in only one area in Oklahoma, about 8 miles east and 7 miles north of Kenton, near the Oklahoma-Colorado state boundary, where it was frequent in protected places on rocky slopes. There, *6189* was collected on July 6, 1948, quite past the flowering stage.

Cirsium undulatum (Nutt.) Spreng. This species has been reported several times from Oklahoma. Material keying to *C. undulatum* was found throughout the Mesa de Maya Region, of which *4826* was collected atop the Black Mesa north of Kenton on July 11, 1947.

Erigeron flagellaris A. Gray. Though recorded for Colorado and New Mexico, as well as other Rocky Mountain states, Oklahoma has not been included in the range of this species. Only a few plants were found, these near the Cimarron River north of Kenton where *5704*, verified by S. F. Blake, was collected May 16, 1948. These probably developed from seeds brought down by the river from further west where the species is more common.

Of the nearly six hundred species collected by the writer over the whole Mesa de Maya, approximately five hundred were found, or could be found in Oklahoma. The remaining one hundred, still unknown in the state, came from adjacent New Mexico and/or Colorado. Of these some grow near the western end of the Mesa de Maya, thirty miles or more from the Oklahoma state line and up to 1800 feet higher in elevation, and can scarcely be expected within the state. A number, however, were collected within twenty miles of the state line, in habitats almost identical to those existing on and about the Black Mesa. These should be looked for within the state. Among the more interesting of these species are *Notholaena fendleri*, *Muhlenbergia arenacea*, *Stipa viridula*, *Ribes leptanthum*, *Opuntia phaeacantha*, *O. rhodantha*, *O. schweriniana*, *Oenothera flava*, *Swertia coloradensis*, *Asclepias uncialis*, *Lobelia cardinalis*, *Artemisia frigida*, *Brickellia grandiflora*, and *Pericome caudata*.

There are still many kinds of plants to be collected in the Black Mesa region. Each collecting trip yields additional species. The area, though small, is varied, and every newly explored canyon or mesa may and frequently does contain plants which are not known to exist in the state.

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THE STATUS OF SOME AMERICAN SPECIES OF MYRIOPHYLLUM AS REVEALED BY THE DISCOVERY OF INTERGRADE MATERIAL BETWEEN M. EXALBESCENS FERN. AND M. SPICATUM L. IN NEW JERSEY

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This paper arises out of a coöperative project between the Forests and Parks Section of the New Jersey Department of Conservation and Economic Development and the Botany Department at Rutgers University, the State University of New Jersey. The project was initiated in order to study the ecology and life history of a dominant aquatic weed in several lakes of northern New Jersey and to suggest, if possible, intelligent control procedures. This weed has been identified for Lake Musconetcong as *Myriophyllum exalbescens* Fern. (Renlund 1950, p. 169).

The present study was undertaken when the writer noted that although the plants in Lake Musconetcong keyed readily to *M. exalbescens* in the eastern manuals (Fassett 1940, Muenscher 1944, Fernald 1950 and Gleason 1952), they did not conform strictly to the descriptions of this species. This material has a greater number of capillary leaf divisions than does *M. exalbescens* and displays a decided protrusion of the lowermost floral bracts beyond the fruits. Fernald (1919) had used both of these characters to separate *M. exalbescens* from *M. spicatum* L. (1753) in his original description of the former:

> . . . aquatic herb; the stem glabrous, leafy, simple or branching, purple, in the dried state becoming white: leaves verticillate, rarely in 3's, commonly in 4's, 1.2–3.0 cm. long, with 7–11 pairs of capillary flaccid or barely a little rigid segments [this range later became 6–11 pairs: Fernald 1950, p. 1073]: spikes terminal, almost naked, the flowers verticillate; the lower pistillate, the upper staminate, sessile: bracts rarely equalling the fruit, spatulate-obovate or oblong-cochleiform; the lower serrate, the upper entire: bracteoles ovate, entire, brown-margined, 0.7–1.0 mm. long; petals oblong-obovate, concave, 2.5 mm. long: stamens 8; anthers oblong, 1.2–1.8 mm. long: fruits subglobose, very slenderly 4-sulcate, 2.3–3.0 mm. long; the merocarps rounded on the back, smooth or rugulose.

According to Fernald, "*M. exalbescens* [had] always passed in America as *M. spicatum* L. The latter species of Eurasia, however, differs from the American plant in several characters:

the principal leaves of the primary stems have 14–21 pairs of rigid slenderly linear divisions; the bracts are rhombic-obovate; the bractlets are suborbicular or reniform, broader than long, and distinctly shorter than in most of *M. exalbescens*, 0.5–0.8 mm. long; and the linear anthers tend to be longer, being 1.8–2.2 mm. in length. In *M. exalbescens*, furthermore, the dried stems very strongly tend to become white, although this change is not always noted; in *M. spicatum*, however, the old herbarium specimens still retain a fulvous or olivaceous tone in the stems."

Concerning the floral bracts, Fernald (1919, p. 123) implies that they only occasionally exceed the fruits in some varieties of *M. spicatum*. Hegi (1926, p. 901), however, states that they are typically as long as or exceeding the flowers. This would appear, therefore, to be an additional valid character upon which to separate the two species.

As a further point of separation, Hultén (1947, pp. 1159–1160) stated that winter buds never develop in *M. spicatum* while such buds are often prominent in *M. exalbescens*.

A summary of the published differences between these two species is provided on Table I.

TABLE I

Comparison of characters used to separate *M. exalbescens* from *M. spicatum* in Series I and Series II material from New Jersey

Character	*M. spicatum*	*M. exalbescens*	*Series I*	*Series II*
1—shape of floral bracts	rhombic-obovate to elongate	spatulate-ovate or oblong-cochleiform	ovate to elongate	spatulate-ovate
2—relative length female bracts	longer than fruits	rarely equalling fruits	exceeding fruits	rarely equalling and never exceeding fruits
3—shape of bracteoles	suborbicular or reniform	ovate	ovate	ovate
4—dimensions of bracteoles	broader than long	longer than broad	both	both
5—dried stem color	olivaceous or fulvous	whitened	whitened to olivaceous	whitened to fulvous
6—winter buds	absent	present	reduced	present
7—number of pairs of leaf divisions	14–21	6–11	7–20	4–12
8—length of bracteoles	0.5–0.8 mm.	0.7–1.0 mm.	♂: 0.5–1.2 ♀: 0.6–1.0	♂: 0.5–1.3 ♀: 0.7–1.1
9—length of anthers	1.8–2.2 mm.	1.2–1.8 mm.	0.9–2.1 mm.	1.2–2.0 mm.

In the same paper containing the description of *M. exalbescens*, Fernald also described *M. magdalense* (later corrected to *M. magdalenense:* Fernald 1924). This species very closely resembled *M. exalbescens* except for the possession of "fruit so very unlike that of the latter species or of the old world *M. spicatum.*" This appears dubious since "the material of *M. magdalense* [was] mostly immature, only one plant being found with good fruit," and two other species, *M. exalbescens* and *M. verticillatum* var. *intermedium* Koch, were present in the vicinity so that the possibility of hybridization was genuinely extant. *M. magdalenense* was described as follows:

Similar to *M. exalbescens*; the stem branching, becoming white when dried: leaves mostly in 4's, 1–2 cm. long, with 3–7 pairs of capillary flaccid segments 0.5–1.3 cm. long; the upper emergent ones elongate-oblanceolate or linear, short-pectinate or subentire: spikes terminal, with the rachis filiform; flowers verticillate, the lower pistillate, the upper staminate, sessile: bracts elongate, linear oblanceolate, conduplicate, up-curved at the end, entire or the lower pectinate, 0.3–1 cm. long: bractlets ovate, 0.6–0.8 mm. long: petals ovate-oblong, concave, 1.5 mm. long: stamens 8; anthers oblong, 1.5 mm. long (immature); fruits subglobose, 3 mm. long, very broadly 4-sulcate; the merocarps with rounded rugose backs.

Chapman (1889, p. 143) cited the description of a Floridian species, *M. laxum* Shuttl., which is obviously very closely related to the two species of Fernald:

. . . stem long, slender; leaves four in a whorl; the floral ones reduced to minute nearly spatulate bracts, shorter than the flowers, which thus formed an interrupted almost naked spike; fruit roughened with minute warts, with the lobes obtuse.

Small (1933, pp. 954–955) supplies additional information on this species:

Stamens 8; corolla deciduous. Leaves in 4's; blades of the approximate submersed ones with 3–7 pairs of capillary segments; those of the floral ones spatulate; petals elliptic, 2.3–3.0 mm. long; anthers linear to narrowly elliptic, about as long as the filaments; fruit ovoid-globose, about 1.5 mm. long; carpels minutely warty.

In addition, Grout (1896, p. 11) described the bractlets as small, lanceolate and hyaline.

From a careful comparison of these descriptions, it would appear that these four species are closely related as a single complex whose geographic segments have differentiated in very small degrees along different pathways away from the common stock. The question arising is whether or not these segments have achieved "truly" specific status. It is the purpose of the subsequent sections of this paper to provide an answer to this question for *M. exalbescens* through a comparison of material from New Jersey coupled with the use of herbarium and literature resources.

Two series of collections from various locations in New Jersey were made. Series I contained specimens resembling the material of Lake Musconetcong in having a large number of leaf divisions and the lowermost floral bracts exceeding the fruits. Series II comprised more typical *M. exalbescens* in having shorter bracts and fewer leaf segments. The Series I material was collected at the following locations: 1) A fertile population from Lake Musconetcong, Morris and Sussex Counties. 2) Lake Lakawanna, several miles northwest of Lake Musconetcong in Sussex County; fertile. 3) The Delaware and Raritan Canal, Middlesex County; fertile. 4) Johnson Park Pond (Upper), several hundred yards from the third site; fertile. Series II material was collected from 1) Gardner's Pond, Sussex County; fertile. 2) Wolf Lake, less than a mile above Lake Lackawanna; sterile. 3) Wright's Pond, located above and connecting with Wolf Lake; sterile. Of interest is the fact that the latter two locations flow into Lake Lackawanna, yet this lake has only Series I material represented. The material which was sterile was grouped into Series II on the basis of the small number of leaf divisions alone since floral bracts were lacking.

There are only two additional species of *Myriophyllum* known to the writer in the Sussex-Morris County area from which most of the above collections were made. *M. heterophyllum* Michx. is very widespread. The material from Wolf Lake and Wright's Pond can be separated from it in the sterile condition, even though the number of leaf divisions is similar, by the whitened stems and the large winter buds of the former. *M. verticillatum* (var. *pectinatum* Wallr.) is represented by a single sterile population inhabiting the shallow ecotonal waters of a cove in Lake Musconetcong.

Using the qualitative and quantitative premises for the separation of *M. exalbescens* from *M. spicatum* (Table I), the two New Jersey series were carefully compared. Quantitative information was obtained by counting or measuring random samples of each of the structures indicated. The frequency distributions obtained by so-doing were subjected to statistical analyses to determine the degree of significance of any differences observed between means of the two series. Table I compares the results and Table II provides a summary of the statistical findings. In the discussion following, each character is numbered to correspond with similar numbers in the tables to facilitate reference by the reader.

TABLE II

Summary of statistical analyses of quantitative characters in Series I and Series II material

Series	n	r	M	σ	$\sigma/\sqrt{n}$	D/E_d	t_5
			7—Number of pairs of leaf divisions				
I	538	7–20	14.94	11.66	0.50	7.034	1.95996
II	592	4–12	8.23	10.10	0.41		
			8a—Length of male bracteoles (mm.)				
I	91	0.5–1.2	0.964	3.03	0.32	0.016	1.95996
II	60	0.5–1.3	0.978	3.56	0.46		
			8b—Length of female bracteoles (mm.)				
I	90	0.6–1.0	0.889	3.32	0.35	0.025	1.95996
II	72	0.7–1.1	0.913	4.62	0.54		
			9—Length of anthers (mm.)				
I	576	0.9–2.1	1.70	12.10	0.50	0.048	1.95996
II	142	1.2–2.0	1.65	6.97	0.58		

n equals the number of variates included in each sample; r is the range in the magnitude of each character; M is the mean of each character as calculated by the assumed mean method; σ is the standard deviation; $\sigma/\sqrt{n}$ is the standard error; t_5 signifies Fisher's t-value at 5% probability (see any statistics text for a table of t); D is the difference between the means of the two series; E_d is the standard error of this difference (calculated from the expression $E_d = \sqrt{\sigma/\sqrt{n_1} + \sigma/\sqrt{n_2}}$). If D/E_d exceeds t_5, the observed differences between the means of the two samples are significant. Such is the case only in the comparison of number of pairs of leaf divisions in the two series.

1. *Shape of floral leaves.* The uppermost (staminate) bracts were similar in both series: spatulate, both ovate and obovate; margins usually denticulate but often entire. The lowermost (pistillate) bracts differed: elongate and serrate to completely pinnate in Series I; spatulate-ovate and serrate in Series II. No rhombic contours were encountered.

2. *Relative length of lowermost bracts.* Almost always exceeding the fruits in Series I; rarely equalling and never exceeding the fruits in Series II.

3. *Shape of bractlets.* Ovate in both series.

4. *Dimensions of bractlets.* Some were broader than long and others were longer than broad in both series.

5. *Dried stem color.* Examination of sheets at the New York Botanical Gardens indicated this character to be of little utility to the average observer. There was free intergradation of stem color in both American and continental material. The dried stems of Series I material are whitened to olivaceous; those of Series II whitened to fulvous.

6. *Winter buds.* Turions are very prominent in Series II material, obtaining several centimeters or more in length. They are present in Series I specimens but are very much smaller, being usually only a centimeter or less. Futhermore, those of Series I are bright red through stramineous to light green whereas those of Series II are deep green.

7. *Number of pairs of capillary leaf segments.* The sheets at the New York Botanical Gardens supported Fernald's contention that *M. exalbescens* possessed fewer pairs of leaf divisions than *M. spicatum.* American material had 5–12 pairs and Eurasian 10–21 pairs, with the exception of that from Scandinavia and a single specimen from the Soviet Union which resembled American specimens more in this regard. The Series I plants had 7–20 pairs of divisions with a mean of nearly 15; the Series II material had only 4–12 pairs with a mean of 8.23. The analysis (Table II) indicated these differences to be significant: D/E_d was greater than t_5. This significance was at less than one per cent probability indicating that less than one variate in one-hundred from either series would intergrade with those from the other series.

8. *Length of bracteoles.* Although Fernald did not treat separately the bractlets of the two sexes, this was done here to eliminate that factor as a source of variability. None of the differences was significant. There was, however, a non-significant degree of sexual dimorphism in both series, the male bractlets being somewhat longer than those of the pistillate flowers.

9. *Anther length.* No significant differences existed between the means of the two series.

Reference to Table I allows ready comparison of the results outlined above with the published descriptions of the same characters for *M. spicatum* and *M. exalbescens.* Both series of New Jersey material are seen to intergrade between the two species. Although a specific character may be skewed in the direction of one of the species, it is generally influenced by the other. For example, the bracteoles of *M. spicatum* are described as shorter than those of *M. exalbescens,* and although the Series I bracteoles are insignificantly shorter than those of Series II, the degree is less than described.

Thus both series display an admixture of characteristics from both species, and although Series I leans more toward *M. spicatum* and Series II the opposite, the conclusion must be that none of the New Jersey material sampled is strictly either of the described species.

Three possibilities exist by which to explain the status of this New Jersey material:

1. *That the indigenous M. exalbescens hybridizaed with another indigen to produce a similitude to M. spicatum.* Although the potential for this occurrence is extant in the presence of *M. heterophyllum* and *M. verticillatum,* the writer is of the opinion that the production of a hybrid so closely resembling an existing species from another continent is clearly beyond probability. However, it should be mentioned that *M. verticillatum* is a highly variable circumboreal species so that many present species, including *M. spicatum* and *M. exalbescens,* could actually be well-differentiated varieties of a vast *M. verticillatum* complex. Indeed, Gmelin believed *M. verticillatum* and *M. spicatum* to be one and the same species, and Perrot (1900) provided a degree of anatomical evidence which supported this view (p. 202). The writer shares this point of view. After flowering of the Series I material in Lake Musconetcong the lowermost floral bracts often grow outward and, in basipetal succession, assume the fully-dissected character of normal submerged leaves or of the pinnately-divided floral leaves of *M. verticillatum.* It is therefore possible that the Series I plants are actually derived from *M. verticillatum* or a combination of this species with *M. exalbescens.* Since, however, conclusive evidence in support of such broad considerations is lacking, this hypothesis must be regarded as the least valid of the three possibilities.

2. *That M. spicatum became introduced and intergraded with the indigenous M. exalbescens.* Lake Musconetcong was originally impounded eleven decades ago to supply water for the trans-state Morris Canal. There existed at one time direct connection between canal and lake. This canal and the Delaware and Raritan Canal in central New Jersey were both used in the transportation of goods, probably including continental imports, across the state. Thus there existed in previous time two possible sites of introduction of *M. spicatum* from Eurasia. There is, however, no proof to support this hypothesis and the following evidence tends to negate it. The *M. spicatum*-like Series I plants are not widespread in the Delaware and Raritan Canal occurring, to the author's knowledge, only at the collection site. The Morris Canal is now abandoned, only discontinuous seg-

ments of it remaining submerged. Of these areas only one, into which Lake Musconetcong flows directly, is known to contain a sparse population of Series I material. Thus if *M. spicatum was* introduced into either of the canals, it did not there meet with the widespread success characteristic of the Series I plants in other sites where it occurs.

3. *That the New Jersey material represents intergrades between geographically disjunct segments of a circumboreal M. spicatum-M. exalbescens complex.* The distribution of such a complex is depicted roughly in Figure 1. Under this hypothesis two possibilities prevail: 1) that complete separation of the two species was never achieved and that intergrades exist at the peripheries of the overlapping ranges, or 2) that subsequent to complete disjunction (which permitted the differentiation of Eurasian and American populations) reunion was achieved and intergrade material resulted. The latter is similar to hypothesis number two above, only broader in aspect. The writer favors hypothesis number three because of the following direct and indirect evidences.

Since Fernald's separation of *M. exalbescens* from the complex, various American investigators working in various regions have failed to recognize it either through unfamiliarity or because their material would not permit them to do so. House (1924), working in New York, listed the species of that region as *M. spicatum*, making only casual note of Fernald's synonymy. Wiegand and Eames (1925), however, working in the Cayuga Lake Basin, did recognize the distinction. Jepson (1925), working with limited collections from California, assigned Fernald's species to the varietal status, *M. spicatum* var. *exalbescens* Jeps. Other western workers, Peck (1941) in Oregon and Kearney and Peebles (1942) in Arizona, recognized *M. exalbescens* and merely mentioned the synonymy of Jepson. Tidestrom (1925) in Utah and Nevada, Tidestrom and Kittell (1941) in Arizona and New Mexico, Pepoon (1927) in Illinois, and Rydberg (1932) in the Plains and Prairie regions all list *M. spicatum* for their respective regions. They do not, however, list synonymy. Deam (1940) listed *M. exalbescens* for Indiana. Standley (in Cooper 1930) referred Alaskan material to *M. spicatum*. Hultén (1947), also working in the Alaskan region, assigned *M. exal-*

Figure 1. Condensed equal area sinusoidal projection of the world. The land areas which are unblacked represent the approximate range of the *M. spicatum-M. exalbescens* complex after Fernald 1919, 1950, Hegi 1926 and Hultén 1947. Hultén cites the occurrence of *M. spicatum* in South America and Australia whereas Hegi stated its absence from both these continents.

bescens to a subspecies, *M. spicatum* subsp. *exalbescens* Hult., because ". . . the difference between the types is . . . so small that I prefer to regard *M. exalbescens* as a geographical race of *M. spicatum*." Finally, Fernald (1919), in his citations of collections, notes some Colorado material with unusually elongate bracts, a condition relating more to *M. spicatum* than to his species.

In Figure 1 the approximate locations of those citations above which appear to be in dispute with Fernald's separation are denoted as circles on this continent. It is obvious that these points lie in areas which can be considered peripheral in relation to the whole range of *M. exalbescens.*

To attest further to the variability of *M. spicatum,* one needs only to consult European floras such as that of Hegi for a list of several varieties. Indeed, Lange (1887) described one, *M. spicatum* var. *capillaceum* Lange, for Greenland which is quite adjacent to the range of *M. exalbescens.* It is unfortunate that this work was not readily available for comparison with the species considered earlier, especially since Fernald cited a specimen of *M. exalbescens* from Greenland (1919, p. 120).

To further support the implied variability of the complex, sheets from the collections at the New York Botanical Gardens were examined. The number of pairs of leaf divisions and stem color were given emphasis since other characteristics do not show well in the dried material. Three specimens labeled *M. spicatum* var. *exalbescens* Jeps. were examined: 1) No. 1402, 1477. 1941. A. H. Holmgren, Nevada. 2) No. 4910. 1939. C. L. Hitchcock, Oregon (Deschutes River). 3) No. 5139. 1939. I. W. Clokey, California (Lake Arrowhead). These specimens could not be separated from *M. exalbescens* Fern. by superficial characters.

Three specimens of Scandinavian material were examined: 1) 1869. Prof. Boeck, Norway; labeled simply "Myriophyllum" (placed in *M. spicatum* file). This specimen resembled *M. exalbescens* in every superficial character: whitened stem, short floral bracts and 6–8 pairs of leaf segments. 2) No. 823. 1913. E. of Hälström, Sweden (Lake Torankijärvi); labeled *M. spicatum;* possessed whitened stem and 6–7 pairs of leaf divisions. 3) 1882. Thedensis, Sweden (Stockholm); whitened stem and 8–10 pairs of leaf segments.

Ten specimens of far-eastern material were examined: 1) No. 18420. 1928. China (Univ. of Nanking); labeled *M. spicatum;* fulvous stem and 16–21 pairs of leaf divisions. 2) No. 807. 1933. China; whitened stem, elongate pistillate bracts, up to 27 pairs of leaf divisions. 3) No. 3337. 1903. Leg. D. Litvinov, Manchuria (Sangari River); labeled *M. verticillatum* because of prominent elongate lowermost bracts; specimen the precise image of Series I material from New Jersey. 4) No. 3412. 1902. Litvinov, west. Manchuria (Sta. Chingis-Khan); label and characteristics same as above specimen. 5) No. 9669. 1936. W. Koelz, India (Shigar, Baltistan); labeled *M. spicatum;* two specimens duplicating those of N. J. Series I. 6) No. 8959. 1936. India (Dal Lake in northwestern Himalayas, Srinagar, Kashmir); labeled *M. spicatum;* characters same as sheet above. 7) No. 6752a. 1922; 8) No. 399a. 1913; 9) No. 10205a. 1929. All three by R. R. Stewart, Dal Lake; characters same as No. 8959 above. 10) No. 895. 1927. U.S.S.R.; labeled *M. spicatum;* characterized by whitened stem and only up to eight pairs of leaf divisions. Additional material examined from the interior of Eurasia showed no variation from typical *M. spicatum.*

These sheets indicate for the most part an *M. exalbescens* influence in both Scandinavia and the Far East, both of which regions are peripheral in relation to the whole distribution of *M. spicatum.* The approximate locations of the above collection sites appear in Figure 1 as circles on the Eurasian continent. The distribution of *all* the circles in the figure suggests definite intergrade areas between *M. spicatum* and *M. exalbescens.* Thus the third hypothesis appears to be fairly well substantiated and there is indicated a variable circumboreal complex which it seems desirable to treat nomenclaturally as a single species.

It would not seem expedient to carry the present classification since this necessitates the naming of all the kinds of intergrades which might occur, a task with plural limitations. There exists a possibility that *M. exalbescens* Fern. and *M. spicatum* var. *capillaceum* Lange are the same since both of these descriptions were based, in part only in the former instance, upon material from Greenland. This would invalidate Fernald's name in the varietal category through precedence. However, the results of this study indicate a subspecific rank for this taxon and the name may be written *M. spicatum* subsp. *exalbescens* (Fern.) Hult. Intergrades can then be referred to this taxon or to *M. spicatum* L., depending upon which a particular collection more nearly resembles. Excluding from consideration Eurasian variations which may already have been treated but which the writer is in no position to discuss, the Series I American material and the far-eastern intergrade material belong, under this classification, to *M. spicatum* L. The Series II material, other American material, and probably also the Scandinavian intergrades are to be taken as *M. spicatum* subsp. *exalbescens* (Fern.) Hult.

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Sheets of the New Jersey material analyzed in the study are filed in the Chrysler Herbarium at Rutgers University.

Summary

1. This study was undertaken because of the discovery that some of the material of *M. exalbescens* Fern. bore a superficial resemblance to the Eurasian counterpart, *M. spicatum* L.

2. The descriptions of four species are provided 1) to indicate their close similarity, 2) to emphasize the variable nature of the group in general, and 3) possibly to question several of the descriptions.

3. Two series of New Jersey material, one resembling typical *M. exalbescens* and the other *M. spicatum*, were compared to determine their relation to one another and to the two species which they resembled. They were indicated to be intermediate between these species.

4. Three hypotheses were propounded to explain this intergradation. The one selected as best-supported was based upon evidence favoring the consideration that *M. exalbescens* is a geographical variant of a circumboreal *M. spicatum* complex.

5. Due to the indicated probability of widespread intergradation, it was deemed advisable hereafter to consider *M. exalbescens* Fern. as a subspecies, *M. spicatum* subsp. *exalbescens* (Fern.) Hult.

6. Thus both *M. spicatum* L. and *M. spicatum* subsp. *exalbescens* Hult. go on record for New Jersey, the record for the former being a new one.—BOTANY DEPARTMENT, RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY.

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Germination of Spores of Isoetes Tuckermani A. Br. in Their Natural Habitat.—Collecting pond plants in Worcester County, Massachusetts, was unusually successful last season, because it was possible to walk over most of an entire pond-bottom and up the bed of the entering stream. Mrs. Gates and I found *Isoetes* at various spots. The plants were much matured with the spores mostly discharged and about the color of the exsiccated muck. In the plant society, among many species, the following were abundant: *Eleocharis Smallii* Britton, mats of *Eleocharis acicularis* (L.) R. & S., *Scirpus Smithii* Gray, forma *setosus* Fernald, *Xyris caroliniana* Walt., *Juncus militaris* Bigl. in relatively deeper depressions, and *Eriocaulon septangulare* With. scattered in shallower areas.

A patch of vivid green on the margin of the dried-out mill pond, marked a stranded concentration of *Isoetes*, green with the first few leaves of a multitude of germinating spores. This green patch covered irregularly some fifteen to twenty square feet, at the southern end of the pond, near, but at one side of the outlet. When flooded to normal highwater, the gentle slope would be roughly a foot below the surface, at the deepest point. A collection of the *Isoetes* was made with the sandy soil of the pond bottom adhering to the mature and fruiting plants. Microscopical examination at the laboratory confirmed the germination and the development of sporelings in all stages, the cracking open of the spores, spores with emerging leaves and rooted plantlets with several leaves, the spore-coat in some instances remaining attached. Myriads of spores speckled the soil.

The species was determined by Mr. Philip G. Meissner as *Isoetes Tuckermani* A. Br. (Hadwen Herbarium sheet 28,524). Dr. Norma E. Pfeiffer of Boyce Thompson Institute has kindly verified the determination (27 April 1954), which is much appreciated. The collection was made 27 September 1953 in Douglas, Massachusetts, at an abandoned mill pond, on the west side of South Street, approximately at the boundary of Burrillville, Rhode Island. The pond was again visited 15 June 1954. It was found at capacity level and the spot where the *Isoetes* had been collected was completely covered. The species could not be found even though a careful search was made.

The apparent absence of *Isoetes* this year may be attributable to the earliness of the season.—BURTON N. GATES,

RESEARCH ASSOCIATE IN BIOLOGY, CLARK UNIVERSITY, WORCESTER, MASSACHUSETTS.

SOME NOTES ON THE FLORA OF SOUTHERN ILLINOIS.—While botanizing in southern Illinois during 1953 and the early part of 1954, several plants of unusual occurrence for the area were found. Some of these mark additions to the flora of Illinois while the remainder either are range extensions or new station records.

Unless otherwise stated, all specimens cited are on deposit in the herbarium of Southern Illinois University, Carbondale, Illinois.

ASPLENIUM BRADLEYI Eaton. This rare fern was found growing in crevices in a sandstone bluff. A frond from a large plant was found to have eighteen pairs of pinnae. COLLECTION DATA: crevice of sandstone bluff, along Piney Creek, one mile west of West Point, Randolph County; May 22, 1954. *Mohlenbrock and Voigt 2491.*

CAREX AQUATILIS Wahlenb. This species was found in a clump along a stream in Randolph County. COLLECTION DATA: along Piney Creek, one mile west of West Point, Illinois; April 24, 1954. *Mohlenbrock 2290.*

CAREX TORTA Boott. This recently discovered plant for Illinois has been recorded from several stations. COLLECTION DATA: clumped in a flowing stream, Dixon Springs State Park, Pope County: April 16, 1954. *Mohlenbrock 2057.* Along Rock Creek, four and one-half miles north of Cave-in-Rock, Hardin County; April 17, 1954. *Voigt and Mohlenbrock 2146.* Emerged in Piney Creek, one mile west of West Point, Randolph County; April 24, 1954. *Mohlenbrock 2322.*

JUNCUS DIFFUSISSIMUS Buckl. The diffuse rush, found in the adjacent states of Indiana and Missouri, was collected for the first time in Illinois along a roadside ditch. COLLECTION DATA: wet soil along country road, one-half mile south of Makanda, Giant City State Park, Jackson County; September 19, 1953. *Voigt and Mohlenbrock 1507.*

TRILLIUM RECURVATUM Beck, forma SHAYI Palmer & Steyerm. This yellow color-form is found at several sites in a rich mesic woodland at Lake Murphysboro. COLLECTION DATA: rich, mesic woods, Lake Murphysboro, Jackson County; April 23, 1954. *Mohlenbrock 2207.*

RANUNCULUS HARVEYI (Gray) Britt. This species was known previously from southern Missouri, Arkansas, and Alabama. COLLECTION DATA: dry rocky slopes along Piney Creek, one mile west of West Point, Illinois, Randolph County; April 24, 1954. *Mohlenbrock 2316.*

Geum virginianum L. The range of this species formerly extended westward to Indiana. It occurs only sparingly at Giant City State Park. collection data: dry woods, one-fourth mile northeast of the lodge, Giant City State Park, Union County; June 24, 1953. *Mohlenbrock 1594.*

Celastrus orbiculata Thunb. An escape from cultivation, this bittersweet has become established in Giant City State Park. collection data: wet woods, one-half mile south of county line, Giant City State Park, Union County; June 23, 1953. *Mohlenbrock 292.* Climbing on various trees, roadside, across from stonefort, Giant City State Park, Jackson County; May 10, 1954. *Mohlenbrock 2416.*

The stations for the following plants apparently are extensions of their ranges in Illinois.

Cyperus lancastriensis Porter. This species, first found in Illinois in Massac County in 1949 (*Evers 19952*),[1] was collected in Jackson County in 1953. collection data: moist meadow, near entrance, Giant City State Park, Jackson County; August 20, 1953. *Mohlenbrock 550.*

Cyperus schweinitzii Torr. Stream bed, Giant City State Park, Jackson County; October 23, 1953. *Mohlenbrock 715.*

Carex haleana Olney. Dry ground in open woods, Giant City State Park, Jackson County; May 15, 1954. *Mohlenbrock 629.*

Rosa blanda Ait. Roadside, shaded, Giant City State Park, Union County; May 15, 1954. *Mohlenbrock 66.*

Euphorbia obtusata Pursh. Foot of limestone talus slope, Pine Hills, Union County; May 2, 1954. *Mohlenbrock 2417.*

Rhus typhina L. Rich moist woods, Giant City State Park, Jackson County; September 20, 1953. *Mohlenbrock 221.*

Hypericum denticulatum Walt. A new station has been found for this species making the second for it in Illinois. It was first collected in Hardin County in 1949 (*Bailey & Swaine 1683*). collection data: wet, shaded woods, Giant City State Park, Jackson County; August 9, 1953. *Mohlenbrock 515.*

Chaerophyllum tainturieri Hook. Wet soil along State Highway 3, two miles northeast of Gorham, Jackson County; May 14, 1954. *Mohlenbrock and Weber 2668.*

Hedeoma hispida Pursh. Dry woodland, Giant City State Park, Jackson County; August 25, 1953. *Mohlenbrock 784.*

Viburnum lentago L. Edge of woods, Giant City State Park, Jackson County; April 30, 1953. *Mohlenbrock 641.*

Bidens polylepis Blake. Wet roadside ditch, Giant City State Park, Jackson County; October 9, 1954. *Mohlenbrock 323.*

Robert H. Mohlenbrock,
southern illinois university, carbondale, illinois.

[1] The specimen of *Cyperus lancastriensis* Porter (*Evers 19952*) is on deposit in the Illinois Natural History Survey Herbarium, Urbana, Illinois.

THE EXTRAORDINARY FUNICULUS OF ACACIA CONFUSA MERRILL*

The funiculus is ordinarily a short and simple structure which serves as a stalk for the ovule. As such, it shows little structure and is usually a straight cord, often of very slight length. Because of its simplicity it has largely been neglected. Eames and Mac Daniels (1947) do not mention it, nor does Esau (1953). Netolitzky (1926) discusses the insertion of the funiculus on many seeds but never mentions its vascular structure. Yet it must have sufficient vascular structure to carry the food and water, often large in amount, needed for the growth of the ovule from a minute structure to a comparatively large one, sometimes even a very large one.

In a few species it has been noted that outgrowths of the funiculus have given rise to structures caruncular or arillar, which formerly were supposed to be outgrowths from the seed coats. The Magnolia has an unusual funiculus which stretches when the fruits break open and allow the large seeds to fall. For a time the elongated funiculi support the seeds outside the fruits but they soon part and allow the seeds to drop. The funiculus of this plant stretches by the extension of the spiral thickening of the tracheids Prantl (1894).

Bailey (1925) states that the Acacias frequently have elongated funiculi, and that the funiculus is found "either twice encircling the seed or bent back upon itself." I had not known of this peculiarity when I observed an Acacia (later identified as *Acacia confusa* Merrill), in the plantings of the Federal Experiment Station at Mayaguez, Puerto Rico, which showed brilliant orange threads hanging over it. Examination showed that the ripe pods were breaking open and allowing the seeds to fall. But the fall of the seeds was soon checked by the orange threads which were found to be unusually long funiculi. Some of the seeds remained suspended for days although the greater number became detached within a few hours. Wetting of the structures by rain caused a considerable retraction of the seeds but never enough to pull them back into the fruits. Usually it reduced the distance of the seed from the fruit by about one half. This

* Paper No. 1022 from the Department of Botany, University of Michigan.

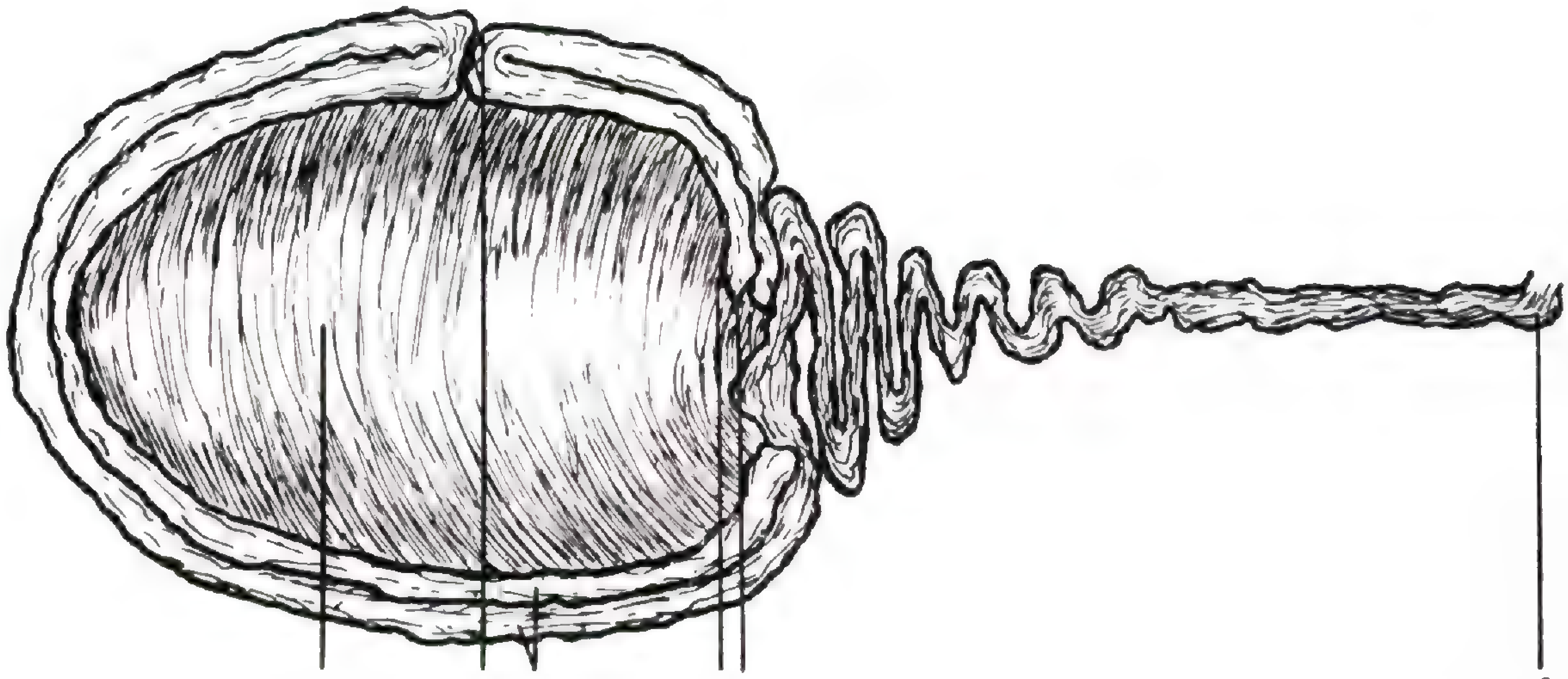

Figure 1. A seed of *Acacia confusa* surrounded by two strands of the funiculus; *a.* seed, *b.* two strands of funiculus, *c.* point at which strands of funiculus fold back upon themselves, *d.* micropyle, *e.* hilum of funiculus, *f.* funiculus near attachment to the placenta.

shortening was brought about by further bending and twisting of the funiculus rather than any shrinking of the funicular cells.

The color which first called my attention to the structures was a very rich, bright orange. Nothing is known of it save that 2 months in 85 per cent lactic acid did not fade or clear it to a noticeable degree.

In the fruit the funiculus is very curiously coiled. Near the placenta several sets of reverse curves are formed and then two layers of funiculus are formed around the seed (Fig. 1a). But strangely enough this does not mean that two coils pass around the seed. A strand of the funiculus goes about three fourths around the seed then folds sharply backward (Fig. 1c) and passes around the seed in the other direction until it meets the fold just described. Now it folds backward and extends to the attachment of the seed. At first I thought to the location of these folds (Fig. 1c) came at the micropyle but it does not, for the micropyle is found at the end of the seed (Fig. 1d). No explanation for this peculiar folding of the funiculus occurs to me.

The strand of the mature funiculus shows a central thread of xylem surrounded by a loose sleeve of parenchymatous cells. The xylem is made up exclusively of spiral tracheids. The parenchymatous cells have thickened walls which contain the orange color previously mentioned. They are somewhat elongated in the lengthwise direction of the funiculus but otherwise show no noticeable peculiarities.

A careful study of cross and longitudinal sections of the funicular strand reveals no trace of phloem or any structure which could have resulted from degenerating phloem. Unfortunately, I had only mature tissues, and have no proof that phloem was not present at an earlier stage. If so, its absolutely complete disappearance at maturity is remarkable.—CARL D. LARUE; DEPARTMENT OF BOTANY, UNIVERSITY OF MICHIGAN, ANN ARBOR, MICHIGAN.

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CAREX AENEA FERNALD (TYPICAL) IN COOK COUNTY, MINNESOTA.—During the preparation of the final manuscript of "A floristic study of Cook County, northeastern Minnesota," coauthored by the late Fred K. Butters and me and published in RHODORA **55** (1953), the records of *Carex aenea* Fernald (typical) were omitted. Paragraph 2, page 130 of RHODORA **55** should read as follows:—

CAREX AENEA Fernald (typical). Proc. Amer. Acad. Arts & Sci. **37:** 480. 1902. Perigynia ovate-lanceolate, veinless to moderately veined on the ventral face; achenes ovate. LECTOTYPE, M. L. Fernald, June 8, 1901, gravelly bank, Orono, Maine (in Herb. Gray).—*Lakela 3646*, Jul. 4, 1940, along a path on a rocky ridge, Windigo Point, Sea Gull Lake; *Butters, Burns & Hendrickson 103*, Jul. 11, 1938, top of cliff south of Rove Lake; *Burns & Hendrickson 155*, Jul. 17, 1938, side of cliff just south of portage between Clearwater Lake and West Pike Lake; *Burns & Hendrickson 407*, Aug. 7, 1938, on ledge of cliff, east side of Little Caribou Lake; *Burns & Hendrickson 380*, Aug. 5, 1938, on cliff overlooking west side of Canoe Lake; *Burns & Hendrickson 383*, Aug. 5, 1938, on big cliff, Alder Lake; *Butters, Abbe & Abbe 270*, Jul. 4, 1937, top of ridge on south side and toward west end of Mountain Lake; *Butters, Burns &*

Hendrickson 35, Jul. 7, 1938, top of cliff at west end of Mountain Lake; *Butters, Burns & Hendrickson 57*, Jul. 7, 1938, on rocks along base of cliff at west end and on south side of Mountain Lake; *Butters, Burns & Hendrickson 72*, Jul. 9, 1938, along base of diabase cliff, ½ mile east of east end of Mountain Lake; *Butters, Burns & Hendrickson 86*, Jul. 9, 1938, on cliff, ½ mile east of east end of Mountain Lake; *Burns & Hendrickson 181*, Jul. 20, 1938, cliff ¾ mile north of middle of West Pike Lake; *Burns & Hendrickson 239*, Jul. 25, 1938, top of cliff just south of Royal Lake; *Abbe & Abbe 542*, Aug. 19, 1937, Sailboat Island; *Rosendahl 6000*, Aug. 10, 1929, in rocky-sandy soil, beach east of Grand Marais, along Highway No. 1; *Butters & Rosendahl 4467*, Jun. 29, 1924, gravelly soil, along roadside west of Tofte; *Butters, Abbe & Burns 693*, Jul. 1, 1940, cliff on east side of North Fowl Lake (Thunder Bay District, Ont.).—

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NORMAN CARTER FASSETT 1900–1954

DONALD CULROSS PEATTIE

IN each generation there are certain people (just a few in a million), who are born botanists. One such was Norman Carter Fassett, whose death on September 14, 1954, at Boothbay Harbor, Maine, is a loss to his science as to his friends. A member of the New England Botanical Club since 1920, he was at the time of his death President of the American Society of Plant Taxonomists, and a full professor of botany in the University of Wisconsin. But these and many other professional connections, activities, and achievements, do not begin to suggest the depth of his feeling for his science. It is not too much too say that the great love of his life was the flora of his native land.

To be a born botanist, as Fassett was, is not the same thing as being a born gardener. The most ardent gardeners I have known are preoccupied with making plants grow where, and as, they do not seem naturally inclined to grow; your real gardener wants to bring every plant that appears in his eyes worthy of the honor into cultivation, and to improve upon it. I could never discover that my friend Fassett had the gardener's gift. He loved plants as he found them, and where he found them, and looked with some distaste upon plants out of place. The planting of thousands of Colorado blue spruce on Mt. Washington, New Hampshire, was proudly announced at a meeting of the New England Botanical Club in 1921, and I distinctly recollect how this left my friend not cold but hot under the collar.

Nor was he one of the type that I shall venture to call the "made" botanist. By that I mean one who at some time in his college training or even later decides to turn upon plants an intellect that would have been equally happy, perhaps, in physics, chemistry or even mathematics. This group includes, I know, some of the greatest names in botany today. And it is with no intention to belittle their achievements that I say that to those of this persuasion whom I have known, a living plant, *in situ*, may mean comparatively little. It must be brought into the laboratory and "controlled" before it yields up any intellectual satisfactions for the "made" botanist. It is hard to believe that plants could ever have for such botanists any emotional content.

A sentence from a letter which he wrote me in 1921 will show how different was Fassett's approach, even in these early days. "I have fallen in love this summer," he wrote in 1921, "with the three Osmundas." I can imagine a similar sentence (indeed there is one) dropping from the pen of the young Linnaeus, the young Theophrastus, the young Haller (poet-botanist of the flora of the Alps), William Hooker or Konrad Sprengel—all of them born botanists. I cannot conceive that a Nägeli, an Ingen-Housz, a Correns, a von Mohl, or a Weissmann, would ever have fallen in love with a genus of ferns, or if such a weakness had overcome them in early youth, it would never have been admitted in writing!

Norman Carter Fassett was born March 27, 1900 in Ware, Massachusetts. When I first knew him, however, he was living with his delightful family in Leominster, and together we used to tramp the autumn woods thereabouts and the frozen bogs in winter, and fish from the same stream in May. But Norman's real love was for Maine, where his mother had been born and where the Fassett family had a summer home, at Ocean Point. When I visited him there he showed me, as one reveals a holy object, a spot particularly beloved by him—a tunnel-like, moss-grown path through a grove of spruce all hung with Usnea lichen. He felt too deeply about it to speak; he simply stood aside and revealed it to me, with his light blue eyes shining. We looked at each other as two who share a common Faith, and nodded in unspoken understanding.

We first met, as mates of the class of '22 at Harvard, on the opening day of Fernald's famous Botany 7 course, in the autumn of 1919. It was always a very small class; probably few ever took it except those who had already heard of it, and knew it was unlike any other botanical course elsewhere offered. Yet all the others in that particular class have faded from my memory. Only Norman remains clear to me. One might say I remember him because none of the rest of us was destined to go so far in this branch of botany as he. But he had a quiet yet intense enthusiasm, a shy but strong personality that no one could forget.

Fassett as a nineteen-year-old was indeed a shy person—but shy not from a fear that you would not notice him, but from genuine modesty. He told me that (so he fancied) he always made a poor first impression. All that amounted to was that he was decidedly not a born actor. He did not project his personality; his pawky humor and his steady loyalty to friends gradually dawned on you. And it might take you some time to realize how well he knew what he knew. Rather slight in frame, he even entered a room more unobtrusively than anyone of force and importance I have ever known.

In our last two years at Harvard we were roommates and went constantly about together. In this period I came to understand how much he owed to the New England or Thoreauvian tradition. I don't mean that he had ever, at that time, read a word of the Sage of Walden, still less that he was a Transcendentalist or moralist. Rather do I mean that the same attitude taught both men to love New England bogs just because they are so acid, and the family of the sedges because they are, botanically, so tough. Each liked a wrestle with Nature—liked to show that he could start a fire with wet wood and "preferred snow on his wildflowers," as Norman put it to me when I was trying to extol the beauties of a Carolina spring.

Norman had also—at this time but not in later years—the limitations of a sweetly provincial training. His knowledge of fiction seemed to stop with Dickens, and of poetry, with Longfellow. (I introduced him literally to Vachel Lindsay and literarily to Omar.) The higher music he left to his brother Jimmy—now James Fassett the distinguished radio music commentator for the New York Philharmonic Orchestra. But Norman had a fund of comic songs which I have never heard from anyone else, and "Pinafore" was his favorite (and only) opera.

Languages were a devilment to my friend, not I think because of inability but because there seemed to him no good reason for learning to say something as foreigners say it when he could say it perfectly well in English. (I dragged him through his second try at first-year German—a case of the blind leading the blind.)

It was with difficulty that I persuaded him to climb Mt. Washington with me. Mountains, in his philosophy at the time, were rather excessive phenomena not to be given overt approval by one to whom the coast of Maine was the last word in God's good creation. In vain I tried to get him to botanize the southern Appalachians with me. And Fassett had then the perfectly formed conception of the Middle West commonly and firmly held by people who have never been there. Wisconsin—where he was to spend so much of his life and do so much fine work—was, I distinctly recollect, the prime object of his half-humorous scorn. That I had been there and he hadn't merely proved the folly and delusion of travel. (One must reread Thoreau's remarks on the futility of Emerson's trip to Europe, and the superiority of Concord woods over the California redwoods, to understand that my friend was not being a young eccentric but was actually conforming to the conventions of his environment.)

After Botany 7 had come to an end, Fernald urged his students to collect during the summer and he generally referred them to some special problem of interest to him which could best be solved by collecting in the student's "home region." He sent me off, for instance, to my native haunts—the head of Lake Michigan, to look for the coastal plain element in the flora of the Great Lakes, and dispatched Fassett to his beloved Maine, to collect the estuary plants.

This was a promising subject—the aquatic flora of a region that is part brackish, part fresh, and may be expected to give shelter to long littoral extensions of ranges. But collecting plants on mud flats is not light or delightsome work. It is extremely toilsome, sticky, mucky, hot (or cold), and smelly. It was a long wearisome summer that the young man put in, as his letters to me revealed, and he was often lonely. For this was not the Maine coast of surf and rocks, of the odor of spruce and the taste of lobster, that he loved. His brother James dropped in to see Norman and looked out in horror over the muddy waste which Norman was preparing at that moment to cross. "Are you going out *there?*" Jimmy demanded, aghast. "Have to," Norman answered. "You're crazy!" cried Jimmy wildly. Still, not lacking in courage, James followed his brother out on the queazy mass, half liquid, half solid, and helped him collect plants. I believe James never went out a second time, but Norman fought it out along these lines—like General Grant. And it did take all summer.

Estuarine plants do not make a showy collection in an herbarium. It seemed to me, as I reviewed the results of his summer toil, that they were all minute apetalous flowers (or capsules) sessile in the axils of opposite leaves—and I said so. He agreed; he found their identification a tedious business, over which he was busied for a year. But he faced the fact that in science there is a great deal of tedium. Plugging steadily ahead, in following summers he extended his estuarine studies to the Gulf of St. Lawrence and the Maritime Provinces of Canada.

In our last undergraduate year, Fassett and I roomed together in Stoughton Hall and were graduated together, he with the degree of B.S., class of 1922. While I went off to a job in the Office of Foreign Seed and Plant Introduction in the Department of Agriculture in Washington, Fassett continued on at Harvard, teaching there and at Radcliffe from 1922 to 1924 and earning the degree of M.A. in 1923, while in 1925 he went through the ordeal (described to me by its victim in all its horrid details) of a successful Ph.D. degree. His thesis was published, after the usual delays so agonizing to young authors, in 1928 by the Boston Society of Natural History, *Proceedings* vol. 39, pages 73–130, and bore the title of "The Vegetation of the Estuaries of Northeastern North America." Such titles do not set the Seine, far less the Charles and the Mystic, on fire. Yet in the slow course of professorial time, this paper *was* noticed, and with increasing respect, so that he was called upon to make surveys of the aquatic vegetation first of Wisconsin and in later years of Central America, until he became perhaps the country's leading authority on the subject.

In the meantime he had been appointed, in 1925, to an instructorship in botany at the University of Wisconsin. Madison, he reported, was to his (feigned) astonishment quite a delightful place, "almost a New England town." Chicago, where I showed him around for the first time, amazed him. With a twinkle in his blue eyes he remarked that "the place is undoubtedly growing." The Wisconsin North Woods, he wrote, had the "right kind of trees,"—spruces, birches, white and red pines. His first classes did not interest him, he wrote me. After all, who cares to go over the same old ground of elementary plant physiology, and photosynthesis, and the conjugation of Spirogyra?

His rise at Wisconsin was rapid, however; he was Assistant Professor by 1929, Associate Professor in 1937, and full Professor and Curator of the Herbarium in 1944. "Under his guidance," say his colleagues, in *Memorial Resolutions . . ., on the Death of Professor Norman Carter Fassett*, "the Herbarium of the University has grown from a collection of 96,000 specimens, including 15,000 specimens of Wisconsin plants, to the impressive and exceedingly valuable collection of 380,000 specimens, including 68,000 specimens in the Wisconsin collection. The specimens personally collected by him number 28,000."

It is only fitting that his colleagues at Wisconsin should speak for him and his nearly 30 years of brilliant work at Madison, and so I shall take the liberty of quoting further from their admirable testimonial. "Dr. Fassett's profound enthusiasm for the out-of-doors and his sensitive dismay at the changes being wrought by man led him to become one of the leaders of conservation thought in Wisconsin. Although not a writer in the field, his lectures and his conversations with his students and colleagues imbued many with the spirit of conservation. Through his influence an undergraduate major in the biological aspects of conservation was started at the University and the state board for the preservation of scientific areas was brought into being. He was active in the establishment and development of the University Arboretum. His wide influence upon the students from so many diverse fields impressed many of the citizens of Wisconsin with the importance of an ecological conscience. No student ever left his classes without an increased perception of America's magnificent natural resources, the sweep of their evolution in the past, their significance and beauty in the present, and our own responsibility for their full enjoyment by the generations that are to follow us. These attitudes and ideas spread into many departments of the University and far beyond it. . . .

"A forceful and stimulating personality, Dr. Fassett was noted for the excellence of his lectures. His classes were sought by students in many fields of science. Colleagues teaching in other departments paid him a rare tribute in asking him to give the opening lecture in one course and the final one in another. Sparkling wit, dry humor and a wealth of illustrative material characterized his delivery. No man ever did more to bring the salty air of the New England coast to a Midwestern campus. Abundant photographs taken on his many travels were used to illustrate points he wished to make. Always a firm believer in the necessity of field work in botany, Dr. Fassett led his classes on many memorable trips. Who among his students can forget their professor 'swinging on the birches' of the north slopes along the Wisconsin River valley, or his savory stews garnished with the local vegetation, along with many an important botanical precept."

Four excellent books bear Fassett's name. First there is his very concise and handy *Spring Flora of Wisconsin* (1931 reprinted in 1938), his *Leguminous Plants of Wisconsin* (1939) with its very carefully mapped ranges and excellent keys and lucid full descriptions and photographs far above the average of botanists' attempts (they are usually pretty amateurish) at photography. Then in 1940 McGraw Hill published his *magnum opus, A Manual of Aquatic Plants.* With hundreds of excellent diagnostic drawing and 382 pages of text, it was made further useful by very full notes on the uses of aquatic vegetation by wildlife. His last work was *Grasses of Wisconsin* (1951), a model of clarity and conciseness, excellently illustrated and with many distributional maps.

During World War II Fassett was called upon, with other botanists, to make a search upon behalf of our armed forces fighting in malarial regions, to locate in its native countries new sources of *Cinchona*, the tree that yields quinine. The Japanese having seized the Dutch East Indies, the regular supply of quinine was cut off, and the suffering of our troops at Corregidor, from lack of quinine, are too well known to repeat. Fassett tells the story (omitting only his first agonies over the Spanish language) in the *25th Anniversary Report of Harvard Class of 1922*, and he tells it so well that I can only quote his own modest and humorous account of it as he gave it there:

"For me, the war's interruption of normal routine took the form of a year's sojourn in Colombia, South America, where I explored the Andes for *Cinchona*, the tree whose bark yields quinine. The life we led in the Cinchona Mission was well described in a recent issue of the *National Geographic* on the Cinchona mission in Ecuador (which failed to state that more *Cinchona* bark was shipped from Colombia than from all the rest of South America combined).

"The story is this: *Cinchona* is found in the wild state only in the high mountain areas of South America, but for nearly a century the commercial supply has come from plantations (originally from South American seed) in Java and the Philippines. At just the time when need for quinine became most acute these sources became unavailable, so we had to go back to South America to tap the wild supply. But the trees in their native regions are unreliable. In one region they may have a high quinine content and in others be quite useless. So botanists were called for exploration, to locate the stands of trees and bring back samples for chemical analysis. There were about ten of us in Colombia. Each travelled with a Colombian boy for an assistant. We drove, over wild mountain roads overhanging eternity, to villages as remote as could be reached by automobile. The assistant hired guides and mules, and we climbed, usually to eight or nine thousand feet. When the going got too tough for the mules, we continued on foot, cutting trail with machetes and often climbing almost vertically for half a day. Most of the time it rained. After locating a stand of *Cinchona*, we would cut a few trees and strip the bark and make herbarium specimens. If examination of the latter showed it to be the right species and analysis of the bark showed it to have satisfactory alkaloid content, word would be sent back that we would buy bark from that particular region. And that, my friends who were in the tropics, is how you got your quinine—unless you used atabrine!"

Fassett's ever-growing reputation as a specialist on aquatic vegetation caused him to be called more than once to Central America to study the water plants of the tropics. On some of these trips he was accompanied by his adolescent son Charles who, to his great pride, has since followed in his botanical footsteps and is now on the botanical faculty of the University of

Wisconsin. It was in December of 1953, I believe, that he was suddenly stricken down, in Managua, Nicaragua, with a blow to his health. "Until that day," he wrote me in February, "I was just as active as the day we climbed Mt. Washington together." He was hospitalized there for some weeks before being returned to Madison, and there he was told that the lesion in the brain was a very mild one and would soon mend. But on February 21 he had another hemorrhage and the next day was hospitalized, almost dead. And here is the fine, fighting, sporting spirit in which he wrote me on July 18:

"The doctor said I might recover and walk again—you know how a poor old guy stumps along after a stroke. I now walk as well as ever, and yesterday I was climbing trees with a friend's children. On March 11 a tumor was removed just above the right ear. Five days later I staggered to my feet, grabbed a likely looking nurse, and polka'd down the corridor. Forgive my smarty boasting—I have to get what fun I can out of this. Since then I have been in and out of the hospital much of the time delirious or just plain unconscious. For a couple of weeks now I have been out of the hospital, and hard at work. The cancer is coming back, and I am given a few months to live. I am working hard to finish a number of jobs. Just completed a monograph of *Echinodorus*. Now am starting a report on my recent trip to Central America. I have a lot of papers under way, and want to leave them so somebody can pick them up. I fear I shall not get to the Spring Flora of New England. It is finished up into the Cruciferae. Think I shall send you a copy of the Monocots. Wish I could find somebody to finish it. What I plan (or hope) to do is get various persons to take on some of these papers, then leave the manuscript (if I have to leave it) with directions to have it sent to that person. Most of the monographs of Central American aquatics were written at the Gray Herbarium when I was there four years ago, and are just about in the state where Fernald published. That is: one must borrow material from the larger herbaria, work it up and make necessary changes, plot maps, cite specimens, etc. If you think of any likely candidates, let me know. Or, would make some nice theses, under proper direction.

"My eyesight is still very bad, with the left upper quarter of the field of vision gone. Everything looks funny, and I feel as if a flash bulb had just gone off before my eyes. My hands tingle continuously. I get confused very easily. I am living with Marcia*, who is now married, on the edge of town, but still keep my apartment near the University. Ever since you introduced me to Omar, on the banks of the Charles, I have lived by his philosophy, and it has paid off. Now I eat well, sleep well, and enjoy my likker. Wonder how it will strike me at the end—will there be a general decay of faculties as the cancer progresses, or will I have a grand hemorrhage that really slaps me down?

"O. K. It's been fun."

My old friend spent a few very happy last weeks at Boothbay Harbor. Then he was taken to the hospital, unconscious, and lingered, without pain I believe and hope, until the fourteenth of September. He was much too young to go. Years of fruitful research and teaching, and many books, should still have come from his great gifts. His loss is a loss to science. As to his personal friends, they feel it too keenly to be able to speak of it.

CONTRIBUTIONS TO THE FLORA OF NOVA SCOTIA IV

E. C. Smith and J. S. Erskine

During the past few years rather extensive floristic surveys have been carried out in Nova Scotia sponsored mainly by the Nova Scotia Museum of Science and by the Nova Scotia Research Foundation. The former has been directed toward ecological studies of particular areas of the province and the building up of the herbarium of the sponsoring institution under the direction of J. S. Erskine. The latter survey has been conducted by E. C. Smith in connection with forest ecology studies. Some of the results of these surveys have already been published (Erskine, D. S. 1951; Erskine, J. S. 1953 and 1954: Smith and Schofield 1952; Schofield and Smith 1953). In the above and in the present paper, records of new plants for the province of particular interest have been the arctic-montane species reported mainly from northern Cape Breton Island which fill in range gaps from Newfoundland, New Brunswick, and New England.

* His daughter.

New plants of southern affinities have also been found and the coastal plain species of the province have been shown to be more widely dispersed than was previously supposed. The more intensive coverage of the province has also shown that some of our supposedly local and rare plants are more widely dispersed than was formerly thought. A considerable number of the records of species new to the province are naturalized introductions, and it is doubtful whether some of these will persist.

Many of the arctic-montane species have so far been found to be of very local distribution with each of the river valleys of northern Inverness and Victoria Counties having one or two species peculiar to one valley; i.e. *Oxyria digyna* (L.) Hill and *Saxifraga aizoides* L. from Big Southwest Brook, and *Phyllodoce caerulea* (L.) Babingt. and *Diapensia lapponica* L. from Lockhart Brook. The latter two species were confined to one series of north facing cliffs. Not all of these northern plants are restricted to northern Cape Breton. As the systematic exploration of the Cobequid Mountains of Cumberland and Colchester Counties, and the North Mountain, Kings County proceeds, more of these plants are being found, i. e. *Poa glaucantha* Gaudin and *Trisetum spicatum* (L.) Richter, var. *pilosiglume* Fern. at Amethyst Cove, Kings County, and *Solidago macrophylla* Pursh from this area and also from Cumberland and Colchester Counties.

The annotated list below of new and rare plants for the province is mainly the results of the 1952 summer exploration of the two groups mentioned above. During part of this time the two parties coöperated in the study of some areas in northern Cape Breton.

Grateful acknowledgement is made to the Nova Scotia Research Foundation and to the Nova Scotia Museum of Science for financial support and to the following persons who have aided the authors in various ways; D. S. Erskine for aid in identification and for bringing numerous interesting records to the attention of the authors; to W. G. Dore and staff of the Central Experimental Farm, Ottawa for determination of the *Gramineae* and other groups; to A. E. Porsild and H. J. Scoggan of the National Herbarium for checking the identity of some difficult species; and to A. E. Roland, Provincial Botanist, and others for permission to publish various records.

Various abbreviations are used throughout the paper. 1. JSE preceding a collection number refers to J. S. Erskine as collector. 2. The collections of the forest ecology parties are designated as follows: SECS: E. C. Smith, D. S. Erskine, E. H. Collins, W. B. Schofield in 1948; SCBS: E. C. Smith, E. H. Collins, J. M. Bruce, D. R. Sampson in 1949; SCBSB: E. C. Smith, E. H. Collins, J. M. Bruce, D. R. Sampson, F. C. Bent in 1950; SSSB: E. C. Smith, W. B. Schofield, D. R. Sampson, F. C. Bent in 1951; STWS: E. C. Smith, J. C. Taylor, D. H. Webster, L. B. Slipp in 1952 and 1953; SSTWS: E. C. Smith, W. B. Schofield, J. C. Taylor, D. H. Webster, L. B. Slipp in July 1953. 3. Can: National Herbarium, Ottawa; DAO: Department of Agriculture, Ottawa. 4. NSAC: Nova Scotia Agriculture College, Truro, N. S.

Lycopodium Selago L. Reported first for the mainland of Nova Scotia by J. S. Erskine (1953), this plant is also known from Digby County: bank of run, Seal Cove, Brier Island, Roland, Smith *et al.*, June 15, 1949; occasional to rare on moss hummocks bordering small runnel through bog near Seal Cove, Brier Island, W. B. Schofield, September 4, 1951.

Selaginella selaginoides (L.) Link. Known to be of scattered occurrence in the bogs of northern Cape Breton, the following two collections show the presence of this plant on the mainland and on southern Cape Breton. Richmond County: rare in bog, West L'Ardoise, SSSB 5137; Digby County: common in bog, center of Brier Island, Roland, Smith *et al.* 90.

Woodsia glabella R. Br. To the three known stations, all from Inverness County, for this rare fern (Robinson, 1904; Smith and Schofield, 1952) the following may be added: Victoria County: very rare on damp north-facing cliff wall, Indian Brook, STWS 6606; very rare in crevices of dry cliff, Lockhart Brook, Salmon River, SSTWS 7895.

Cryptogramma Stelleri (Gmel.) Prantl. Inverness County: abundant on shaded limestone cliff, Hillsborough, STWS 6684; abundant in shaded crevices of conglomerate cliff face near Whycocomagh, SSTWS 8672. A northern or alpine species, known from Newfoundland, New Brunswick, and New England, these collections are the first for the province.

Sparganium multipedunculatum (Morong) Rydb. Reported by Roland (1947) as present at Sydney, North Sydney and Sable Island, the following two stations are of interest. Inverness County: in water of pond, Presquile, SCBSB 3380; Digby County: pond, Sandy Cove, JSE 52.1261.

Sparganium fluctuans (Morong) Rob. Rarely collected in the province, the following collections show a wider distribution than was formerly supposed. Cape Breton County: in water of pond back of beach, Main-a-Dieu, SCBS 2849, the first collection for Cape Breton Island; Guysborough County: leaves floating in water of Mannassette Lake, STWS 6793; in water of lake, three miles south of Goldenville, SECS 575; Halifax County: Chain Lakes, St. Margaret's Bay Road near Halifax, E. Gorham 45.1383; Cumberland County: in shallows of Big

Lake, JSE 52.978; Annapolis County: floating in two feet of water, McEwan's Lake, Albany, J. S. and D. S. Erskine: 262.

Sparganium minimum (Hartm.) Fries. Collected but once before on the mainland (Fernald, 1921), this plant was found growing in a lagoon of the Gaspereau River near Gaspereau, Kings County: D. H. Webster, September 3, 1952. To the known stations on Cape Breton Island may be added those from water of a lagoon of the Southeast Mabou River, Hillsborough, Inverness County, STWS 6704; and from a pond, Main-a-Dieu, Cape Breton County, JSE 51.1325.

Poa alsodes Gray. This rare grass was collected previously from four stations, two each from Colchester and Inverness Counties. Victoria County: in meadow at river edge, Cape North Village, STWS 6421.

Poa glaucantha Gaudin. The report of *P. glauca* Vahl from the Province (Smith and Schofield, 1952), and at that time considered by Dore (*in litt.*) to be not quite typical, is now placed by him in *P. glaucantha* as are the following collections. Victoria County: cliff crevices, Gray Glen, JSE 52.358; occasional on dry cliff, one mile from mouth of Indian Brook, STWS 6629; Kings County: cliff crevices, Amethyst Cove, JSE 52.580. The latter collection is the first from the mainland of the province.

Eragrostis cilianensis (All.) Lutati (= *E. megastachya* (Koeler) Link). Kings County: edge of beach, Hall's Harbour, J. S. Erskine, August 12, 1949 (NSAC). Reported once previously as an adventive in the vicinity of Halifax in 1938 by Dore and Roland (1942), this station was also adventive.

Lolium multiflorum Lam. Kings County: old lawn, Wolfville, G. C. Warren, September 21, 1950; Hants County: in old field where it must have persisted for many years, Windsor, JSE 52.1143. Previously reported by D. S. Erskine (1951) from Halifax County, these records were confirmed by Dore who also knew of other stations not reported in his work (Dore and Roland, 1942).

Elymus canadensis L. Pictou County: beside river at Alma, JSE 53.430. This collection confirms Macoun's report of this species from Pictou County. Cape Breton County: Sydney, G. C. Warren, July 5, 1938.

Arrhenatherum elatius (L.) Mert. & Koch. Cape Breton County: Sydney, G. C. Warren, July 5, 1938 and July 15, 1948. These are the first collections for Cape Breton Island. Lunenburg County: gravelly roadside, East River, SECS 352; Kings County: Lake George, G. C. Warren, July 18, 1951; Digby County: roadside at North Light, Brier Island, Roland, Smith *et al.* 514. This grass was previously known from a well established station in Yarmouth County (Dore and Roland, 1942).

Trisetum spicatum (L.) Richter, var. pilosiglume Fern. Kings County: in cliff crevices and on ledges, Amethyst Cove, JSE 52.576; W. B. Schofield and D. H. Webster 4647. The Amethyst Cove station for this grass is the first for the mainland of Nova Scotia although it has been found to be present in many cliff habitats in northern Cape Breton.

Muhlenbergia mexicana (L.) Trin. Halifax County: Grand Lake,

M. O. Malte, September 5, 1924 (Can.). Known also from the Gaspereau, Halfway and St. Croix Rivers of the Minas Basin drainage in Kings and Hants Counties as reported by Dore and Roland (1942) and shown by the following collections, all from Kings County: crevices in rock cliff, Curry Brook, Wallbrook, D. S. Erskine, September 11, 1945; moist gravelly river bank, White Rock, J. S. and D. S. Erskine, September 7, 1945; dryish soil along the Gaspereau River, above Gaspereau, D. S. Erskine, August 12, 1946.

Panicum virgatum L., var. spissum Linder. This grass is native to the southwestern part of the province only, where it occurs at scattered stations. The following collections represent new county records and extensions of range into the central counties. Queens County: edge of north arm of Ponhook Lake, JSE 51.1501; Kings County: Lake George, G. C. Warren, July 18, 1951. The typical variety, apparently introduced, has been collected in Halifax County; railway yard under grain carrier, Halifax, L. S. Brown, September 27, 1949 (NSAC).

Panicum xanthophysum Gray. Lunenburg County: open thickets, Bridgewater, J. Macoun, July 18, 1910 (Can. 81489). Record omitted by Dore and Roland (1942). An extension of range from Maine.

Scirpus cespitosus L., var. delicatulus Fern. Inverness County: abundant in damp cliff crevices, McCoy's Pool, Northeast Margaree River, STWS 6312; a second collection for the province.

Carex bromoides Schkuhr. Previously collected from a marsh near Truro by Macoun, the following collection, identified by J. A. Calder, represents the second for the province and the first for Cape Breton Island. Inverness County: in large clumps, damp woods, Stratlorne, STWS 6175.

Carex scirpoidea Michx. Victoria County: locally abundant in damp cliff crevices and on ledges, Lockhart Brook, Salmon River, STWS 6385. A second collection for the province, it having been collected near Glace Bay by Macoun.

Carex abdita Bickn. Digby County: wet run in old field, south of North Point, Brier Island, Roland, Smith *et al.* 305. This Brier Island occurrence is in keeping with the more northerly range of this species relative to *C. umbellata*.

Carex Tuckermanii Boott. Hants County: small swale by woods road northeast of Sweets Corner, J. S. and D. S. Erskine 50.384. New to the province, the collection represents a range extension from New Brunswick.

Juncus trifidus L. Inverness County: one clump on rock face overhanging river, upper Northeast Margaree River, JSE 52.359; Victoria County: occasional in dry crevices of north facing cliff, Lockhart Brook, Salmon River, STWS 6342; dry cliff crevices, Gray Glen near Cape North Village, JSE 52.359. These collections are the first for the province for this arctic-montane species and represent an extension of range from the mountains of Quebec, Newfoundland and New England.

Cypripedium reginae Walt. This species is one of the rarest of the genus in Nova Scotia with few recorded stations. The following collections are therefore of interest. Victoria County: rare in swamp, Bay St. Lawrence, JSE 52.392; occasional in alkaline bog near Baddeck Forks, SSTWS 8194; Inverness County: occasional in alkaline bog, Black River, SSSB 4925; Cape Breton County: very abundant in large clumps, swamp, Ball's Creek, SCBSB 3295.

Habenaria viridis (L.) R. Br., var. bracteata (Muhl.) Gray. Few recent collections of this rare orchid have been made. Rarely abundant, it has been found at scattered stations in northern Cape Breton. Victoria County: abundant in deciduous forest, Lockhart Brook, Salmon River, STWS 6360; occasional in rich intervale forest, North Aspy River, SECS 1131; Inverness County: occasional in fir forest, Cape St. Lawrence, SCBSB 3542.

Salix candida Flügge. Inverness County: black spruce bog in alkaline area, Black River, SCSB 4926 and STWS 7708. A first collection for Nova Scotia and a range extension from Newfoundland and New Brunswick where it is found in calcareous bogs and thickets.

Betula Michauxii Spach. This species was reported from two stations in the province by Rousseau and Raymond (1950), one each from Digby and Guysborough Counties. The former record is based upon the following collections. Digby County: locally abundant in wet parts of peat bog, Big Meadow, Brier Island, Roland, Smith, *et al.* 312 and 539. A third station for this rare species has since been found. Guysborough County: a single colony in grassy sphagnous bog, near mouth of Gaspereau Brook, STWS 9470.

Comandra Richardsiana Fern. Previously reported from two stations on the east coast of Cape Breton, the following collections show this plant to be more widespread in this area than was formerly thought. Victoria County: a few large clumps under spruce on sand dunes, South Pond, Aspy Bay, STWS 6461 and JSE 52.376; locally abundant at edge of pond behind beach, one mile south of Black Brook mouth, STWS 6560.

Rumex mexicanus Meisn. Kings County: abundant on river bank below bridge, Kentville, JSE 52.1314. This species was collected once previously by J. S. Erskine at Sweets Corner, Hants County but the specimen was lost. These records are the first for the province and form an extension of range from Chatham, New Brunswick where the species was collected by Groh in 1926.

Chenopodium capitatum (L.) Aschers. Yarmouth County: in garden at Yarmouth, September 19, 1951, collector unknown, leg. I. V. Hall (DAO). New to the province and an extension of range from the Bay of Chaleur, New Brunswick.

Montia lamprosperma Cham. Digby County: rather rare in wet crevices of sea cliff between North Point and Seal Cove, Brier Island, Roland, Smith *et al.* 276; Inverness County: one plant floating in a hillside trickle, Port Hawkesbury, JSE 52.164. Previously collected at Northwest Arm, Halifax by Macoun and Burgess, these recent collections represent a second and third station for the province and a first for Cape Breton.

Thalictrum confine Fern. Halifax County: a collection made by M. O. Malte at Grand Lake, September 5, 1924 (Can.) appears to be the first record of this species for the province.

Caltha palustris L. This plant apparently has a sharply restricted range in Nova Scotia being found in marshy places along the coastal plain of northern Inverness County. The collection of Macoun from Whycocomagh in 1883 and the record in Lindsay's list (1877) from Mahone Bay have not been substantiated by collections in recent years although several attempts have been made to relocate it. The following collections indicate the present known range of this species. Inverness County: wet meadow, Northeast Margaree, SSSB 4032; wet river edge, Margaree River near Margaree Harbour, SECS 979; wet places, Terre Noire, STWS 7370; wet places, St. Joseph du Moine SSSB 4028; swamp, Cheticamp, SCBSB 3639; occasional in marsh near mouth of Grand Anse Brook, Pleasant Bay, SSSB 4244.

Draba pycnosperma Fern. and Knowlt. Victoria County: locally abundant and diseased, dry cliff ledges, Lockhart Brook, Salmon River, STWS 6376. This collection is a first record for the province.

Draba arabisans Michx. Collected once previously in the province from Cape Blomidon, Kings County (Roland, 1947), the following collections show this species to be rather characteristic of cliff ledges and talus slopes in northern Cape Breton. Victoria County: locally abundant on dry ledges and talus, Lockhart Brook, Salmon River, STWS 6373; abundant, cliff ledges and talus, Indian Brook, SSTWS 8144; abundant in cliff crevices, Brunt Mountain, Gray Glen, STWS 6438.

Arabis hirsuta (L.) Scop., var. pycnocarpa (M. Hopkins) Rollins. Victoria County: dry cliff crevices and talus slopes, Indian Brook, STWS 6618, SSTWS 8124, and JSE 52.483. These first collections extend the known range of this species from New Brunswick and New England.

Arabis Drummondi Gray. Reported by Roland (1947) as "scattered in northern Cape Breton from Big Intervale Margaree to Cape North," the following represent new stations in Victoria County: dry cliffs and talus, Lockhart Brook, Salmon River, SSTWS 7894; rare on dry cliff and talus, Indian Brook, SSTWS 8118; abundant at shaded cliff base, Burnt Mountain, Gray Glen, STWS 6446.

Potentilla Hippiana Lehm. Kings County: rare, in field, Marchants Farm, Brooklyn Corner, W. B. Schofield, July 6, 1948. A single crown root was seen representing a casual adventive from the prairies.

Geum Peckii Pursh. Fernald's (1950) note of the occurrence of this plant in Nova Scotia is based upon the following collection. Digby County: abundant and scattered over an area of several acres, bog between Westport and Big Cove, Brier Island, Roland, Smith *et al.* 95 and 321. As noted by Fernald, this station represents an extension of range from the White Mountains of New Hampshire.

Desmodium glutinosum (Muhl.) Wood. Hants County: on gypsum bluff among *Rhus radicans*, Halfway River, JSE 53.294. This collection is a second station for the province although only twelve miles from the first.

Impatiens parviflora DC. Kings County: one plant in barnyard, Wolfville JSE 53.208, probably introduced in plant collections from Prince Edward Island.

Impatiens glandulifera Royle. Omitted from Roland's Flora but listed by Fernald for Nova Scotia, the following collections were made from well established stations. Pictou County: common in vacant lots, New Glasgow, A. E. Roland 2612; Digby County: common as weed in dooryard, Westport, Brier Island, W. B. Schofield, 1664; Cape Breton County: growing with *I. capensis* in swamp, North Sydney, SSSB 5404.

Epilobium strictum Muhl. Cumberland County: pond edge, Amherst Point, JSE 52.911. Reported by Erskine (1951) from Antigonish County and Kings County, this collection indicates its presence in the north-central part of the province.

Epilobium nesophilum Fern. Inverness County: bog, head of South Blair River, SCBSB 3800; Victoria County: occasional in swamp, Bay St. Lawrence, SSSB 4505; Cape Breton County: rare in bog, Northwest Cove, Scatari Island, SSSB 5345. New to the flora of the province, consistent with its Gulf of St. Lawrence distribution (Newfoundland, Magdalens, and var. *sabulonense* on Sable Island).

Epilobium Hornemanni Reichenb. Not listed in the provincial flora by Roland (1947) but mentioned by Fernald (1948 and 1950) as occurring in Cape Breton, this plant is now found to be characteristic of the banks of cold brooks in the northern part of that island. Inverness County: abundant, banks of cold brooks, Cheticamp River, SSTWS 7803; abundant, wet places along river bank, Three Brooks Pool, North-east Margaree River, STWS 6318; abundant, shaded brook bank, east side of Big Intervale, Margaree, STWS 6285; occasional in damp places, birch-fir forest at an elevation of 1200 feet, Grand Anse Brook, SSSB 4222; Victoria County: abundant, edge of brook eight miles from mouth of Salmon River, STWS 6341; occasional, brook banks, Lockhart Brook, Salmon River, STWS 6363.

Oenothera grandiflora Ait. Digby County: an escape from cultivation established for one hundred yards along main road at Plympton, JSE 53.216.

Oenothera cruciata Nutt. Previously known in the province from the slopes of sand dunes on Sable Island, this collection is the first for the mainland. Lunenburg County: Wentzell's Lake, JSE 52.1065.

Phyllodoce caerulea (L.) Bab. The discovery of this northern and montane plant in Cape Breton extends its range from Newfoundland, Quebec and Maine. Victoria County: locally abundant on steep north facing cliff slope, Lockhart Brook, Salmon River, JSE 52.513.

Vaccinium uliginosum L., var. alpinum Bigel. The distribution and habitat of this arctic-alpine blueberry in the province is not well known. The following collections are of interest. Victoria County: bare gravelly slope of Burnt Mountain, Gray Glen, STWS 6439; a single patch on sand dune, South Pond, Aspy Bay, STWS 6463; occasional on high exposure barren, Lockhart Brook, Salmon River, STWS 6350; forming mats on exposure barren, elevation of 1500 feet, Ingonish Barrens, SSSB 4622; on exposed rocks, exposure barren, seven miles west of Neil's Harbour, SCBSB 3809; local on sand beach of salt pond, Neil's Harbour, SCBSB 3496; on drier part of bog above Gray Glen Brook, SSSB 4415; Inverness County: in large clumps, old pasture, South Cape Mabou, STWS 7003; Cape Breton County: on rock outcrop near center of Scatari Island, SSTWS 8577; rare with *Empetrum nigrum* at coast, Scatari Island, SSSB 5276 and JSE 51.1136.

Vaccinium ovalifolium Sm. Reported once previously for the province (Smith and Schofield, 1952) when it was found as a single colony, the following collection was made from a station covering several acres. Victoria County: shrub under open forest, Lockhart Brook, Salmon River, STWS 6386.

Diapensia lapponica L. Another range gap is closed by the discovery of this arctic-montane plant in Cape Breton. Victoria Country: frequent in clumps on projecting shoulders and in crevices of steep north facing cliff slope, Lockhart Brook, Salmon River, JSE 52.319 and SSTWS 7919.

Scutellaria Churchilliana Fern. Lunenburg County: scattered on lake shore, Wentzell's Lake, JSE 52.1059; abundant on lake shore, Lewis Lake, JSE 53.408.

Stachys arvensis L. An adventive not listed by Roland (1947). Halifax County: gardens and roadsides, Halifax, J. Fletcher, September 10, 1904 (DAO); Bedford Basin, Halifax, J. Fletcher, September 10, 1904 (DAO): weedy garden, Halifax, W. G. Dore and E. Gorham, 45.979; weed in garden of Dalhousie University Medical School, Halifax, J. S. Erskine, August 2, 1949; Lunenburg County: Nauss' Swamp, Chester, M. N. Zinck 480 (DAO); Hants County: abundant weed in cultivated field, Windsor, J. S. Erskine, October 5, 1945; Kings County: edge of lawn, Main Street, Kentville, J. S. Erskine, September 13, 1948.

Lindernia dubia (L.) Pennell. First collected by Fernald at Sheffield Mills, Kings County, the following collection is a second station for the province. Lunenburg County: abundant on bottom of drained mill pond, Maitland Pond, JSE 52.1109.

Veronica tenella All. (= *V. serpyllifolia* L., var. *borealis* Laestad.). New to the province, this plant has been found to be present in its habitat on many of the cold northern brooks. The isolated populations in the different ravines seem to differ somewhat in flower color and in general appearance. Victoria County: abundant, wet mossy brook banks, eight miles from mouth of Salmon River, STWS 6338; common along Gray Glen Brook, SSSB 4461; Inverness County: occasional on gravelly river bank, South Blair River, SCBSB 3793; abundant on wet cliff face, Big Intervale, Margaree, STWS 6251.

Veronica peregrina L. Halifax County: edge of bare slate, Martello Tower, Halifax, J. S. Erskine, July 31, 1948. New to the flora, a weedy species native to North America and well known east to Quebec.

Rhinanthus Crista-galli L. The typical variety of this plant is very rare in Nova Scotia (Roland, 1947). The following collections, all from the more exposed coastal areas, have been made in recent years. Digby County: old hay field near North Light, Brier Island, Roland, Smith *et al.* 500; Inverness County: common in pasture at shore, Cape St. Lawrence, SCBSB 3512; Cape Breton County: rare in field at Northwest Cove, Scatari Island, SSSB 5363; abundant on exposed areas behind beach, Eastern Harbour, Scatari Island, SSTWS 8525.

Galium labradoricum Wieg. Known from the neighbouring provinces and from the New England States, a range gap is filled by the discovery of this plant in Victoria County: abundant in wet meadow, Bay St. Lawrence, SSSB 4508.

Campanula aparinoides Pursh. Hants County: abundant along river beaches and in meadow, Kennetcook River near Mosherville, JSE 53.356; Pictou County: abundant in meadow, Marshy Hope, SSTWS 8824.

Eupatorium rugosum Houtt. Cumberland County: frequent along brook near outlet to the sea, Mill Brook west of West Advocate, JSE 52.897. A new record for the province and an extension of range from New Brunswick.

Aster pilosus Willd., var. demotus Blake. Hants County: well established and scattered over several acres, west of Wentworth. A new record for the province representing an extension of range from central Maine.

Antennaria Parlinii Fern. Not of common occurrence in the province, the following records may be added to those already published. Hants County: on gypsum cliffs, Halfway River, JSE 53.296; on dry bluffs, Kennetcook River, JSE 53.364; Kings County: open wooded bluff above Gaspereau River at Melanson, D. S. Erskine 912. In the case of the first two collections, all plants were sterile.

Gnaphalium sylvaticum L. Rather common eastward in the province, this plant has not previously been reported from the western counties. Queens County: rare on roadside near Devonshire, SSTWS 10315.

Anthemis tinctoria L. Colchester County: common escape along railway track, Truro, SSSB 4804; Hants County: roadside, "probably a garden escape," Fish Hatcheries, Lebreau's Creek, Martock, H. T. Bell, A. Gorham, J. Bailly and A. Marshall 50.138; Halifax County: edge of ballast heap, Steele's Pond, Point Pleasant Park, Halifax, J. S. Erskine, July 26, 1949. New to the province, this escape is becoming well established in the central part of the province.

Senecio squalidus L. Halifax County: ballast heap, Steele's Pond, Point Pleasant Park, Halifax, J. S. Erskine, July 1949. Adventive from Europe, this appears to be a first record for Canada.

Lapsana communis L. Inverness County: common in old orchards and gardens, Hillsborough, SECS 1206; Victoria County: edge of brook beach, west of Warren Lake, SCBSB 3451. A persistent garden weed not previously reported from Cape Breton Island.

Hypochaeris radicata L. Victoria County: meadows, Aspy Bay, M. S. Brown, July 15, 1946. This collection is the first for this weedy species in Cape Breton.

Prenanthes × mainensis Gray. Digby County: sea cliff, Sandy Cove, JSE 52.1149. R. Erskine had collected *P. racemosa* on these sea cliffs in 1949, but a return visit yielded only one plant of this species and one plant which appears to be a hybrid between this and *P. trifoliolata*.

Material substantiating the majority of these records has been deposited at the Acadia University Herbarium and the Herbarium of the Nova Scotia Museum of Science.—perry biological laboratories, acadia university, wolfville, nova scotia and nova scotia museum of science, halifax, nova scotia.

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NUTTALL IN 1815

JEANNETTE E. GRAUSTEIN[1]

THE taxonomist who works with Nuttall's specimens gets only vague help from the labels toward determining their origin; a date of any sort is most rare, and stations are indicated in prodigious areas like "Shores of Lake Erie," "Col. R." and "Rocky Mts." It is incumbent on the student to be versed in the many journeys of this pioneer botanist in order to spot the approximate time and location of a collection. Hence, it is fortunate that accounts of Nuttall's most far-reaching expeditions were published either by Nuttall himself or by some companion of the journey—the trips to the Upper Missouri (1810–11), along the Arkansas (1818–20), by the Oregon Trail to the mouth of the Columbia (1834–36), even the rounding of Cape Horn in the depth of the southern winter with its glimpse of Staten Land, tantalizing to Nuttall but barren and repellant to the sailors. However it is quite otherwise in the case of his shorter collecting excursions of less than a year's duration made east of the Mississippi; of these no contemporary descriptions were published and the obituaries deal with them in airy generalities.

The bulk of Nuttall's collecting in the east was done prior to the publication of *Genera of North American Plants, and a Catalog of the Species to the Year 1817* which appeared in 1818, ten years after the author's first arrival in America. Since he was in the eastern United States for only half of the decade the task of mapping the forays involved is narrowly circumscribed, but no guide to them was compiled for more than a hundred years after the specimens were harvested. We are indebted to Pennell's 1936 biography for the first serious attempt to establish the times and routes of the major eastern tours.[2] This was done successfully for most of the period under discussion by plotting the places and dates mentioned in Nuttall's numerous publications, with the invaluable aid of a few key letters of the botanist which had come to light.

Pennell's chronicle indicates no long botanical excursions

[1] JEANNETTE E. GRAUSTEIN. "Nuttall's Travels into the Old Northwest," *Chronica Botanica* XIV (1950/51), 1–88.

[2] Francis W. Pennell, "Travels and Scientific Collections of Thomas Nuttall," *Bartonia* XVIII (1936), 1–51.

during Nuttall's first year in America. In 1809 there was a journey in June to Delaware and a second in late summer and autumn to Niagara Falls. The famous trip which culminated in the ascent of the Missouri occupied most of 1810 and 1811, and the next three years were spent in England with a return made to America at some time in the fourth year, 1815. Pennell's account for 1815 is pure speculation except for the documented visit which Nuttall paid to William Baldwin in Savannah in the "fall." On the other hand his recording of Nuttall's extensive 1816–17 travels through western Pennsylvania, down the Ohio, through Kentucky, and across the southern Appalachians is well authenticated. The rest of 1817 and early 1818 was spent in Philadelphia compiling the *Genera*.

Fortunately the record for 1815 can now be filled in from Nuttall's own account found in a letter which he wrote on January 26, 1816, from Wilmington, North Carolina, to Sir Aylmer Bourke Lambert, wherein he gave an animated narrative of his experiences during the previous nine months.[3] This letter [the text is given below] reached a haven at the Herbarium of Kew Gardens many decades ago.

Incidentally the letter also solves the mystery of whether Nuttall ever made a report in person to Dr. Benjamin Smith Barton, the promoter of his expedition to the West. The answer to this question must be an "Everlasting No." since Barton had left Philadelphia for the continent of Europe in April, 1815, whereas Nuttall's letter reveals that he did not reach that port until mid-July; and Barton came back to America only shortly before his death at the end of the year while Nuttall was in the South. In this connection it should be recalled that Nuttall, returning down the Missouri River to New Orleans in the autumn of 1811, instead of taking his booty to Barton in Philadelphia had shipped seeds and dried specimens to him and embarked for England.

Whether sailing to his homeland was a free decision or one forced by rising hostilities is still not clear, but once in England Nuttall was obliged to remain there until the peace was signed at the close of 1814. Then he seems to have started promptly

[3] "Lambert's Correspondence," Letter No. 96. MS, Royal Botanical Gardens, Kew. The writer is grateful to the Keeper of the Herbarium, for the opportunity of consulting the manuscript collections preserved there.

to settle his various affairs for a second emigration to America for his letter informs us that he took passage in the spring of 1815.

Wilmington [North Carolina]
Jany 26th 1816

A. B. Lambert, Esqr–

Dear Sir,

A detail of all my journeys, my adventures, and Botanical discoveries, is much more than I can promise you in this sheet, however happy I might be to indulge my vanity and perhaps tire your patience. If they shall be hereafter deemed worthy by my friends I shall not hesitate to offer my journals to the public, notwithstanding their imperfections.

It was on the 8th of last May that I left Gravesend again to traverse the Atlantic. I had scarcely proceeded to see [sic] when I discovered that myself and about 30 other passengers with a numerous crew of liberated prisoners, had committed our propertys and persons to the conveyance of a wreck and the guidance of a knave. I shall not trouble you with a detail of the villanies and negligence of a renegado who had even fought under the banners of French anarchy and enlisted in the sacrilegious mob whose only aim appeared to be to annihilate the last bonds of human society. By better Fortune than we had any reason to expect, after a tedious passage of *nine* weeks in a vessel every moment on the point of foundering or shipwreck we arrived at the port of Philadelphia about the middle of July. The season was extremely sultry, but my health remained unimpaired. Commercial concerns of trifling importance held me in this place untill the close of August. I now proceeded by Lancaster, York, Hanover and Fredericktown in Maryland to Harper's-Ferry in Virginia the stupendous scene so elegantly described by the ex-president Jefferson in his Notes on Virginia where the rivers Shenandoah and Potomac uniting, appear to burst their way thro' the Blue Ridge, a chain of the Alleghany Mountains, a landscape of horrible grandeur and wild magnificence, of mingled rocks, roaring rivers, and gloomy forests, beyond all the powers of the pencil to imitate.

From the romantic and fertile vale of the Blue Ridge after an excursion of about a month, I proceeded down the Potomac, occasionally lined by the magnificant *Quercus macrocarpon*, *Robinia Pseud-acacia*, and *Porcelia triloba*, to the port of Alexandria, and on the way I had a sight of Washington in its ignominious ruins, the deserted palace of the president and the magnificent wreck of the imaginary Capitol!

On the same day that we left Alexandria, the breeze conducted us past the rural seat of the immortal Washington,—the sacred groves of Mount Vernon, the peacefull but forsaken residence of the Father of America!

In two days more we entered the tepid gulph of Florida and witnessed no less than 6 waterspouts in succession accompanied by streams of rain and thunder. in the midst of winter we have experienced the mildness of a perennial spring. In ten days we arrived at the port of Savannah in Georgia, a town built in the West India style upon a high bank of moveable sand and surrounded by deep and undrainable swamps, a situation so unhealthy as to be justly dreaded by Europeans who but seldom escape either death or disease. Here I was so fortunate as to meet in Dr. Baldwyn of the United States navy, a botanist better acquainted with the plants of America than any other person I have yet met with. For more than a week together we were engaged in looking over his herbarium replete with new plants, collected in East and

West Florida near the sea-coast. it was here I first became acquainted with the interesting *Epidendrum Magnoliae*, a plant wh. Doctor B. described as common upon various trees near the town of St. Mary's, in Florida. Some days after this admiring the magnificence and extraordinary elevation of a fine *Magnolia grandiflora* a mile from Savannah I thought I beheld a parasitic plant embracing its lofty branches. I now instantly examined all the Magnolias round me and found that I had discovered the *Epidendrum* by this time I doubt not but you have seen this plant of which I sent a considerable quantity to Anderson and desired him to send you a plant. Near Savannah grows a singular thicket of the *Pinckneya*, the *Tripterella* * *coerulea, Caladium speciosum, Dichroma leucocephala, Lilium Carolinense, Liatris speciosa, L. odoratissima, L. paniculata, L.* * *puberula, L. spicata, L.* * *pedunculata* (I am now acquainted with 14 species of this genus) *Kalmia hirsuta, Xyris* * *gelatinosa, Gerardia* * *linifolia* (this new species I have sent to Anderson under the name of *G.* * *crassiuscula* but there can be no better name than that of *G.* * LINIFOLIA, it is a perennial purple flowered species,—I first discovered it near Savannah, and I have now occasionally met with it to Wilmington (North Carolina).

After about a month's residence in Savannah I continued my journey to Augusta in this state. I heard of Abbot but had not the pleasure of seeing him. In my way thro' these forests of perennial verdure almost exclusively filled with the *Pinus australis*, in a soil of almost pure sand, I was occasionally gratified by repeated discoverys of new and rare plants. In Doctor Baldwyn's herbarium I observed a very singular new genus of syngenesious plants, wh. he found on the banks of the Altamahah, the river ascended by Bartram, accompanied by a new species of *Hymenopappus* with entire lanceolate leaves large white flowers, and furnished with a long *acuminated* pappus of 5 divisions, the new genus I have called *Baldwynia cellulosa*, this plant possesses an elevated receptacle perforated by pentagonal cells like honey-comb so deep as completely to envelope the seeds from sight which are furnished with a chaffy pappus; about 20 mls. from Savannah on my way to Aususta I found a second species of this interesting genus accompanied by the . . . *Chaptalia* in . . . and a beautiful new *purple* flowered species of *Coreopsis!* not [at] all allied to the D'Halsa of Mexico. Near here I met with the curious species of *Nymphaea* described by Walter as the N. *longip* . . . [Letter torn] Its leaves a good deal like those of N. *odorata* round large and floating on the surface of the water produces often petioles of a *fathom* in length! and YELLOW *flowers*. Wherever the sterile platform of sand was diversified by a gravelly hill the southern oaks uniformly made their appearance such as the *Quercus Catesbei, Q. nigra, Q. triloba, Q. cinerea, Q. obtusiloba*, and *Q. coccinea* but the most prevalent of all the species is the *Q. Catesbei* wh. appears often after the prevalence of the pines to usurp the place of the long leaved Pine. 32 mls. West of Savannah I observed abundance of the *Mylocarium* the *Brunnichia* and the *Gleditscia* [sic] *monosperma*. 42 mls. from Savannah on the road I found the *Laurus diospyros*, and the *Chrysobalanus* * *oblongifolius* of Muhlenberg's catalogue wh. produces a large edible plumb of a clear red and contains a seed enveloped by a *soft* quinque-partile shell, it is a shrub of scarcely *one* foot in height sending out innumerable surculi, the stem is never branched and the flowering panicle terminal. The leaves are lucid, coriaceous cuneate-oblong, and generally evergreen I next found a new and elegant *suffruticose* species of *Hedeoma*, the *Petalostemon carneum, Raynia perfoliata* a new *Cupressus?* The *Sparganophorus verticillatus*, a new *Rudbeckia*, a new *Polygala* & *Ceanothus microphyllus* two or 3 species of *Podalyria, Psoralea mollis, Galardia* *bicolor*, a grassy leaved *Helonias*, *Amsonia angustifolia*, a new *Aristida* with remarkably long awns. After spending a few days in Augusta in the agreeable company of Dr. T. Wray I crossed the Savannah and have now crossed the center of South Carolina to this place. I cannot here detail to you in any way my discoveries in So. Carolina. I will just mention some of the principal—12 mls. from Agusta I found to my great gratification the singularly beautifull shrub *Ceratiola Ericoides* it looks exactly like a Cape heath, grows 12 feet high and was now filled with aggregate clusters of greenish yellow berries, and I have got abundance of its seeds. here I also found the *Iris tripetala* of Walter and a new *Liatris* perfectly smooth and branched from the base of the stem. Near Wilmington I have found the *Phlea tenuifolia* of Michaux and have sent roots to Anderson and ordered him to send you one.

If no extraordinary disappointment takes place with me I hope to ascend Red River of the Mississippi and examine the adjoining province of Mexico in wh. no doubt I shall meet a rich harvest of Botanical treasure.

Yours by every obligation

Thos Nuttall

Inclosed you will observe the *Tripterella coerulea*, is it not the *Burmennia biflora* of Linnaeus? I should be glad to know. Direct me at the Philadelphia Post-Office.

A Note on Ceratophyllum demersum and C. echinatum in Worcester County, Massachusetts.—Until 1953, only one sheet of *Ceratophyllum* had been collected in fruit from Worcester County, Massachusetts. An ardent plant collector of herbarium specimens, Rev. Frank C. Seymour, has remembered that "I have searched for the fruit of Ceratophyllum all my life, but never found it."[1] The late Dr. Fernald said ". . . We strained our backs, legs and eyes, bending over and carefully fingering, underwater, thousands of plumes of the Ceratophyllum in a vain search for fruit."[2]

However, during the summer of 1953, while studying and collecting aquatic plants of Worcester County, numerous mature fruiting specimens of both *Ceratophyllum demersum* L. and *C. echinatum* Gray were found by the writer. According to Fernald,[3] *C. demersum* ". . . needs careful collecting and study," and *C. echinatum* is ". . . less often collected than No. 1." [the previous species]

One specimen of *C. demersum* was collected in fruit from Bartlett Pond, Northboro, Mass., on August 6, 1953. Speci-

[1] Seymour, F. C., Personal communication.

[2] Fernald, M. L., Another Century of Additions to the Flora of Virginia, Rhodora 43, p. 508.

[3] Fernald, M. L., Gray's Manual of Botany, American Book Co., p. 636, 1950.

mens of *C. echinatum* were collected in fruit from the following stations:

Cider Mill Pond, Grafton, Mass., July 16, 1953.
Perry Pond, North Brookfield, Mass., August 11, 1953.
Muddy Pond, Oakham, Mass., July 17, 1953.
Cemetery Pond, Warren, Mass., September 18, 1953.

These specimens are deposited in the Herbarium of the Hadwen Botanical Club at the Biology Department of Clark University, Worcester, Massachusetts.

After close study of the fruiting material and reference to Dr. Fassett's paper on Ceratophyllum,[4] the sterile specimens in the Hadwen Herbarium have now been identified. It appears at this time that C. echinatum is more common in Worcester County than C. demersum. The former species has been found in 16 of the 60 towns, while the latter has been found in only 3 of the 60 towns in the county.

The fruiting specimens were found only where the plants were "rooted"[5] in the muck substrate and completely submerged. No fruiting specimens were found floating in the ponds. Usually the fruiting specimens were found growing in extensive colonies in water ranging from 14 to 30 or more inches deep. At these depths, at least some of the fruits were definitely visible from the collecting boat. By passing one's hand over the growth to move it slightly, many more fruits were brought clearly into view. Finding the fruiting specimens of Ceratophyllum is more readily accomplished if the plants remain completely submerged than if they are removed from the water.—Philip G. Meissner, Clark University, Worcester, Massachusetts.

A Method of Mounting Pressed Flowers for Study and Preservation.—Some years ago, while I was working on the taxonomy of *Lupinus*, Professor Carl Epling of the University of California at Los Angeles, introduced me to a technique of boiling a flower in an electric baby bottle warmer, which eliminates the hazard of fire in an herbarium that might originate

[4] Fassett, N. C., North American Ceratophyllum, Communicaciones del Instituto de Investigaciones Cientificas, No. 2, March 1953, Universitas del Salvador, Central America.

[5] According to Muenscher in *Aquatic Plants of the United States*, "The roots are absent even in the seedling. The radicle does not enlarge or elongate during seed germination." p. 228–230.

from the use of an alcohol lamp. The flower was then dissected and the parts mounted on a glass microscope slide in a medium of glycerin and mucilage (Lepage's, or any other standard mucilage). The proportions of glycerin and mucilage vary with the geographic region, depending on the relative humidity, and must be worked out for each location. Start with about 1 part of glycerin to 10 parts of mucilage. Test a few drops on a slide allowing the medium to dry thoroughly. The glycerin-mucilage medium should dry to a smooth, hard texture. Too much glycerin will cause the medium to be sticky and too much mucilage will cause the medium to crack and chip loose from the slide.

The addition of hot water to the medium during the dissection of the flower makes the dissection much easier. The slides may be dried and kept as is, indefinitely, as long as they are not moved from one region of the country to another. Transporting the slides from a humid region to a dry region will require the addition of water and glycerin to prevent chipping.

The procedure is valuable from the standpoint of obtaining accurate measurements of the size and shape of the critical characters of the taxa. A set of 25 slides, or more, may be readily prepared and is desirable for the study of the amount of variation within a taxon. This method is also a means of preserving, in a useable state, the limited number of parts remaining on very old type specimens. In addition, the glycerin acts as a clearing agent, often making it possible to count the number of ovules in an ovary, in a whole mount.

With the above technique the slides cannot be attached to the herbarium sheets without the danger of adhering to the paper and destroying the dissected specimen. A coating of plastic remedies this difficulty. The following over-all procedure is one that I have adopted, using the mounting plastic described by Archer.[1] In addition, a short period of staining with Sudan IV is desirable, for those floral structures with ciliation or structures which tend to be come translucent on boiling.

1). Boil the flowers, leaving them to stand in the hot water long enough to return to their original size and shape. A detergent may be used; however, it is not desirable to distort the walls of the cells.

[1] W. A. Archer. New Plastic Aid in Mounting Herbarium Specimens. Rhodora **52**: 298. 1950.

2). Dissect the flower to show the parts in their most advantageous position.

3). Stain those floral parts with ciliation or those that are translucent, for a short time, in Sudan IV and wash thoroughly.

4). Place one flower on the slide as a whole mount, in a position that best shows the relation of the parts.

5). Allow the glycerin-mucilage medium to dry overnight or in a drying oven.

6). Put several drops of toluene on the slide and then coat the slide with the plastic used in mounting herbarium specimens.

7). Bubbles in the plastic may be removed by placing a drop of toluene above each.

8). Fragments of leaves may be pressed into the wet plastic with top and bottom surfaces free. The plastic may render the hairs difficult to see, without staining, if the leaves are completely imbedded.

If the plastic should crack in a thin area it can be readily repaired by a drop of toluene and the addition of more plastic.

Various stains have been tried, over a period of years, but most either darken the flower parts too much or they are water soluble and diffuse out into the medium of glycerin and mucilage. The extra glycerin, mucilage and stain can be washed off with hot water and the slides redried and then coated with plastic. However, thus far, Sudan IV has been found to be the most satisfactory stain, since it stains only the fats and waxes, such the material in the cuticle. The color is delicate and does not mask the ovules, rendered visible by the glycerin, but is still sufficient to make the ciliation readily visible under a microscope. —David B. Dunn, visiting lecturer, botany department, university of minnesota, minneapolis.

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AN UNDESCRIBED DWARF SPECIES OF AMORPHA FROM GEORGIA

ROBERT L. WILBUR

IN the Spring of 1953 an *Amorpha* was collected in the Coastal Plain of southern Georgia which appears to be undescribed. Many of its characteristic features are not matched by any of the species described in either the treatment by Rydberg (1919) or Palmer (1931). The plant was found in abundance in a sandy savannah near Lumber City, Georgia. This previously undescribed species of *Amorpha* is at present known only from the type-locality. No specimen of it was to be found in the herbarium of the University of Georgia or that of the University of Florida.

Amorpha georgiana sp. nov. Frutex erectus paululus caespitosus 3–6 dm. altus. Folia numerosa (3) 6–9 (12) cm. longa, subsessilia. Petiolus 1–3 mm. longus. Foliola numerosa, densa, 23–47, plerumque plus quam 40, (3) 6–9 (11) mm. longa (2) 3–4 (5) mm. lata, plerumque elliptica ad oblonga, apice rotundo, truncato vel emarginato, mucronato; mucrone gracile, fastigato, 0.3–0.5 mm. longo; margine revoluto et parce ciliato. Foliola supra glabra, infra parce ciliata et pellucido-punctata, glandes punctatae uniformes, minus quam 70. Racemi 1–4, (2) 3–5 (6) cm. longi; florae numerosae, compactae, pedicelli c. 1 mm. longi. Tubus calycis turbinatus, 1.7–2 mm. altus, glaber, glanduloso-punctatus supra. Lobi calycis superiores triangulo-dentati, acuti, c. 1 mm. longi; lobi inferiores lanceolati, acuminati, c. 1.2 mm. longi; lobi punctato-glandulosi et glabri sed marginibus dense ciliatis. Vexillum late obovatum, 3.5–5 mm. longum, c. 3.5 mm. latum, rubicundo-purpureum. Filamenta exserta, glabra; stylus antrorso-pubescens; stigma capitatum, penicillatum. Fructus (maturus?) 3.5–4.5 mm. longus, c. 2 mm. latus, glaber, manifeste glanduloso-punctatus, obliquo-obovatus, dorsus rectus.

A low, erect, somewhat caespitose shrub 3–6 dm. high with the several to numerous olivaceous branches of the current season's growth 1–2.5

dm. long and 1–2 mm. in diameter, much angled and grooved, glabrescent or minutely puberulent, strongly ascending from the gray to black, slender (about 2–3 mm. in diameter) growth of the preceding season. Leaves numerous, ascendent, arching upward (3) 6–9 (12) cm. long, nearly sessile. Petioles sparsely short-pubescent, shorter than the breadth of the nearest leaflet, about 1–3 mm. long. Stipules inconspicuous, caducous, glabrous, linear-subulate, 1.5–2.5 mm. long. Rachis slender, puberulent, strikingly channeled above, about 0.5 mm. in diameter. Leaflets numerous, usually more than 40 per leaf but varying from 23–47, (3) 6–9 (11) mm. long, (2) 3–4 (5) mm. wide, ratio of length to width about (1) 1.3–2 (2.2), approximate, often imbricately overlapping, the interval between petiolules about (2) 3–5 (6) mm., mostly elliptical to oblong but varying from narrowly elliptical to rarely almost orbicular, rounded to somewhat truncate at base, rounded or truncate and often slightly emarginate at apex with a slender, tapering mucro about 0.3–0.5 mm. long; texture when dry coriaceous, finely reticulate above from the slightly elevated venation but the midvein depressed, the margin somewhat revolute, entire to finely crenulate, the midvein prominently elevated on the lower surface, the secondary veins slightly raised below; glabrous above except for the slightly ciliate margin; while immature, pubescent beneath, the pubescence principally restricted to the midvein and its branches, becoming glabrescent; the punctate glands on the lower surface inconspicuous but noticeable to the unaided eye, more or less of uniform size, averaging less than 70 per leaflet and fewer than 15 per medial 3 mm. half-section. Petiolule puberulent, short, about 0.7–1 mm. long; upper stipel about 1 mm. long, linear-subulate, often persistent, the lower stipel reduced to a glandular, minute, rounded swelling. Racemes solitary or few to several (about 2–4) closely associated, short, (2) 3–5 (6) cm. long, almost sessile with a short peduncle up to 8 mm. long; the puberulent rachis strongly ridged and sharply angled; the flowers densely clustered and borne on short, slightly puberulent to glabrescent pedicels about 1 mm. long subtended by linear-subulate, about 1.5–2 mm. long, ciliate, quickly caducous bracts which leave noticeable scars near base of pedicels. Calyx-tube turbinate, about 1.7–2 mm. high, slightly higher on the abaxial side, glabrous, the punctate glands mostly restricted to the upper half of the tube and arranged more or less in two rows. The two adaxial (= ventral or upper) calyx-lobes triangular-dentate, acute, about 1 mm. long; the three abaxial (= dorsal or lower) calyx-lobes lanceolate, acuminate, somewhat longer than the adaxial lobes, about 1.2 mm. long with the lowermost lobe slightly longer than the two lateral lobes; all lobes punctate-glandular and glabrous except for the densely ciliate margins. Vexillum about 3.5–5 mm. long, about 3.5 mm. wide, very broadly obovate, tapering abruptly to a narrow claw, strongly arching and incurved, enveloping the internal floral parts, the margin slightly irregular to somewhat finely erose, reddish-purple. Androecium monadelphous, about 6 mm. high; the filaments purple, glabrous, filaments united at base for about 1 mm.; anthers about 0.4–0.5 mm. long, exserted, yellow. Pistil about 6 mm. long; the ovary about 1 mm. high, glabrous, obovoid, containing two ovules, the style about 5 mm. long, purple, densely antrorsely pubescent; the stigma terminal, capitate, penicillate. Fruit (fully grown?) 3.5–4.5 mm. long, about 2 mm. wide, appearing slightly stipitate, glabrous, bearing conspicuously punctate resinous glands, slightly exceeding the calyx in length, strongly flattened, obliquely obovate, the adaxial side straight or nearly so, the abaxial side strongly bowed, terminated by the strongly recurved persistent style, and apparently with only one seed.

TYPE:—Sandy wire-grass savannah about 3 miles northwest of Lumber City, Telfair County, Georgia. May 9, 1953. *R. L. Wilbur* no. *3158*. (GH). Isotypes: (GA, MICH, MO, NCS, NY, US.). Known only from the type-locality. An additional collection (*Wilbur* no. *3448*) was made May 24, 1953 at which time fruiting material was available.

Growing in close association with *Amorpha georgiana* were two rarely collected and narrowly restricted endemics, *Penstemon dissectus* Ell. and *Marshallia ramosa* Beadle & Boynton. *Penstemon dissectus*, according to both Harper (1906) and Pennell (1935), is found only on outcrops of the Altamaha Grit, believed to be of Pliocene age. *Marshallia ramosa* is geographically limited to this same formation. It is quite possible that *A. georgiana* is similarly restricted. Harper, who made an intensive study of the flora of the Altamaha Grit, reports only two species of *Amorpha* from the region, *A. fruticosa* L. and *A. herbacea* Walt.

The very low stature of *A. georgiana* distinguishes it at once from the more robust species of the southeastern Coastal Plain, e.g. *A. nitens* Boynton, *A. crenulata* Rydb., *A. curtissii* Rydb., *A. virgata* Small, *A. croceolanata* Wats., or *A. fruticosa* L. Other striking features by which the new dwarf species may be distinguished from the more robust species are the length of the petiole, size of the leaflets and the number of leaflets per leaf. *Amorpha georgiana* is characterized by a petiole less than 5 mm. long, by leaflets typically less than 1 cm. long, and usually more than forty leaflets per leaf. All of the more robust species mentioned above typically possess petioles 1 cm. or more in length, leaflets longer than 1 cm. and seldom more than twenty-five leaflets per leaf, and very rarely more than thirty-five.

The affinities of *A. georgiana* then appear to be with the southeastern dwarf species, *A. herbacea* Walt., *A. cyanostachya* M. A. Curtiss and particularly with *A. floridana* Rydb. In

FIGURES 1–6. AMORPHA GEORGIANA. Fig. 1. Habit sketch × ½; Fig. 2. Leaflet × 5; Figs. 3 & 4. Vexillum × 5; Fig. 5. Flower × 5; Fig. 6. Calyx and young fruit × 5.

addition to a similar dwarf habit these species all typically possess petioles 1 cm. or less in length. These characters serve to separate the dwarf species as a group from the aforementioned robust species centering about *A. fruticosa.* The following key to the southeastern dwarf species of *Amorpha* is offered in hope that it will prove to be an aid in identification.

KEY TO THE SOUTHEASTERN DWARF SPECIES OF AMORPHA

1. Leaves and branches densely canescent throughout, calyx-tube densely pubescent, fruit pubescent........................*A. herbacea* Walt.
1. Leaves and branches glabrous or nearly so or but moderately pubescent and then usually glabrescent, calyx-tube glabrous or bearing but few scattered hairs, fruit glabrous.
   2. Leaflets 15–25 in number, medial and lower petioles 8 mm. or more in length.............................*A. cyanostachya* M. A. Curtiss.
   2. Leaflets 21–47 in number, usually 35 or more per leaf, medial and lower petioles less than 8 mm. long.
      3. Midvein scarcely if at all extending beyond the blade, terminating in a swollen almost globose tip; leaflets usually more than 1 cm. long; punctate glands of the lower surface of the blade numerous, more than 90 per leaflet, or about 15 or more per 3 mm. medial half-section, appearing to be of 2 sizes; racemes several to numerous, elongate, 10–20 cm. long; calyx-lobes pubescent on the surface in addition to the densely ciliate margins.........*A. floridana* Rydb.
      3. Midvein extending beyond the blade as a tapering slender mucro 0.3–0.5 mm. long; leaflets mostly less than 1 cm. long; punctate glands relatively few, less than 70 per leaflet, or less than 15 per 3 mm. medial half-section, more or less uniform in size; racemes few, short, less than 7 cm. long; calyx-lobes glabrous except for the densely ciliate margins..................................*A. georgiana.*

I am indebted to Miss Lillian Arnold of the University of Florida, Dr. David D. Keck of the New York Botanical Garden, Dr. A. C. Smith of the Smithsonian Institution and Dr. C. Earle Smith, Jr. of the Philadelphia Academy of Science for the loan of specimens needed in this study. I should also like to express my appreciation to Mr. Howard Rock for the preparation of the accompanying figures.—DEPARTMENT OF BOTANY, NORTH CAROLINA STATE COLLEGE, RALEIGH, N. C.

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CLADONIA SUBRANGIFORMIS IN NORTH AMERICA[1]

Alexander W. Evans

Among the *Cladoniae* belonging to the subsection *Chasmariae*, *C. furcata* (Huds.) Schrad., *C. subrangiformis* Sandst., and *C. rangiformis* Hoffm. constitute a group of closely related species. The primary squamules in this group are well developed but short-lived. Many of the specimens, in consequence, are composed entirely of podetia which die at the base and continue growing at the apex until their growth is terminated by the appearance of apothecia or by some other cause. The podetia, which are cupless and terete, branch repeatedly by dichotomies or whorls and form complex branch-systems, comparable with those of the *Unciales*. Both closed and open axils are present in most cases, and podetial squamules may be lacking altogether or more or less abundantly produced. The podetial wall is bounded on the outside by a well-developed cortex and on the inside by a continuous layer of cartilaginous tissue surrounding the central canal. In many cases numerous podetia are associated in extensive colonies.

Of the three species under consideration *C. furcata* is by far the commonest and has an almost cosmopolitan distribution. Vainio (1887, p. 361) assigns a similar distribution to *C. rangiformis* and cites stations for the species from all the continents including Australia. In North America, however, *C. rangiformis* is apparently much rarer than the published records imply, and the writer has seen no specimens that agree fully with authentic European material. The range of *C. subrangiformis* is incompletely known. All three species exhibit a wide range of variation in size, in color, in the extent of the branching, and in the characters derived from the podetial surface. This is particularly true of *C. furcata* under which a number of varieties and forms are now recognized. The forms of *C. subrangiformis* and *C. rangiformis* parallel those of *C. furcata* to a certain extent, and it is difficult in some cases to assign specimens definitely to the species of the group on the basis of morphological characters alone.

In the following account of *C. subrangiformis* a list of the

[1] Contribution from the Osborn Botanical Laboratory.

North American specimens in the Yale Herbarium is given, and the characters which have been assigned to the species are discussed.

Cladonia subrangiformis Sandst. Abhandl. Naturw. Ver. Bremen **25:** 165. 1922. *Cenomyce furcata* δ. *hamata* Del. in Duby, Bot. Gall. 622. 1830. *Cladonia furcata* var. *palamaea* f. *hamata* Oliv. Expos. Lich. Ouest France **1:** 69. 1897. *C. furcata* var. *palamaea* f. *spectabilis* Zahlbr. Oesterr. Bot. Zeitschr. **57:** 26. 1907. [*C. furcata*] **C. subrangiformis* Des Abbayes, Bull. Soc. Sci. Bretagne **14:** 154. 1937.

On dry soil, preferably calcareous but not uniformly so. Widely distributed in Central Europe and recently reported from Venezuela (Sandstede, 1938, p. 86). New to North America.

MASSACHUSETTS, Barnstable County: Brewster, *Evans*, 1929; South Chatham, *Torrey*, 1930; Eastham, *Evans*, 1935. Martha's Vineyard: between Oyster and Job's Neck Ponds, *Torrey*, 1936; east of Oyster Bay, *Torrey*, 1936. Nantucket: Gibb's Point, *Torrey*, 1937; Siasconset Road, *Torrey*, 1936; without definite stations, *Sheldon*, 1940; Eel Point region, Great Point, and Sesachacha, *Sheldon*, 1940.

CONNECTICUT, Litchfield County: Washington, *Evans*, 1922 (listed, Trans. Connecticut Acad. **30:** 423. 1930, as *C. furcata* var. *subclausa*); New Milford, *Evans*, 1928 (listed, Ibid. 420, as *C. furcata*).

NEW YORK, Long Island: Manorville, *Latham*, 1937; Sag Harbor, *Latham*, 1946; East Hampton, *Latham*, 1947.

MEXICO: without definite station, *E. Palmer*, 1878.

JAMAICA: Cinchona and vicinity, *Johnson*, 1903 (University of Michigan Herbarium); *Seifriz*, 1919; *Maxon* and *Killip*, 1920 (listed, The Bryologist **50:** 42. 1947, as *C. cubana*); below Newhaven Gap, *Maxon* and *Killip*, 1920; between Castleton and Hardware Gap, *Evans*, 1937, 1938.

When Sandstede proposed *C. subrangiformis* as a new species in 1922 he used the phrase "n. spec.," thus implying that he was the author of the name; and in Nos. 784 and 882 of his *Cladoniae* Exsiccatae, distributed in the same year, the labels are inscribed "*Cl. subrangiformis* Sandst." In Nos. 1159 and 1182, however, distributed in 1923, and in No. 1842, distributed in 1929, the labels are inscribed "*Cl. subrangiformis* Scriba." In 1931 (p. 231) Sandstede gave, as the reason for this change, the fact that Scriba was the first to recognize the species. In the opinion of the writer this reason is inadequate, and Sandstede's name should be restored as the author of the species.

In his original description of *C. subrangiformis* Sandstede emphasized the presence of conspicuous white spots on the older parts of the podetial surface, and such spots are clearly shown in the figure published by Anders in 1928 (pl. 9, fig. 11) and in the later figure published by Sandstede himself in 1931 (pl. 15, fig. 6). They represent masses of interwoven hyphae derived from the outer medullary layer of the podetial wall. Through the action of some stimulus the hyphal cells in localized areas are incited to grow and divide, and the masses of such hyphae as they increase in size rupture the cortex and thus become exposed to the air. The algal cells among the hyphae soon lose their green contents and are distinguished only with difficulty.

According to Bachmann's observations, which Sandstede cites in detail, the spots contain no soredia, and their development is not caused by the presence of a parasitic fungus. It is suggested that they may represent a response to unfavorable climatic conditions, such as those associated with very dry habitats. It is pointed out also that similar white spots may develop in *C. rangiformis* var. *muricata* (Del.) Arn., when growing with *C. subrangiformis*, and Asahina has since detected such spots in *C. furcata* (1942, p. 669). In all probability the spots are pathological in character, as Anders intimates (1928, p. 76), since their development is restricted to special habitats; and Asahina states definitely that they are abnormal and that they are associated with the deposition of calcium oxalate in the outer medulla. In any case little or no taxonomic significance can be assigned to the spots, in spite of their conspicuous appearance, and other characters will have to be used in distinguishing *C. subrangiformis* from its allies.

Among the other features of the species to which Sandstede called attention in his original description are the bitter taste, the definite and persistent yellow color induced by treatment with K,[2] and the following morphological characteristics of the podetia: the robustness, the presence of numerous lateral outgrowths, the sharp apices of the sterile ultimate branchlets, the scanty development of podetial squamules, and the wrinkled and rimose surface of the basal portion. In *C. furcata*, which is likewise bitter to the taste, treatment with K produces a dull yellow color which quickly deepens to a dingy reddish brown. Of course the K+ yellow reaction indicates the presence of atronorine and the bitter taste the presence of fumarproto-

[2] The letter "K" is an abbreviation for an aqueous solution of potassium hydroxide, and the letter "P" for an alcoholic solution of paraphenylene-diamine.

cetraric acid. The P+ red reaction now supplements the bitter taste in the demonstration of the latter substance.

In 1937 Des Abbayes discussed the characters of *C. subrangiformis* and emphasized its relationship, not only to *C. furcata*, but also to *C. rangiformis*. Typical specimens of *C. subrangiformis*, according to his conception, are definitely P+ yellow and have robust podetia with white spots in the basal portion. The podetia develop also a variable number of lateral outgrowths in the form of spines and are colored more or less brown by exposure to the sun.

Between such specimens and specimens of *C. furcata* he distinguished a number of intergrading forms from France, based partly on morphological features and partly on chemical. These intergrading forms include specimens with the following types of podetia: slender podetia without white spots, which agree morphologically with *C. furcata* var. *palamaea* (Ach.) Vainio f. *implexa* (Floerke) Aigret but which are K+ yellow; slender podetia with white spots, which agree morphologically with *C. furcata* var. *palamaea* f. *spadicea* (Pers.) Aigret but which are likewise K+ yellow; robust podetia without white spots, which agree morphologically with *C. furcata* var. *palamaea* f. *recurva* (Floerke) Des Abbayes but which (as in the preceding cases) are K+ yellow; and podetia, which agree morphologically with *C. subrangiformis* but which are not definitely K+ yellow, showing instead the color-changes induced in *C. furcata* by this reagent or some color-change intermediate between these two extremes. Assuming the presence of both fumarprotocetraric acid and atronorine in *C. furcata*, as well as in *C. subrangiformis*, Des Abbayes attributed the different color-reactions induced by K to differences in the relative amounts of these two lichen-substances in the specimens tested.

From the data which have just been summarized Des Abbayes concluded that *C. subrangiformis* did not constitute a distinct species but that it represented a well-marked variety of *C. furcata*. At the same time he assigned to it an ecological significance, since he associated it with a special habitat, and on this basis maintained the name *C. subrangiformis*, preceding it with an asterisk to indicate its subordinate character.

Des Abbayes distinguished also intergrading forms connecting

C. subrangiformis with *C. rangiformis*. The latter species is definitely K+ yellow, indicating the presence of atronorine, and most specimens are P−, indicating the absence of fumarprotocetraric acid. Occasional specimens are met with, however, which are P+, although this reaction may be restricted to the podetial squamules; and specimens of this sort, in which traces at least of fumarprotocetraric acid are present, were interpreted by Des Abbayes as intergrades.

In 1942 Asahina published the results of his microchemical studies on various *Chasmariae*, including *C. furcata*, *C. subrangiformis*, and *C. rangiformis*. His studies of these three species were based on European material distributed by Sandstede in his *Cladoniae* Exsiccatae, supplemented in the case of *C. furcata* by Japanese and North American material. This material included 62 specimens from Europe, an indefinite number from Japan, and 46 from North America, and he found that atronorine was lacking in all, with the exception of four from Europe and one from North America. Although Zopf in 1908 had reported the presence of atronorine in *C. furcata*, Asahina concluded from his results that fumarprotocetraric acid was the only lichen-substance characteristic of the species and that the material examined by Zopf must have been mixed. He concluded further that specimens containing atronorine, which had been referred to *C. furcata*, must either be excluded from the species altogether or interpreted as transitional forms between *C. furcata* and *C. subrangiformis*.

His material of *C. subrangiformis* consisted of the five specimens in Sandstede's Exsiccatae. He demonstrated both atronorine and fumarprotocetraric acid in four of these but found the latter substance only in No. 1182. He therefore suggested that this specimen, in spite of its conspicuous white spots, might be interpreted as a form of *C. furcata* paralleling *C. subrangiformis*.

In the case of *C. rangiformis* Asahina found that 25 of Sandstede's numbers were P− but that 4 were P+, thus confirming the statements made by Des Abbayes. He found further that all these specimens, whether P− or P+, contained both atronorine and rangiformic acid, although the amount of the latter substance might be too small to be demonstrated readily by microchemical methods.

The writer, as late as 1950 (p. 92), expressed the opinion that atronorine represented a rare accessory component of *C. furcata* and called attention to a number of specimens so-named from southern New England in which this substance had been demonstrated. If, however, Asahina's conclusions are accepted, these specimens should no longer be retained under *C. furcata*, and it seems justifiable to transfer them directly to *C. subrangiformis*, under which they are listed in the present report. The same course should probably be pursued with the K+ yellow specimens which Des Abbayes interpreted as intergrades between *C. furcata* and *C. subrangiformis* and with some at least of his specimens in which the K+ yellow reaction was obscured by the large amount of fumarprotocetraric acid present. Des Abbayes himself, in fact, distributed one of his K+ yellow intergrades, represented by No. 48 of his Lichenes Gallici, under the name *C. subrangiformis*. The "intergrades" between *C. rangiformis* and *C. subrangiformis*, which Des Abbayes distinguished, have not been reported from North America and are hardly to be expected, since the occurrence of *C. rangiformis* itself on this side of the Atlantic is somewhat problematical.

The recognition of atronorine as a characteristic lichen-substance of *C. subrangiformis*, but not of *C. furcata*, makes it practicable to separate the species from each other without difficulty, since atronorine is readily demonstrated by means of Asahina's G.A.o-T. solution. It must be admitted, however, that the known forms of *C. subrangiformis* parallel forms of *C. furcata*. The K+ yellow intergrades of Des Abbayes, for example, have the morphological features of *C. furcata* var. *palamaea*, and some of the specimens from Massachusetts have the morphological features of *C. furcata* var. *racemosa* (Hoffm.) Floerke. As a matter of fact no constant morphological distinctions between the two species have as yet been pointed out. The relation of *C. subrangiformis* to *C. furcata*, therefore, is similar to that of *C. ecmocyna* (Ach.) Nyl. to *C. gracilis* (L.) Willd. (see Evans, 1952).

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Vainio, E. 1887. Monographia *Cladoniarum* universalis. Pars Prima. Acta Soc. F. et Fl. Fennica **4:** 1–560.

The Occurrence of Rubus Chamaemorus in Minnesota.—From the Quetico-Superior Wilderness area is herewith recorded the addition of *Rubus Chamaemorus* L. to the flora of Minnesota. Its discovery was not surprising to the veteran botanists of the state. It came as a fulfillment of expectations consistent with previously known boreal elements in the flora of the area.

The plant was discovered by Mr. Clifford Ahlgren, Research Director of the Quetico-Superior Wilderness Research Center at Basswood Lake. His collection came to my attention, July 10th, last, while identifying and checking herbarium materials at the Research Center Herbarium. His collection, No. 3000 was made on June 13, 1954 from a bog forest along the Back Bay of Basswood Lake, when the plants were in full flower. On July 30, I was privileged to accompany Mr. and Mrs. Ahlgren on their return to the bog for additional collections.

The particular area of the bog including the *Rubus* colony is in sect. 17, Twp. 64, R. 10 at 48° 7′ N. lat. and 92° 43′ W. long. in Lake County. The swampy shoreline about one mile in extent with a dense growth of alder and dwarf birch passes abruptly into a sphagnum bog with a mature black spruce forest. The forest, about one-fourth mile wide and flanked by a high ridge, is moderately dense and moist, with a deep sphagnum ground-cover and

Above: habitat of *Rubus Chamaemorus;* below: a single plant.

unstable depressions. According to Mr. Ahlgren and his associates, in a nearby bog along the same shore-line, the peat, underlaid with blue clay, is 14½ ft. thick.

Within an area of about one-quarter section of the bog, *Rubus Chamaemorus* occurs in scattered but vigorously growing colonies, in association with *Carex trisperma* and *Smilacina trifolia.* In spots with favorable illumination, as seen in plate 1204, its growth is dense and luxuriant with fruiting plants. Collection number *Lakela 18043,* with Clifford and Isabel Ahlgren on July 30, 1954 was made from fruiting colonies. The specimens compare well with those of higher latitudes from Mackenzie District, Quebec and northern Europe. In the field the leaves appear deeply lobed with a maximum width up to 14 cm.

To one who has known *R. Chamaemorus* in other regions, the collecting of Minnesota specimens and the sampling of its fruit is a gratifying experience especially when mingled with an appreciation of the wonders of plant growth and distribution. I recall enjoying the luscious golden fruit on mountain slopes of the Arctic Ocean at 69.5° N. lat. near Liinahamari, then a part of Finland, where I collected No. 3312, Àug. 17, 1939. Although the fruits of the Minnesota plants are smaller than those from the arctic latitudes, the characteristic flavor is the same.

This find of *R. Chamaemorus* in Minnesota, a species with circumpolar distribution in arctic realms, is the first known record from the center of the continent.—OLGA LAKELA, UNIVERSITY OF MINNESOTA, DULUTH BRANCH.

ERAGROSTIS CURVULA IN MISSOURI.—In July, 1952, scattered but dense clumps of what was later determined as *Eragrostis curvula* (Schrad.) Nees. were observed in Howell County in southern Missouri. The appearance of this grass was striking, it being rather tall and erect, averaging about a meter in height, and having elongate blades which tapered to a very fine tip. No spikelets were present at this time. The following year and during the past season the species was observed in flower. The spikelets averaged about nine florets. The panicle branches were somewhat stiff and upright. This perennial species, originally observed along U.S. Highway 60 and adjacent open woods, T27N, R7W, section 24, has spread noticeably in two years. It is not a native species, being listed as an introduction in several southern states including Texas and Florida. Considering its multiplication and spontaneity of spread, the species appears in this area to be well established without benefit of cultivation.

Specimens have been deposited in the University of Missouri Herbarium.

Appreciation is expressed to Dr. J. R. Swallen of the United States National Herbarium who observed some of the collected material.—C. L. Kucera, botany department, university of missouri, columbia, missouri.

Breweria Pickeringii in Illinois.—Over 80 years ago Harry Norton Patterson was probably the first collector of *Breweria pickeringii* (Torr.) Gray in the vicinity of Oquawka, Henderson County in western Illinois. Half a dozen sheets of Patterson's specimens are deposited in the Chicago Natural History Museum Herbarium. Dr. Julian Steyermark reports that Patterson identified his material as *Stylisma pickeringii* and as *Bonamia pickeringii*. Some of the Patterson specimens are also deposited in the University of Illinois Herbarium as well as a collection by Dr. Virginius Chase in 1934.

Within the state sandy prairie and blow-sand areas adjacent to the Illinois and Mississippi Rivers seem to be the preferred habitat of this species. The sprawling plants are abundant where they do occur, but the habitats are widely scattered. It has also been attributed to eastern Iowa.

On 21 June 1954 the writer, accompanied by Mr. R. T. Rexroat of Virginia, Illinois, visited a locality in southwestern Mason County. This locality is about 70 air-line miles southeast of Patterson's Oquawka area. On a gentle, sandy slope *Breweria pickeringii* was plentiful. Subsequently, on 8 July, Mr. Rexroat continued a search and located specimens of *B. pickeringii* in adjoining Cass County. The specimens collected should be referred to var. *pattersoni* Fern. & Schub. Associated with *B. pickeringii* in the Mason County location were *Opuntia rafinesquii* Engelm. and *Hymenopappus scabiosaeus* L'Hér., the latter itself an uncommon plant in Illinois. Specimens of the

Mason County collection (*No. 11113*) have been deposited in the herbaria of Illinois State Museum, Springfield, University of Illinois, Urbana, and Chicago Natural History Museum.

ILLINOIS RECORDS: Oquawka, Henderson County, 10 August 1873, *H. N. Patterson.* Henderson County, 12 August 1934, *V. H. Chase 5109.* Mason County, 21 June 1954, *G. S. Winterringer 11113.* Cass County, 8 July 1954, *R. T. Rexroat 950, 951.*—GLEN S. WINTERRINGER, ILLINOIS STATE MUSEUM, SPRINGFIELD, ILLINOIS.

THE DATE OF PURSH'S FLORA AMERICAE SEPTENTRIONALIS.—Barnhart's conclusion[1] of 1904 that Pursh's *Flora* was published in January 1814, has been found acceptable by recent investigators. However a consultation of the Minutes of the Linnaean Society of London[2] reveals that Pursh was present at the meeting of December 21, 1813, as a guest of Anderson, and that

> Flora Americae septentrionalis or a Systematic arrangement and description of the Plants of North America by Frederick Pursh in 2 Vols 8°° London 1814 was presented by the Author.

Lambert had written to Sir James Edward Smith[3] after the preceding meeting of the Society on December 7, 1813, "We had a good meeting of the society last night . . . *Flora Americana* will finish printing this week . . . " and on February 3, 1814, he wrote to Smith that he supposes he has Pursh's Flora Americana "by this time as it has been published sometime."

It is interesting to note that Asa Gray[4] gave the close of 1813 as the time of publication.—JEANETTE E. GRAUSTEIN.

RANGE EXTENSION FOR ISOTRIA MEDEOLOIDES.—During a walk in the moist woods in the vicinity of Sebago Lake I came upon a colony of plants then unknown to me. A specimen was taken to the Annual Meeting of the Josselyn Botanical Society and readily identified as *Isotria medeoloides* (Pursh) Raf. According to Correll, "Native Orchids of North America," the plant

[1] Barnhart, John H., "The date of Pursh's Flora." *Torreya* IV (1904) 132–136.
[2] MS. Minutes of the Linnaean Society of London.
[3] MS. Correspondence of Sir James Edward Smith VI, 150, 151.
[4] Gray, Asa, "Remarks concerning the Flora of North America." *Amer. Jour. Sci.* ser. 3, XXIV (1882) 323–331.

is found locally in New England. According to the Check-list of the Vascular Plants of Maine, Bulletin of the Josselyn Botanical Society of Maine, Number 8, no record of the plant was found for Maine. The specimen is filed in the University of Maine Herbarium.—Iva M. Knight, r. f. d. 1, kennebunk, maine.

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ERRATA

Cover of No. 662; for **inseparata** read **insperata.**
Page 43, page heading; *for* inseparata *read* insperata.
Page 57, line 21; for *fasciculata* read *fasciculatum.*
Cover of No. 667; for *Duncun* read *Duncan.*
Page 160, line 32; for Centaureum read Centaurium.
Page 180, line 28; for *Phragmitis* read *Phragmites.*
Page 219, line 3; for *hybridizaed* read *hybridized.*

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New scientific names and combinations are printed in bold face type.